DOSAGE

Pedigree & Performance

Steven A. Roman, Ph.D

Forward

by James Quinn

"We look for the athlete, never mind the bloodlines."
Trainer D. Wayne Lukas,
Los Angeles Times, 1984

In 1982, after having watched the Kentucky Derby for a dozen years and pressed by a lady accomplice to render a judgment on that season's classic, finally I wagered.

Aware of the unreliability of the conventional methods of handicapping when doping the Derby—speed figures, class evaluation, pace analysis, form cycles—which, after all, were tethered to performances at middle distances only, and in fact had persistently fallen flat on their Derby predictions, I had not even bothered to scour the past performances of the runners. I had been provoked, however, by a 1981 Bloodlines column of Daily Racing Form, written by pedigree authority Leon Rasmussen, in which Thoroughbred handicappers and students of pedigree alike had been introduced to the charms of Steven A. Roman's Dosage Index and to Roman's "Dual-Qualifier" methodology for handicapping the Derby and the Belmont Stakes.

As Rasmussen told, Roman's research had demonstrated rather unequivocally that Derby prospects should possess a certain desirable blend of speed and stamina in the recent four-generation pedigree, and that indeed since 1940 no Derby winner had possessed such a blend of speed and stamina greater than Roman's statistical guideline figure, his Dosage Index (DI), of 4.00. As a DI of 1.00 would indicate a perfectly balanced blend of speed and stamina, a DI greater than 4.00 would mean a Derby prospect had inherited too much speed in relation to endurance, and would be highly unlikely to win America's race.

Roman's Dual-Qualifiers combined an acceptable DI with early maturity, defined as a ranking within 10 pounds of the leader on the industry's Experimental Free Handicap, a scale of weights dedicated solely to two-year-old performance.

"It's hardly a strong opinion," I advised my 1982 accomplice, "but I've chanced upon an innovative and sensible approach for evaluating the Derby colts that combines pedigree and performance. It's been referred to as 'Dual-Qualifiers' and only three horses in the bulky field qualify: Gate Del Sol, Laser Light, and Cassaleria. All three should be longshots. One is a colt of southern California, Gato Del Sol. Suppose we back him." I bet $40.00.

Gato Del Sol, a nondescript undistinguished closer at middle distances, won the 1982 Derby from far back, and paid $44.40. Laser Light finished second and paid $17.00 to place. The life and times of numerous handicappers and horsemen at the Kentucky Derby have not been the same ever since. Roman's Dual-Qualifiers, few in number at the time, dominated the classic during the 1980's, even as they had in the 1970's, continued to prosper during the 1990's, and by the new millennium few handicappers or other interested observers would deny that pedigree plus performance gets the roses. Trainer D. Wayne Lukas had changed his mind as early as 1986.

Much else has changed as a result of Roman's research, including the matings of Thoroughbreds on farms, and the purchases of yearlings at sales, such that a book by the originator of the Dosage Index that explains it all in historical and contemporary detail has been long and seriously overdue. Beyond the relatively narrow but important applications of Dosage to the three-year-old classics, it's been Roman's broader treatment of pedigree evaluation that has marked him as the nation's most influential authority on the relations between the Thoroughbred's inherited aptitudes and its racetrack performances.

That position of authority does not permit the assertions of conclusions unsupported by facts. Happily, the nation's leading researcher on pedigree evaluation for years directed exploratory research on chemical products and processes for Shell Chemical, in Houston, Texas. Roman has been the author of more than 60 patents and publications in chemistry. An author dedicated to the requirements of scientific inquiry, Roman has steadfastly reminded followers and critics alike that his research is strictly empirical. That is, Roman's findings and conclusions have been hinged directly to the Thoroughbred's performances on the racetrack.

In that respect, as opposed to the largely descriptive and normative nature of most statistical studies of pedigree evaluation, Roman has fretted that this text may be perceived as excessively "technical." The scientist need not worry, as Roman qualifies as well as a highly literate and graceful writer. His text is a pleasure to read. Roman should be recognized here as especially adept with multiple regression techniques, which can delineate a line of "best fit" between related variables, such as Dosage and distance. Stallion owners, breeders, buyers, and even handicappers should be provoked by several of the statistical charts, as when Roman shows that studies of open stakes winners from 1983 to 2001 reveal the recommended Dosage Indices for sprinters at six furlongs will be 4.00 to 4.75, but for middle distance runners from eight furlongs to nine furlongs the recommended Dosage will be 2.97 to 3.74, and for the classic prospects from 10 furlongs to 12 furlongs the recommended Dosage will be 2.00 to 2.60.

Whether mating, buying, or betting, that's nice to know.

Horsemen and breeders dare not miss this book, but an audience having a greater incentive to pay attention than many of them might appreciate is the beleaguered array of handicappers toiling for profits at the nation's racetracks and betting parlors. Handicappers generally have known for a couple of decades that horses bred for grass should go well on grass at the first and second attempts, but other applications of pedigree to performance have remained murky and elusive. Roman presents copious performance data on two-year-olds, distance changes, and stakes races that handicappers can scarcely afford to ignore.

Perhaps Roman's signature, most meaningful contribution to the fields of Thoroughbred racing and breeding will be as arbiter and caretaker of the chef-de-race roster, that selective membership of prestigious sires that have been deemed "prepotent" and that contribute through the variations in aptitudes they pass to their progeny to the improvement of the breed. No role is more important and no task is more challenging. The great myth is that the sport's most dominant sires should transmit to progeny the attributes they have exhibited as runners on the track.

Roman's extensive, continuous, meticulous research on these matters supplies the evidence that not only documents the unreliability of numerous high-class runners as sires that can make a difference, but also assures the level of quality control over the roster of chefs the evaluative objectives demand. The author as scientist and the scientist as author is probably at his best when debating the proper and improper designations of popular sires as chefs.

As his book demonstrates in a strict but delightful way, on matters of pedigree evaluation great and small, Roman is not likely to be misled, and neither therefore is the Thoroughbred sport and industry.

James Quinn,
Los Angeles

Table of Contents

Introduction

Contemporary Dosage methodology was introduced to Thoroughbred racing and breeding in Leon Rasmussen's "Bloodlines" column in Daily Racing Form during the spring of 1981. It is a continuation and refinement of research initiated by Lt. Col. J. J. Vuillier in France over a century ago and modified by the Italian Dr. Franco Varola in the 1960s. Unlike traditional pedigree analysis, Dosage attempts to identify key ancestors in a Thoroughbred pedigree and ascribe qualities to those ancestors that together describe the horse's character or type. Despite fundamental philosophical differences among the various approaches to Dosage, they all agree on one thing – that the development of the Thoroughbred can be described through the influence of very few individuals in any era.

Unlike the earlier forms of Dosage, the current technique involves extensive use of statistical analysis to test its premises. As a result, the reader will see numerous tables of data and charts within the text. Many of the charts display statistically generated trend lines that present relationships in a visual form for easier comprehension, the premise being that "a picture is worth a thousand words". Although somewhat technical, the subject matter is not academic. The concepts are accessible to everyone with an interest in how pedigree-performance relationships express themselves in the real world. On the other hand, the information is not merely anecdotal. This is not light story telling. To fully understand the essence and utility of Dosage, readers will have to absorb the information presented and then draw conclusions for themselves. In addition, the author hopes that much of the data found in the tables and appendixes, while providing basic evidence in support of the ideas and concepts presented, will be used as basic reference material for owners, breeders, handicappers and general racing fans. Most of the data is relevant through 2015 with some through the 2016 American classics.

Although the author has written and lectured widely about contemporary Dosage for over thirty years, this is a revision of the first comprehensive and complete text on the subject by its creator.

STEVE ROMAN, *San Anontio de Belén, Costa Rica, January 1, 2016*

Chapter 1

Dosage and Speed

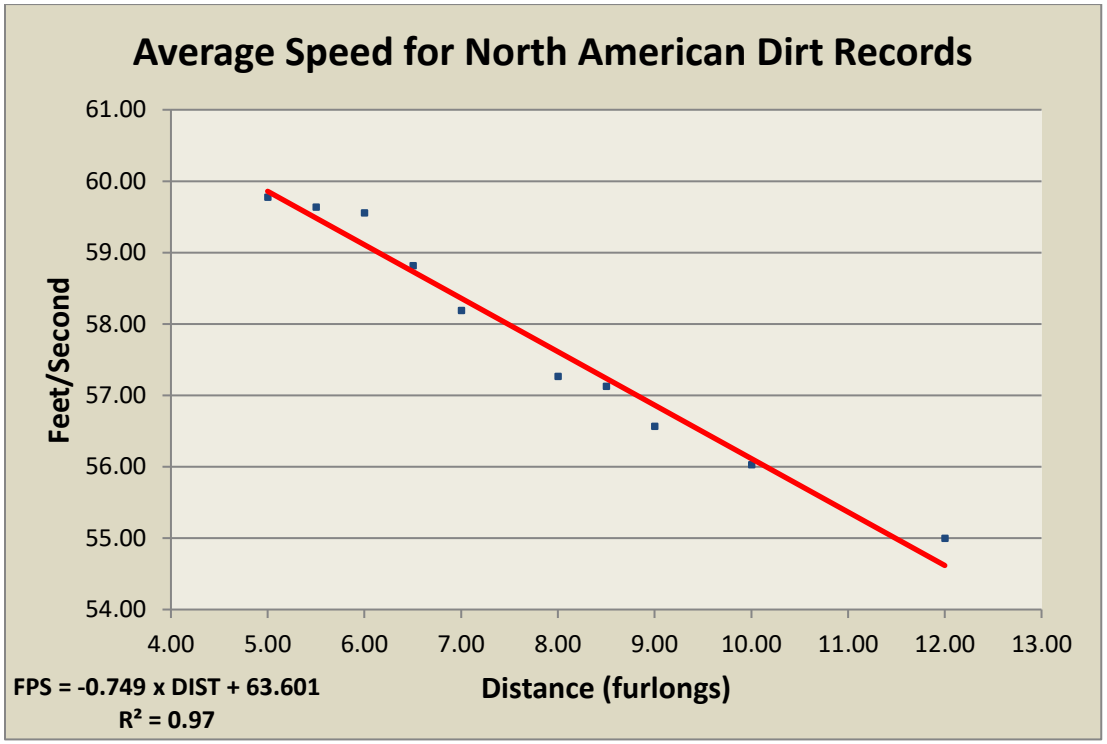
Dosage is a non-traditional method of Thoroughbred pedigree analysis and, as a result, a focus of controversy. Originated as a breeding theory, in its latest form it may be described more accurately as a pedigree classification technique. Dosage largely ignores the typical historical interpretation of pedigrees in which one emphasizes the accomplishments or achievements of individuals from the horse's past. These accomplishments invariably highlight major wins at the track or superior production in the breeding shed. Rather, Dosage characterizes pedigrees solely through the evaluation and cataloguing of explicit qualities of prepotent or predictable speed and stamina inherited from selected key ancestors. Stamina, as defined in the Merriam-Webster dictionary is *"the ability to sustain a prolonged stressful effort or activity"*. Of course, "prolonged" and "stressful" are relative terms. In Thoroughbred racing, routes are more prolonged because of the greater distance and sprints are more stressful because of the faster pace. The unique interplay of speed and stamina results is what we call aptitudinal type, those attributes that in combination can define the natural abilities and racing preferences of the individual. More broadly, then, Dosage is a methodology applied to large populations of Thoroughbreds for classifying pedigrees by aptitudinal type and, as a research tool, correlating that type with track performance. In reality, speed and stamina are variations of the same phenomenon, much like opposite sides of the same coin. In the racing world, the better horses may be thought of as analogous to higher valued coins, blessed not only with superior speed, but with the ability to sustain it for a longer time. Speed is the defining trait, and stamina is the ability to carry that speed over a given distance, although the importance of stamina is determined mainly by the cultural preferences of the racing community. In that context, the question becomes: is stamina in fact speed over a distance or is it simply winning at a long distance? Danny Perlsweig, trainer of champion Lord Avie, once noted that a horse can get any distance if you give it enough time.

For any individual horse, speed and stamina are inversely related; one is always sacrificed in favor of the other. Whether cheap or high-class, all horses are limited in type by their inherited speed/stamina balance. Evidence that speed and stamina are part of the same continuum may be found from the data presented below showing North American record times on dirt through the year 2014 in both tabular (Table 1) and graphical (Chart 1) form. The graph displays the correlation between distance in furlongs and average speed of the record holder in feet per second.

Table 1. North American Record Times on Dirt Through 2014

DISTANCE	HORSE	TRACK	YEAR	TIME	AVG FT/SEC	AVG SEC/FURLONG
5.00f	Chinook Pass	Longacres	1982	0:55.20	59.78	11.04
5.50f	Hollywood Harbor	Emerald Downs	2012	1:00.87	59.64	11.07
6.00f	Twin Sparks	Turf Paradise	2009	1:06.49	59.56	11.08
6.50f	I Keep Saying	Emerald Downs	2014	1:12.94	58.82	11.22
7.00f	Rich Cream	Hollywood Park	1980	1:19.40	58.19	11.34
	Time to Explode	Hollywood Park	1982			
8.00f	Dr. Fager	Arlington Park	1968	1:32.20	57.27	11.52
	Najran	Belmont Park	2003	1:32.24		
8.50f	Hoedown's Day	Bay Meadows	1983	1:38.40	57.13	11.58
9.00f	Simply Majestic	Golden Gate Fields	1988	1:45.00	56.57	11.67
10.00f	Spectacular Bid	Santa Anita Park	1980	1:57.80	56.03	11.78
12.00f	Secretariat	Belmont Park	1973	2:24.00	55.00	12.00

Chart 1. Distance vs. Average Speed for North American Record Holders on Dirt

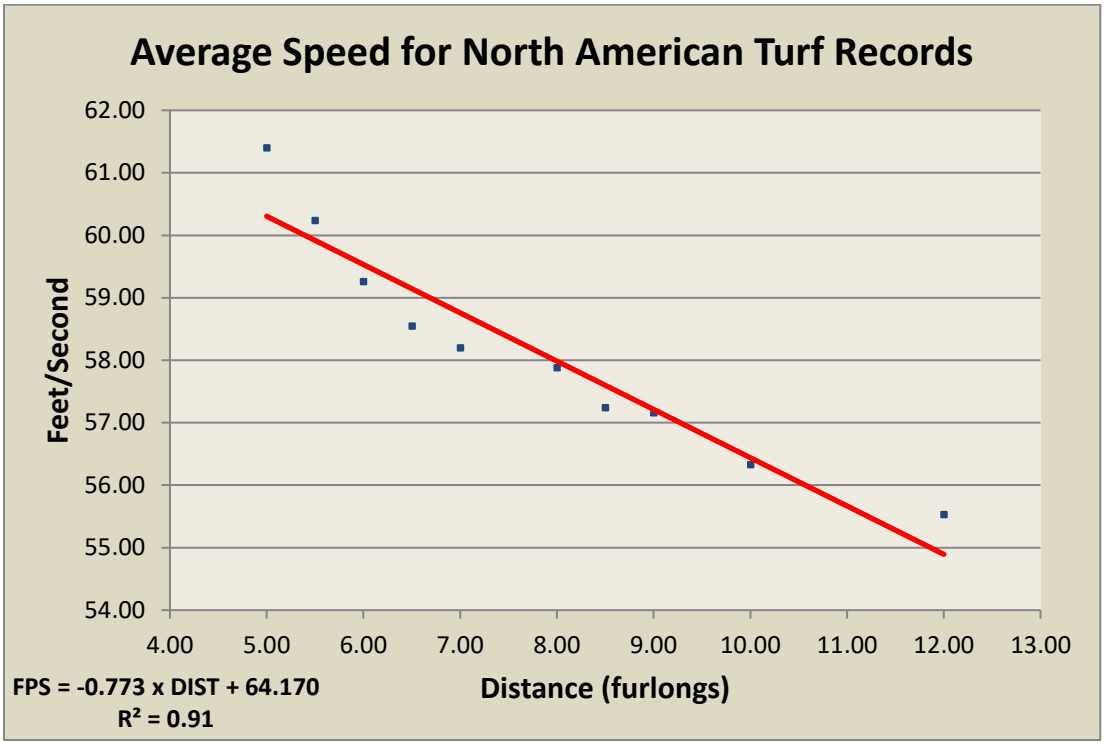


We can do the same for record times on turf, also through 2014, and those results are displayed in Table 2 and Chart 2.

Table 2. North American Record Times on Turf Through 2014

DISTANCE	HORSE	TRACK	YEAR	TIME	AVG FT/SEC	AVG SEC/FURLONG
5.00f	Starfish Bay	Gulfstream Park	2010	0:53.75	61.40	10.75
5.50f	Scottsbluff	Hollywood Park	2006	1:00.26	60.24	10.96
6.00f	Keep the Faith	Belmont Park	2005	1:06.82	59.26	11.14
6.50f	Jungle Wave	Woodbine	2009	1:13.27	58.55	11.27
7.00f	Soaring Free	Woodbine	2004	1:19.38	58.20	11.34
8.00f	Mandurah	Monmouth Park	2010	1:31.23	57.88	11.40
8.50f	Told	Penn National	1978	1:38.00	57.24	11.53
9.00f	Kostroma	Santa Anita Park	1991	1:43.92	57.16	11.55
10.00f	Red Giant	Gulfstream Park	2008	1:57.16	56.33	11.72
12.00f	Twilight Eclipse	Gulfstream Park	2013	2:22.63	55.53	11.89

Chart 2. Distance vs. Average Speed for North American Record Holders on Turf



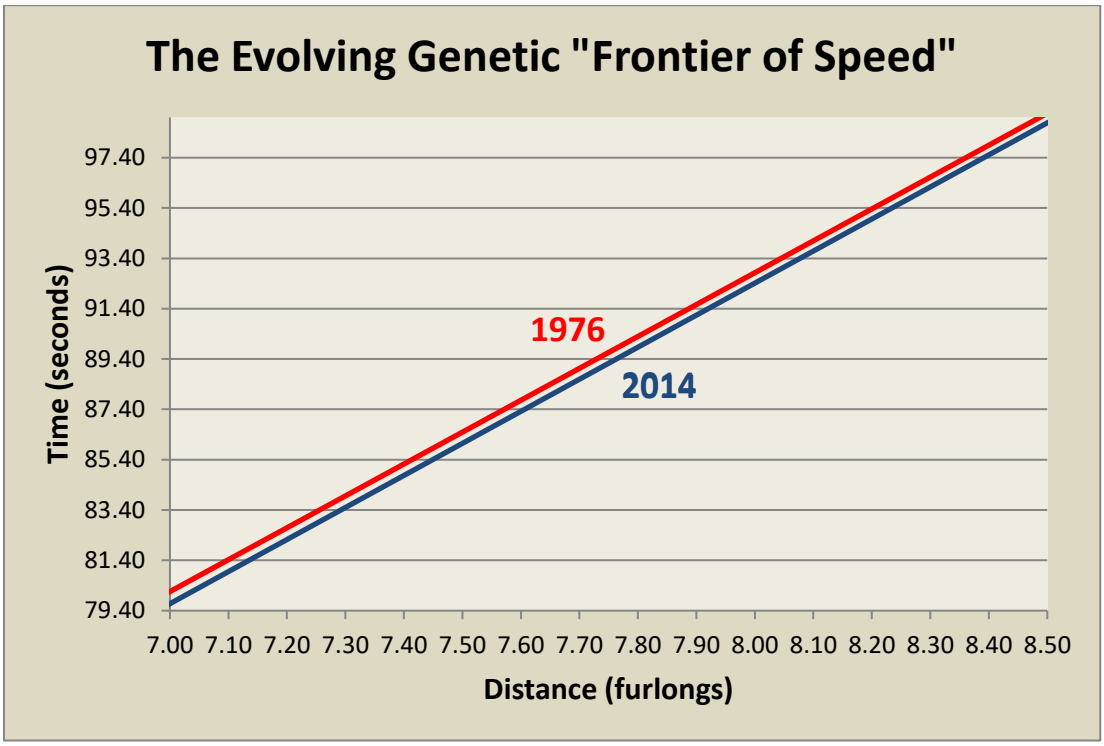
When individual data points are subjected to a mathematical process called linear regression we generate the best straight line that can be derived from them, as shown on the charts. Sometimes the data points can actually be far away from the newly created line. In such a case the fit of the data is not very good and the relationship, here between average speed and distance, would be poor. But, in fact, when the average speed for record times on dirt is plotted against distance, the correlation is outstanding, as shown by the R-squared value of 0.97. This suggests that 97% of the variation in average speed is attributable to distance. A perfect or ideal fit would have a maximum

R-squared value of 1.00. In these examples, the data points do indeed fall close to the regression line. The correlation for record times on turf is not quite as good but still generates an R-squared value greater than 0.9. The significance of the average speed for record times falling close to the straight lines lies in a specific, definable relationship between the average speed at one distance and the average speed at any other distance. The best straight lines are associated with equations (shown in the lower left of each chart where FPS equals feet/second) that allow us to calculate current projected record times at any distance. For example, at 9 ½ furlongs on dirt the projected record average speed is -0.749 x 9.50 + 63.601 or 56.49 feet/second. That equates to a time of 1:52.59. The actual record time at 9 ½ furlongs on dirt is either 1:52.40 held by Riva Ridge set at Aqueduct in 1973 before times were measured in hundredths of a second or 1:52.55 held by Farma Way set at Pimlico in 1991. The differences of 0.19 seconds or 0.04 seconds are on the order of a neck to one length. Similarly, the projected record average speed at 11 furlongs on turf is -0.773 x 11 + 64.170 or 55.67 feet/second which equates to a time of 2:10.41. The current record was set by With Approval at Belmont Park in 1990 at 2:10.26, a difference of about three-quarters of a length.

These relationships are fixed relative to one another and, in a sense, describe the current state of physiological and evolutionary development of the breed. In essence, the line represents a "frontier of speed" in the Thoroughbred; the ultimate expression of directed breeding over centuries.

In the future, records will be broken, one by one, and a new line (or frontier) will be established as the breed evolves toward more speed. This linear relationship between average speed and distance is a permanent phenomenon and can be demonstrated at any point in the past. A shift in position of the straight line on the graph is merely a visualization of the movement of the frontier of speed. This may be seen in Chart 3 which shows a portion of the linear regression lines between seven and 8 ½ furlongs for the records on dirt in 1976 (red) and in 2014 (blue). The 2014 blue line is slightly below the 1976 red line indicating a shift toward greater speed; i.e., faster times.

Chart 3. The Evolving Genetic "Frontier of Speed"



It is fair to say, because of the excellent linearity of the speed-distance relationship, that all of the record holders were equally fast in the context of the distance at which they set their record. That no single horse is likely to ever hold the record for both five and twelve furlongs is simply the result of variation in type, although obviously the record holders at both ends of the spectrum are part of the same gene pool. They differ by some degree in such things as biomechanical efficiency, cardiovascular characteristics, musculature, and so on. These factors then position their optimum performance traits at different regions of the speed frontier. What they all share in common is they have run as fast as a Thoroughbred can run up to this point in time at a given distance. The decrease in absolute speed with increasing distance is the tradeoff we must always make.

Since Dosage is about speed and its influence on performance, it is worth spending time to discuss speed in greater detail. The concept of speed may be the most mysterious in all of Thoroughbred racing. Ask a few friends which racehorse was the fastest in history and you're likely to get more answers than you bargained for. Was it Secretariat, Citation, Dr. Fager, Ruffian, Man o' War? A potential problem is that unless we all use the same definition of speed there is no meaningful basis for discussion, although virtually everyone will agree that speed is very important. Actually, there are several variations of speed worth considering. There is speed over a given distance; e.g., one mile in 1:35.0. There is average speed; e.g., 55.58 feet/second (for the mile in 1:35.0). And there is fractional speed, or pace; e.g., :24.0, :47.3, 1:11.1, 1:35.0 or :22.0, :46.1, 1:10.3, 1:35.0.

The gradual decrease in average speed at each succeeding longer distance is clear. In no case has a record holder at a given distance maintained the same average speed as was achieved by a record holder at the next shorter distance. On this basis the fastest horse on dirt between five furlongs and a mile-and-a-half may have been Chinook Pass. Tell that to your friends and they will begin to question your sanity. But in fact, on an absolute basis, and ignoring the notion of fractional speeds which we will address a bit later, Chinook Pass ran faster than any horse we have seen over the course of an entire race run between five and twelve furlongs. If he were able to sustain that rate of speed over a mile and a half he would have beaten Secretariat in the Belmont Stakes by 58 lengths. Here again we observe the essence of the speed/stamina balance in the racehorse. Speed is not merely the rate at which the horse moves from point to point around the track; it is related to how long he can sustain that rate. As implied earlier, the concept of speed in racehorses has meaning only in the context of the distance involved because the breed is constrained by the present state of evolution and the resulting limits of physiology. It is not physically possible to run the same all out speed at every distance. If all races were contested at five furlongs, Secretariat and Spectacular Bid would be considered slow because their expression of speed would not be apparent in a short sprint. On the other hand, if all races were run at twelve furlongs, then Chinook Pass and Twin Sparks would trail the field under the wire because they would not be able to sustain their best pace over the entire mile and a half. This bears on the high esteem accorded brilliant milers, particularly as breeding animals. Whether we recognize it or not, highlighting the exploits of milers ascribes some notional versatility to a runner which can express near sprint-like speed beyond a pure sprint distance. In fact, milers are no different than any other runners in terms of physiological suitability. They also fit the continuum of the speed-distance relationship described earlier. Apparently some people place a value on ability at a distance that essentially represents the average, neither sprint nor route. In truth, there is no virtue in that view. Great sires can and do come from all distance categories whether it be sprint (e.g., Mr. Prospector), mile (e.g., Fappiano), or route (e.g., Nijinsky II). Most likely, an affection for brilliance is a consequence of our perception of racing opportunity for the foals. As races become shorter and the pressure for early maturity increases, there will be a "natural selection" for sires thought to be capable of transmitting desired traits of speed and precocity. This trend remains, of course, the subject of intense debate throughout the Thoroughbred racing industry.

As described earlier, there is another kind of speed - that of instantaneous speed or, more realistically, fractional speed and pace. If one wishes to consider the truly fastest horses, then there are a host of runners capable of getting the first quarter mile in 21 seconds plus or minus a fraction. Quite often they flash their speed for only a brief time in the early stages of a race, usually tiring dramatically well before the finish. Many call this "cheap speed". It is only “cheap” because it is not expressed over the full distance of a race. Actually it is not “cheap” at all. It is as valid a physiological expression as any other kind of speed. It just so happens that it occurs at one extreme of the speed frontier and well outside our normal frame of reference for conventional racing. We view

these runners in the same way we view runners at the other end of the continuum, say three miles. In the end, we are drawn to speed displayed at distances that we, as a society, prefer to race. Within those bounds, all record holders are essentially equally fast in terms of genetic expression.

To further illustrate the concept of aptitudinal type, in human sports we often describe athletes according to their body structure. In the world of track and field we may refer to a sprinter's physique or a marathoner's physique. Even before the competitor sets foot on the track, we have projected a perceived suitability to the event at hand based on our understanding of how body type affects athletic skills. In this example, the athlete's physique suggests his or her "aptitudinal type". In the world of Thoroughbred racing, the essence of Dosage is its ability to relate aptitudinal type to performance on the racetrack, although here the aptitudinal type is not necessarily physical type but pedigree type.

Chapter 2

The Value of Pedigree Classification

Classification, best described as the arrangement of something according to a systematic division into classes or groups, is a useful exercise when dealing with complex information requiring substantial and extensive interpretation. It helps structure the information and provides a framework within which the various elements can be examined and compared. Ideally, classification can help create order out of chaos and simplicity out of confusion. Certainly, some would argue that the subject of Thoroughbred pedigrees is both chaotic and confusing. To the extent that it is chaotic and confusing, a practical classification methodology that makes the study of Thoroughbred pedigrees less intimidating and more accessible is a desirable thing.

The concept of classification is not new to Thoroughbred pedigrees. Perhaps the first to apply it was the brilliant though often maligned Bruce Lowe, an Australian living in the last half of the 19th century. Lowe's name survives to this day primarily through his monumental text "Breeding Racehorses by the Figure System", first published after his death in 1895. Lowe observed that every horse listed in the General Stud Book traced to one of fifty mares. Based on a detailed statistical evaluation of the winners of the English classics, he categorized the tail female lines from which they descended and assigned a ranking that reflected the number of winners within each family. The family with the most winners was family No. 1. The family with the second most winners was No. 2, and so on. In all, 43 families had produced an English classic winner. Lowe ranked the others according to his personal opinion of quality. Lowe then attempted to base a breeding theory on his figures, suggesting that the first five "running" families (those with the most classic winners) and the first five "sire" families (those from which the most successful sires were derived) would continue to express their superiority. This, however, has not been the case, as many female lines have since emerged that have produced a large number of top class winners. As a result, the Bruce Lowe Figure System has been discredited by many mainstream pedigree pundits. For most people that is the complete story. Lowe is often casually dismissed as the originator of a breeding theory that failed and there are those who resent the influence his work had on the breeding establishment early on. Much of the criticism leveled at Lowe has been bitter and sarcastic, especially by those who would deny the value of any attempt to organize the science of breeding racehorses. To them, "breeding the best to the best" is about as well as one can do, which is fine. On the other hand, this conventional approach, although perhaps necessary to achieve the highest goals, may not always be sufficient. In fact, Lowe's contributions are fundamental and profound, extending far beyond the failure of the Figure System. His success in organizing and structuring the information presented in "Breeding Racehorses by the Figure System" resulted in one of the most detailed and thorough histories of the Thoroughbred, tracing the breed back through the female lines to the most important mares of the 17th century. The sense of order that Lowe applied to his work subsequently became the model for the approaches

taken by Vuillier and Varola in their development of Dosage. The lasting value of his contribution lies in the integrity of his research, his precise methodology and the philosophical framework he created for other investigators. For the benefit of the reader, the Bruce Lowe families of many classic winners since 1940 are tallied in Appendix V.

Conventional pedigree analysis often lacks a scientific or technical foundation and can take a variety of forms. It may emphasize perceived patterns of inbreeding or linebreeding to notable ancestors to explain a contemporary horse's abilities. In these cases, multiple presences of names in the pedigree and where these names appear are deemed critical. A profound influence is accorded such duplications even when found in far remote generations. Specific patterns of inbreeding or linebreeding may become fashionable from time to time when high-profile individuals representing those patterns become successful. Depending on what transpires on the racetrack, specific patterns can become unfashionable as well.

An issue remaining unresolved is a universal understanding of what inbreeding and linebreeding actually mean. There is no standard definition that is accepted by all students of pedigree. Much of the debate centers on the remoteness of the duplications and what they represent. From the standpoint of rigorous research methodology, it is clearly beneficial to have a definition that all pedigree researchers can agree to. In its absence, data will be interpreted without scientific guidelines. Acceptable science-based definitions are available, and those proposed by Jones and Bogart in "Genetics of the Horse", Edwards Brothers, Inc., Ann Arbor, Michigan, 1971, seem reasonable:

"Inbreeding is the mating of animals more closely related than the average of the breed. Linebreeding is a form of inbreeding in which the blood of particular individuals is concentrated…without an attempt to rapidly inbreed."

By this definition the difference is one of degree rather than kind, and although the distinction may seem trivial, it becomes very important when trying to appreciate the significance of a pedigree interpretation. For example, is a five by six duplication of names truly an expression of inbreeding? Some might say yes while others might say no. Whether it is or isn't affects how one interprets the relevance of the pattern. If the average for the breed is a duplication of four by five, then it could be argued that a five by six duplication should have a marginal effect. Yet duplications in a pedigree far removed from four by five or five by six are invoked routinely to explain some aspect of quality or ability. Even more common is the invocation of multiple duplications that are often credited with an additive effect. Are such claims of a cause and effect relationship justified? Without a standard of measurement it is difficult to say. For the most part, the evidence of an impact on quality from remote duplications in a pedigree is anecdotal at best. Unfortunately, anecdotal evidence doesn't lend much scientific

credibility to one's conclusions. The problem here is that inbreeding or linebreeding patterns have not been catalogued nor their effects measured on a scale such that cause-effect relationships are even recognizable. Inbreeding and linebreeding assuredly have an important role to play in Thoroughbred breeding. There is no intent here to downplay their genetic consequences. However, until a classification system is developed on a population-wide basis that correlates inbreeding and linebreeding patterns with measurable effects, the accuracy and predictive ability of inbreeding- and linebreeding-based pedigree interpretation will always be less than optimal. Conclusions will be vague and obscure. In essence, they are more opinion than fact.

Jones and Bogart praise the theory of linebreeding because it concentrates the blood of superior individuals without risking the loss in vigor often seen when inbreeding becomes too intense. Nevertheless, they point out that linebreeding is limited by how well we judge the superiority of the individual whose blood is being concentrated. As with duplication patterns, this would be an area of study amenable to classification. Conceivably, one could address the details of what it means to linebreed to Buckpasser versus Mahmoud or Princequillo, for example. For many it is the inbreeding or linebreeding itself that is the driver, not the absolute quality or specific influence of the individuals being concentrated. Here again, predictability is compromised and sub-optimal.

Conventional analysis may also emphasize interactions between bloodlines, a pattern commonly called "nicking". These interactions may have an historical record of success or failure involving specific sires in combination with broodmare sires and broodmare sire lines. Conversely, one may consider how individual broodmare sires have performed when paired with certain sires or sire lines. The concept of two bloodlines or individuals having a unique compatibility is quite appealing because the decision-making process is that much easier. The fundamental problem with individual nicking patterns, however, is that only rarely are there enough examples to provide a statistically significant sample size. By statistically significant we are referring to the established statistical criteria affording a meaningful confidence level where the observed pattern has only a small probability of being a random event. For example, suppose sire A is bred to mares by sire B and ten foals are produced. If two of these, or 20%, become listed stakes winners and sire A gets 10% overall stakes winners, i.e., regardless of his mares' bloodlines, then this A/B cross surpasses sire A's overall stakes winner production by two to one, which some would consider evidence of a positive nick. On the other hand, suppose that none of the ten foals (0%) won any stakes but three placed in Grade I events. To some, zero stakes winners from ten foals is a red flag. But here the truth may be that the Grade I stakes-placed runners are far superior to the two listed stakes winners in the first case. Do 20% stakes winners represent a positive nick while 0% stakes winners represent a negative nick? Probably not. Actually, depending on how you measure the quality of runners (and we all do it differently), you might conclude that the second case indicates a greater affinity between sire A and broodmare sire B than does the

first. In extreme cases such as five Grade I stakes winners from five foals produced by the A/B cross or, at the other end, five maiden claimers, the conclusions may be more obvious. But these circumstances are so rare that to generalize about the validity of individual nicking patterns on this basis stretches credibility. Ten or even twenty or thirty specific examples of a cross between A and B still may not be sufficient to establish statistical significance simply because there is no objective universal measure of the success of that cross.

An example of the danger inherent in the use of small sample sizes for defining nicks is the breeding of Baldski to Diplomat Way mares. In 1989, The Blood-Horse published tables of nicking patterns for many North American sires. Included were the records of sires which had gotten at least five foals from daughters of a particular broodmare sire. At that time the Baldski/Diplomat Way pattern had resulted in no stakes winners from 19 foals, seemingly supporting the notion of an inferior cross. However, the AEI (Average Earnings Index) for these foals was 1.84 while the CI (Comparable Index) was 1.64. So although there were no stakes winners, Baldski did upgrade the Diplomat Way mares to which he was bred. Perhaps the situation wasn't so bad after all. Subsequently, there appeared a Baldski/Diplomat Way stakes winner named Express Star, which ultimately won seven stakes races with lifetime earnings of over $450,000. One out of twenty, or five percent stakes winners is not statistically different from Baldski's 7% lifetime stakes winner production rate at the time. Suddenly the prospect of Baldski being bred to Diplomat Way mares wasn't so terrifying. As of October 2001 there were 28 foals representing the Baldski/Diplomat way cross. Of these, three (11%) were stakes winners, exceeding Baldski's 9% lifetime percentage of stakes winners at that time. The combined AEI of the 28 foals was 2.03 (which exceeded Baldski's lifetime AEI of 1.75 through 2001), with a CI of 1.59.

The issue raised here relates more to timing than it does to any genetic compatibility. Does a nick change if the one stakes winner from 20 foals is the first foal or the last one? Obviously not. The total record after 20 foals is the same. Bloodline compatibilities can change over long periods of time as new breeding stock from those bloodlines emerge. But the idea that the compatibility between a specific sire and a specific broodmare sire can change over time is suspect, although the quality of mares produced by a particular broodmare sire can change over time depending on the broodmare sire’s opportunities.

Another problem using small sample sizes to define individual nicking patterns is the tendency to revert to close up ancestors if there are no actual examples involving the particular sire and broodmare sire. This is more often the case than not. For example, millionaire Dispersal was one of the better colts in America in 1989-90 and presumably evidence of a superior nick. Dispersal was by Sunny's Halo and out of a Johnny Appleseed mare, certainly not a well-established breeding pattern and for which there is no basis to draw meaningful conclusions about the viability of the cross. Even today there are few examples, and Dispersal remains the lone stakes winner.

If we now look at the record of Sunny's Halo's sire, the deceased Brilliant/Classic *chef-de-race* Halo, which was a superior stallion of long-standing, we find that, at the time, he had sired as many as five foals from mares representing a single branch of the Prince Rose broodmare sire line (of which Johnny Appleseed is a representative). From six Prince John mares he had gotten one minor stakes winner, but overall he had seriously downgraded these mares with AEI 0.93 compared to CI 1.97. This is not the stuff that great nicks are made of. Apparently, using any other representative of a bloodline as a basis for the compatibility of another member of that bloodline is a dangerous practice because with each succeeding generation there is a significant dilution of the genetic relationship between the two.

One can look at nicking patterns more globally by focusing only on bloodlines rather than individuals. For example, it can easily be determined what percentage of Northern Dancer line sires and Raise a Native line broodmare sires are present in a population of stakes winners. For argument's sake let's say that 30% of all stakes winners are by Northern Dancer line sires and that of all stakes winners, 10% are out of Raise a Native line mares. In a random world, then, we could expect that one in ten stakes winners sired by a Northern Dancer line stallion would be produced from a Raise a Native line mare. Conversely, three in ten stakes winners produced from Raise a Native line mares would be sired by Northern Dancer line stallions. To avoid confusion, we'll use real numbers to illustrate. In a population of 100 stakes winners, a total of 30 would represent the Northern Dancer sire line. If, randomly, 10% of all stakes winners are from Raise a Native line mares, then three of the thirty Northern Dancer sire line stakes winners would be expected to represent the Northern Dancer/Raise a Native cross. Similarly, since 30% of all stakes winners are by Northern Dancer line sires then three of the ten stakes winners from Raise a Native line mares would be expected to be by those sires. Thus, from either direction, we expect three out of 100 stakes winners in the population to represent the Northern Dancer/Raise a Native cross. If, however, we find that there are actually six or nine of the hundred that are bred Northern Dancer/Raise a Native, we have a situation in which two or three times as many representatives of that cross have been produced than had been anticipated from the total population statistics. This might be construed as a positive nick. But here, too, there are problems associated with interpreting the data.

First, the derived statistics and nicking patterns, as we will see with Dosage, would apply only to large populations and not necessarily to individuals. In fact, we breed individuals, not bloodlines. Second, do the statistics really reflect general compatibility of bloodlines or the quality of individuals that make up the population? Bloodlines rise and fall for many reasons. But a characteristic of ascending bloodlines is that the individuals representing that bloodline are superior breeding animals relative to the remainder of the population. Declining bloodlines are similarly characterized by inferior breeding animals. Therefore, dominating the situation is the fact that breeding superior sires to mares by superior broodmare sires increases the probability of producing

superior foals. This returns us to the concept of individual nicking patterns and the problems associated with statistical significance.

Bloodline compatibilities are statistically meaningful only in terms of large populations and in that context are useful in assessing general trends within bloodlines. On the other hand, individual nicking patterns almost never meet the criteria for statistical significance.

In the context of the two common approaches to pedigree interpretation just discussed, we have highlighted issues of categorization or classification, cause and effect, and statistical significance. These issues will be addressed at length in the following discussion of Dosage.

Chapter 3

The Origins of Dosage: Vuillier

Dosage was created in the early part of the 20th century by Lt. Col. Jean Joseph Vuillier, a retired French military officer and pedigree authority who was an active and vocal participant in the pedigree debates of his day. One of the more contested issues at the time among racing devotees focused on the relative merits of two of the three stallions from which all of today's Thoroughbreds descend, Eclipse and Herod. Vuillier contributed to a resolution through an in-depth analysis of the pedigrees of major European winners, classic and otherwise. To the delight of one side and to the dismay of the other, he found that Herod was the dominant influence of the two. More importantly, he determined that the proportion of Herod's influence in extended pedigrees through twelve generations was essentially the same in all of the horses analyzed. This was indeed a remarkable discovery, laying the groundwork for further research and development of the original Dosage System, eventually published in "Les Croisements Rationnels" (Rational Crossbreeding).

Vuillier noted that very few ancestors among the thousands present in the extended pedigree of the good horses he studied appeared with great frequency. Furthermore, as with Herod, the influence of these special ancestors through twelve generations also became constant, each with a unique contribution (or "dosage"). This critical observation led to Vuillier's identification of three series of key Thoroughbred ancestors separated by discrete timeframes. He called these ancestors *chefs-de-race*, a term he used to distinguish those rare individuals he believed had a unique, profound and long-term effect on the breed.

Vuillier's first series, from the early 19th century, includes the stallions Pantaloon, ch., 1824 (Castrel-Idalia, by Peruvian); Voltaire, br., 1826 (Blacklock-Phantom Mare, by Phantom); Touchstone, br., 1831 (Camel-Banter, by Master Henry); Bay Middleton, b., 1833 (Sultan-Cobweb, by Phantom); Birdcatcher, ch., 1833 (Sir Hercules-Guiccioli, by Bob Booty); Gladiator, ch., 1833 (Partisan-Pauline, by Moses); and Melbourne, br., 1834 (Humphrey Clinker-Cervantes Mare, by Cervantes). The series also includes one mare, Pocahontas, 183? (Glencoe-Marpessa, by Muley), the only mare Vuillier ever included among his *chefs-de-race*.

The second series, from the middle of the 19th century, includes just two *chefs-de-race*, Newminster, b., 1848 (Touchstone-Beeswing, by Dr. Syntax) and Stockwell, ch. 1849 (The Baron-Pocahontas, by Glencoe).

The third and final series of Vuillier's *chefs-de-race*, now from the late 19th century, includes Hermit, ch., 1864 (Newminster-Seclusion, by Tadmor); Hampton, b., 1872 (Lord Clifden-Lady Langden, by Kettledrum); Galopin,

Photo Courtesy of Z

Mr. Prospector

DP 23-12-13-4-0, DI 3.95, CD 1.04

Mr. Prospector, b.c., 1970	**Raise a Native (B)**	**Native Dancer (I/C)**	**Polynesian (I)**	Unbreakable
				Black Polly
			Geisha	**Discovery (S)**
				Miyako
		Raise You	Case Ace	**Teddy (S)**
				Sweet Heart
			Lady Glory	American Flag
				Beloved
	Gold Digger	**Nashua (I/C)**	**Nasrullah (B)**	**Nearco (B/C)**
				Mumtaz Begum
			Segula	Johnstown
				Sekhmet
		Sequence	**Count Fleet (C)**	Reigh Count
				Quickly
			Miss Dogwood	**Bull Dog (B)**
				Myrtlewood

	DP Contribution	**Equivalent to:**	
Sire	16- 8- 4- 4- 0	DI 4.33	CD 1.13
Dam	7- 4- 9- 0- 0	DI 3.44	CD 0.90

Along with Brilliant/Classic *chef-de-race* Northern Dancer, Brilliant/Classic *chef-de-race* Mr. Prospector, b.c., 1970 (Raise a Native-Gold Digger, by Nashua) is arguably one of the two most important North American sires of the late 20th century. His accomplishments as a sire, a sire of sires and a broodmare sire are legendary. As a performer he was a very fast sprinter, capable of getting six furlongs in under 1:08. His Gulfstream Park six-furlong track record remained unequaled for 26 years. Mr. Prospector derives his speed from both his sire and his dam, with an emphasis on his sire, Brilliant *chef-de-race* Raise a Native. The result is DP 23-12-13-4-0, DI 3.95 and CD 1.04. This is close to a "down-the-ladder" pattern dominated by the very large number of Brilliant points. Although second in the one-mile 1973 Derby Trial, Mr. Prospector was not truly competitive beyond sprint distances.

b., 1872 (Vedette-Flying Duchess, by The Flying Dutchman); Isonomy, b., 1875 (Sterling-Isola Bella, by Stockwell); Bend Or, ch., 1877 (Doncaster-Rouge Rose, by Thormanby) and St. Simon, br., 1881 (Galopin-St. Angela, by King Tom).

This process, in which new series of *chefs-de-race* periodically emerge, achieve dominance and establish a constant influence in pedigrees over time, is a rational model for the evolution of the Thoroughbred. Vuillier's method for measuring the influence of each *chef-de-race* depends on the fact that 4,096 ancestors populate the 12th generation in a pedigree. Using that number as a point total, he allowed that each generation should tally that same figure of 4,096. This leads to the obvious conclusion that every occurrence of a 12th generation ancestor is worth 1 point since that ancestor occupies 1 of 4,096 positions. A parent occupies 1 of 2 positions, equivalent to 2,048 of 4,096. The respective figures assigned for each occurrence in the 1st through the 12th generation are 2,048; 1,024; 512; 256; 128; 64; 32; 16; 8; 4; 2; and 1. A result of Vuillier's counting technique was the observation that by 1900 the actual percentage of blood of some of the most significant foundation animals in the breed (e.g., Eclipse, Herod and Highflyer) was close to the same in all pedigrees, generally varying by no more than three-quarters of one percent. The same was true for the *chefs-de-race* assigned to Vuillier's three series, although each *chef-de-race* had a different "Dosage" number that could vary greatly from one *chef-de-race* to another. The well-known pedigree authority, Abram S. Hewitt, noted in "The Great Breeders and Their Methods" (Thoroughbred Publishers, Inc., Lexington, Kentucky, 1982) that St. Simon's Dosage figure was more than twice as high as that of Bend Or even though the latter's sire line was far more prevalent in England in the 1920s.

Vuillier believed in designing a mating to align the Dosage figures in the foal with those established for the breed. If, for example, the sire's Dosage figure for St. Simon was too high, then the mare's figure should be lower in order to compensate it. Vuillier applied his skills in the employ of H. H. The Aga Khan who, following World War I, decided to greatly expand his interests in racing. Utilizing Lord Derby's trainer, the Hon. George Lambton, to select individuals, and Lt. Col. Vuillier to evaluate pedigrees, the Aga Khan established one of the most successful buying, racing and breeding operations in history. Among the yearlings purchased were Teresina, by Tracery (dam of Irish Oaks winner Theresina and of the high class American sire Alibhai); Mumtaz Mahal, by The Tetrarch (tail-female ancestress of Nasrullah and Mahmoud); Friar's Daughter, by Friar Marcus (dam of English Triple Crown winner Bahram and of Irish Derby winner Dastur); Diophon, by Grand Parade (winner of the 2000 Guineas); Salmon Trout, by The Tetrarch (winner of the St. Leger); Blenheim II, by Blandford (winner of the English Derby and a top-class sire); and Qurrat-al-Ain, by Buchan (dam of 1000 Guineas winner Majideh, she the dam of Belmont Stakes winner Gallant Man and of English and Irish Oaks winner Masaka). For more than thirty years the Aga Khan also bred an impressive number of superior horses including a host of champions and classic winners. Some of the more prominent include the aforementioned Bahram, Dastur, Majideh, Gallant Man,

Nasrullah and Mahmoud, as well as Firdaussi, Turkhan, Khaled, Migoli, Tulyar, Saint Crespin III, Sheshoon, Charlottesville and others.

Although the direct impact of Lt. Col. Vuillier on the Aga Khan's success cannot be quantified, it is true that the Aga Khan's breeding program seriously declined after Vuillier's death. Neither can the actual role of Dosage methodology be accurately measured. However, we can be certain that Lt. Col. Vuillier's creation was instrumental in shaping his pedigree insights and preferences. There is an undeniable link between Vuillier's philosophy and the Aga Khan's achievements.

Vuillier's work leaves many questions unanswered. Will his data and conclusions hold up in the light of today's more sophisticated analytical techniques? Can Dosages be shown truly to differentiate the quality of a pedigree? Do the principles that he developed still apply to contemporary Thoroughbreds? There are students of pedigree who continue to seek answers to these questions. Regardless of the outcome, and regardless of one's acceptance of Vuillier's ideas, it is clear that he made a revolutionary contribution to pedigree evaluation. By creating a methodology that classifies the configuration of an individual pedigree in quantitative terms, he changed forever the philosophical basis of pedigree analysis.

Chapter 4

The Origins of Dosage: Varola

The next major step in the evolution of Dosage is attributed to Dr. Franco Varola. An Italian lawyer, Varola introduced his approach to pedigree interpretation in a series of articles published in The British Racehorse between 1959 and 1972 and in two books, "Stalloni Capirazza dal 1900 ad oggi" published in 1960, and "Nuovi Dosaggi del Purosangue" published in 1967. These were followed by two more comprehensive volumes, "Typology of the Racehorse" (J. A. Allen, London, 1974), and "The Functional Development of the Thoroughbred" (J. A. Allen, London & New York, 1980).

Varola accepted Vuillier's premise that the evolution of the Thoroughbred takes place through a tiny fraction of the stallions standing at stud in any era. Over time, only a few names will survive in pedigrees while the rest will pass into obscurity. A consequence of this convergence of thought was that Varola also limited his selection of *chefs-de-race* to a relatively small number, although larger than Vuillier's.

The fundamental difference between Vuillier and Varola is the difference between quantitative analysis and qualitative analysis. Whereas Vuillier concerned himself only with the frequency (a quantity) with which his *chefs-de-race* appeared in a pedigree, Varola shifted the emphasis to the aptitudinal type (a quality) contributed to a pedigree by his *chefs-de-race*. Like Vuillier, Varola applied his technique to extended pedigrees. Unlike Vuillier, Varola did not differentiate the contributions of his *chefs-de-race* by generation. In other words, Varola allowed that an aptitudinal contribution in one generation would have the same significance as an aptitudinal contribution in another. Although his arbitrary dismissal of Galton's Law may disturb purists who believe in a diminishing influence with increasingly remote generations, and despite questions about the scientific accuracy of his approach, Varola offered a new perspective on pedigree interpretation. Instead of simply considering the historical exploits of the various ancestors in a pedigree, he emphasized the dynamic interplay of aptitudinal type that defined the character of the horse being analyzed. He concentrated on the aptitudinal influences passed along at stud rather than highlighting accomplishments on the track, a profound and significant change in direction. The importance of this shift in philosophy cannot be overstated because all too often our assumptions about ancestral influences are based on questionable information.

It is common practice to cite a horse's racing attributes in order to rationalize the potential performance of his progeny. A classic winner is expected to get classic distance runners. A sprint champion is expected to get sprinters or sprinter-miler types. Many times reality does match expectation. English Triple Crown winner Nijinsky II was one of the world's great sires of stayers on both dirt and grass. On the other end of the scale, two-

time Eclipse champion sprinter Housebuster got over 75% stakes winners at less than a mile. Yet it isn't always that straightforward. There are numerous examples that contradict our expectations. Take, for example, the pensioned international sire, Kingmambo. Kingmambo, a foal of 1990, is a son of the immortal Mr. Prospector and out of Miesque by Nureyev. Mr. Prospector is arguably the most important Thoroughbred stallion of the last 30 years, with a host of successful breeding sons and producing daughters. He was a brilliantly fast sprinter, able to run six furlongs in under 1:08. As a direct sire of runners, he is generally recognized as a source of speed, getting many early-maturing sprinters and sprinter-milers. Miesque, considered by many as among the greatest race mares in history, twice won the Grade 1 Breeders' Cup Mile on the turf. Kingmambo himself was a multiple Group 1 winner at a flat mile in France and England, never winning beyond that distance. He has a full brother that was a Group winner in France at six furlongs. Traditionally, a miler out of a miler and by a sprinter and sire of sprinter-milers would be expected to reproduce those qualities in his offspring. Yet Kingmambo became a major source of great stamina in a Thoroughbred world ever evolving toward more and more speed. Through 2014, the average winning distance of his progeny in North American open stakes races was a very long 8.94 furlongs. Only 5.4% of his progeny stakes wins were at less than eight furlongs. His best runners are Belmont Stakes winner Lemon Drop Kid and Japan Cup winner El Condor Pasa, both victorious at twelve furlongs, the former on dirt and the latter on grass.

In contrast to Kingmambo we have the example of Slewpy, a foal of 1980. Slewpy is a son of Triple Crown winner Seattle Slew and out of Rare Bouquet by Prince John. Seattle Slew, in addition to winning the Kentucky Derby, Preakness Stakes and Belmont Stakes, is also the sire of classic winners A.P. Indy and Swale in addition to the champion stayer Slew o' Gold. Rare Bouquet produced two other stakes winners in addition to Slewpy, both winners at middle distances. Slewpy stayed as well, annexing the Grade 1 mile and a sixteenth Young America Stakes as a two-year-old and the mile-and-a-quarter Grade 1 Meadowlands Cup at three. Thus we have a Grade 1 winner at a classic distance by a Triple Crown winner and sire of classic winners and out of a middle distance to classic distance producer. Conventional wisdom suggests that Slewpy should be a sire of at least middle distance types if not classic performers. The reality is that Slewpy became one of North America's top sprint sires. The average winning distance of his progeny in North American open stakes races is a short 7.07 furlongs and 66% of his progeny open stakes wins are at seven furlongs or shorter. His leading earner, Thirty Slews, won the Grade 1 Breeders' Cup Sprint in 1992.

The differences between Kingmambo and Slewpy are dramatic and revealing. In a "logical" world their records at stud would be reversed, with Kingmambo getting the sprinters and Slewpy getting the stayers. The fact that the opposite is true reinforces Varola's insistence that qualities passed along in the breeding shed dominate qualities

displayed on the racetrack. For some, it is a difficult notion to accept, but one that separates Dosage from traditional pedigree analysis.

Table 3 displays a list of recent sires whose progeny have won at least 30 major open stakes races and which, themselves, won at least five. Included are their average winning distances (AWDs) as runners and as sires, as well as the difference between the two. Those which won at distances considerably longer than their AWD as sires are shown first (negative difference) followed by those which won at distances considerably shorter than their AWD as sires (positive difference). At the top we find horses such as Marquetry and Lost Code which were legitimate routers but were mainly sires of sprinters. At the bottom we find horses like Distorted Humor and More Than Ready which were mostly sprinters on the track but sires of sprinter/miler to middle distance/classic types in the breeding shed. The difference between the AWDs as performers on the track and as sires is at least one full furlong. So although we may speculate on the distance at which the progeny of a particular sire will best perform based on his racing record, there are more than enough examples to suggest that there could, in fact, be a major discrepancy between the two. In other words, we can not automatically assume before the fact that a sprinter will become a sire of sprinters or a classic winner will become a sire of middle distance or classic horses.

Table 3. Average Winning Distances of Stallions as Runners and as Sires

SIRE	AWD AS A RUNNER (f)	AWD AS A SIRE (f)	DIFFERENCE (f)
Marquetry	9.07	6.65	-2.42
Lost Code	8.91	7.06	-1.85
Theatrical	11.00	9.28	-1.72
Street Sense	9.20	7.78	-1.42
English Channel	10.35	9.02	-1.33
In Excess	8.94	7.63	-1.31
Slew o' Gold	9.88	8.64	-1.24
Cryptoclearance	9.38	8.29	-1.09
Tabasco Cat	9.40	8.32	-1.08
Gulch	7.00	8.01	1.01
City Zip	6.13	7.36	1.23
Distorted Humor	7.10	8.45	1.35
Chief's Crown	8.20	9.60	1.40
More Than Ready	5.92	7.80	1.88

Returning to the concept of ancestral influence, Varola explains his resistance to applying Galton's Law to his being a "humanist" and "not a geneticist nor a scientist". By this exercise in logic, Varola rationalizes the position that he "can afford to take an independent view of the influence of early progenitors" and that he "is concerned with typology in a functional sense, and not with percentage of influence in a genetic sense". Choosing to ignore

scientific principles simply because one is not a scientist may be construed by some as a peculiar and self-serving thing to do, but it is consistent with Varola's excitement over his "sociological" rather than genetic interpretation of the Thoroughbred. On the other hand, if one chooses to overlook certain rules of logic, then observing pedigrees in terms of the distribution of aptitudinal qualities is refreshing and often quite revealing.

Varola's initial selection of twenty *chefs-de-race* was based largely on his perception of those sires that had the greatest overall impact on the breed in the 20th century. To ensure adequate typological variation among his *chefs-de-race*, he had to lower his standards somewhat in making later assignments, focusing primarily on their functional contribution. The final list included 120 stallions. The *chefs-de-race* were then separated into five aptitudinal groups he called: Brilliant, Intermediate, Classic, Stout and Professional. These groups differ in their "essence or character", not necessarily in their inclination to pass along distance capability. That having been said, Brilliant *chefs-de-race* tend to transmit quickness, speed and early maturity.

Intermediate *chefs-de-race* are so-called "mixers", necessary for a satisfactory balance of class and finesse. They are a connecting link between the aptitudinal extremes. Classic *chefs-de-race* are most often associated with the three-year-old classic races. Stout *chefs-de-race* produce runners of diminished brilliance, but with soundness, a good constitution and a steady temperament. The Professional *chefs-de-race* generally get pure plodders.

More broadly, Varola likened the five aptitudinal groups to positions along the political spectrum ranging from Left (Brilliant), Left of Center (Intermediate), Center (Classic), Right of Center (Stout) and Right (Professional). He believed the political analogy would avoid any misconceptions that the range of aptitudinal groups paralleled distance capability.

The mechanics of Varola's analysis are fairly straightforward and involve the creation of a Dosage Diagram. *Chefs-de-race* in a pedigree are placed one by one into a table according to their designated aptitudinal group. When all of the *chefs-de-race* are accounted for, the presences in each aptitudinal group are added. The sums of the presences within each group constitute the Dosage Diagram. For illustration, we will use the Dosage Diagram of English Derby winner St. Paddy, b., 1957 (Aureole-Edie Kelly, by Bois Roussel):

BRILLIANT	INTERMEDIATE	CLASSIC	STOUT	PROFESSIONAL
Hyperion		Aureole	(3)Chaucer	Bayardo
Cicero		Gainsborough	Bois Roussel	Son-in-Law
Phalaris		Blenheim II	Vatout II	Dark Ronald
		Blandford	Spearmint	
		Clarissimus		
		(2)Swynford		
		Tracery		
		Rock Sand		
3	0	9	6	3

The parenthesis before a sire's name indicates the total number of presences for that sire found in the pedigree.

The Dosage Diagram of St. Paddy does not necessarily correlate with any specific performance attributes. In fact, Varola insists that Dosage Diagrams have no relation to racing ability. Rather, the Dosage Diagram of St. Paddy fits within the larger framework of what Varola described in 1980 as "a behavioural perspective of the development of the breed in the course of this century". Each Dosage Diagram stands alone, symbolizing the type of horse one may expect by revealing the "proportional representation of the five aptitudinal groups". Varola does remind us that a balance of aptitudinal factors is desirable in a racehorse. The ability to observe that balance was a primary driving force in the development of his methodology.

Varola distinguishes among several types of Dosage Diagrams based on the aforementioned proportional representation. The Balanced Pattern displays a comparable number of influences in each group. Foals by stallions with a Balanced Pattern will largely retain the Dosage Diagram characteristics of their dam. The Classical Pattern has the highest representation in the Classic group and allows for a variety of mating possibilities. The Wing Pattern has its greatest representation in the Brilliant and Professional groups to the detriment of the Intermediate, Classic and Stout groups. Presumably this pattern is created by breeding at the extremes in the hope of producing an average. Varola notes that this effect is not often achieved, a fact that he offers as evidence of the virtue of a balanced distribution. The Brilliant Pattern is dominated by presences in the Brilliant group. Unlike the Wing Pattern, which may require several generations to restore balance, the Brilliant Pattern is easily "redeemed" according to Varola. The Stout Pattern occurs when the number of Stout *chefs-de-race* is the highest. This particular pattern was noted as typical of French- and Italian-bred horses. Finally, the Void Pattern describes a situation in which multiple or contiguous groups have no representation at all. Here again, Varola suggests that the existence of top-class sires and runners that display this pattern is further evidence that Dosage Diagrams have no relation to racing ability. They simply establish "type", thereby reinforcing

Varola’s main point that “Dosages are the study of the differentiation of functions within the Thoroughbred, and not magic formulae”.

Varola's complete works are far more intricate than can be fully covered here. His introduction of split aptitudinal groups, half-point sires and split personality sires, intended to enhance "differentiation", either enrich his theories or make them overly complex depending on one's point of view. Nevertheless, students of pedigree would be well-served by reading Varola's publications on their own because, despite any reservations one may have about the specifics of his methodology, the approach offers a novel perspective on the meaning of a Thoroughbred pedigree.

Chapter 5

Modern Dosage Methodology

Vuillier and Varola had established the foundations of Dosage using distinct quantitative and qualitative approaches. In some ways their philosophies overlapped. In other ways they were quite different. Both employed extended pedigrees and both believed that evolutionary or developmental influences within the Thoroughbred could be defined by a relatively small number of key ancestors. On the one hand, Vuillier applied Galton's Law, assuming a diminishing influence of *chefs-de-race* as generations became more remote. On the other, Varola rejected Galton's Law and gave every *chef-de-race* the same weight regardless of which generation he populated. Vuillier attempted to identify the actual genetic influence of a *chef-de-race* through a quantitative measurement of its presences in a pedigree. Varola tried to assign an aptitudinal type through the qualitative assessment of characteristics prepotently handed down from generation to generation. Neither method relies entirely on conventional pedigree analysis where the emphasis is on the ancestors' achievements on the track or in the breeding shed.

Despite the new directions offered by Vuillier and Varola, some practical problems remained. Not the least of these is the access to extended pedigrees for the vast majority of horsemen. Thanks to computers and both offline and online databases, such pedigrees now may be conveniently generated. Software can be written to calculate the Vuillier Dosage numbers and create the Varola Dosage Diagrams. However, the availability of technology does not guarantee its widespread use, particularly when it is likely to be expensive. Under any circumstances, an analysis technique involving extended pedigrees will always have marginal utility for a general racing audience.

A second limitation of the Vuillier and Varola methodologies is the lack of a statistical framework. Without a statistical base it is difficult to put one's analytical results in the proper context. In other words, if one fails to define control groups or measurable variables that compare the results of one analysis to another, the significance of the results may not be clear. This is particularly true in the case of Varola who specifically dissociated his Dosage Diagrams from any aspect of racing performance. Under those circumstances it is especially difficult to appreciate the real-world significance of pedigree type. Varola opted for "art" over science, and he succeeded. However, his disregard for scientific method clearly puts the user of his technique at a disadvantage, particularly if he or she is looking for a practical application that generates a set of probabilities applicable to real situations. With these limitations in mind, we sought a next-generation approach to Dosage that retained the best elements of the earlier versions while significantly expanding its utility. To that end, we abandoned the extended pedigree in favor of the readily accessible four-generation pedigree. We also rejected Varola's dismissal of Galton's Law, preferring instead to use a counting method similar to that employed by Vuillier. Finally, we felt that Varola's

dissociation of his aptitudinal groups from distance capability was arbitrary and not supported by evidence. The hypothesis we proposed was that the aptitudinal groups cover the entire spectrum of speed to stamina and that the relationship between speed and stamina in the individual will affect every aspect of his racing character, including distance ability. Rather than being contradictory qualities, speed and stamina are inextricably linked. As discussed at the outset, one is always sacrificed in favor of the other. Individual horses, because of the unique traits they have inherited, are positioned at discrete points along the speed-stamina continuum. These points determine their type and affect the full range of performance capabilities.

The *chef-de-race* list used in our original study is displayed in Table 4. The selections are, with minor adjustments, those of Varola as modified by Hewitt in his article on Dosage that appeared in The Blood-Horse issue of May 2, 1977. Hewitt modified the Varola list of largely European *chefs-de-race* in order to make Dosage more applicable to American pedigrees. In several cases the two authors disagreed as to aptitudinal placement. In those instances we accepted the assignments at face value, placing the *chef-de-race* in both categories. These *chefs-de-race* are shown in Table 3 with an asterisk (*) next to their name.

Table 4. *Chefs-de-race* Used in the Initial Contemporary Dosage Studies

BRILLIANT	INTERMEDIATE	CLASSIC	SOLID	PROFESSIONAL
Abernant	Ben Brush	Alibhai	Asterus	Admiral Drake
Black Toney*	Big Game	Aureole	Bachelors Double	Alcantara II
Bold Ruler	Black Toney*	Bahram	Ballymoss	Alizier
British Empire	Broomstick	Blandford	Blenheim II*	Alycidon
Bull Dog	Colorado	Blenheim II*	Bois Roussel	Bayardo
Cicero	Congreve	Blue Larkspur	Chaucer	Bruleur
Court Martial	Djebel	Brantome	Discovery	Chateau Bouscaut
Double Jay	Eight Thirty	Buckpasser	Fair Play*	Crepello
Grey Sovereign	Havresac II	Count Fleet	Herbager*	Fair Play*
Heliopolis	Khaled	Equipoise*	Man o' War	Foxbridge
Hyperion*	King Salmon	Gainsborough	Oleander	Hurry On
My Babu	Mahmoud*	Graustark*	Princequillo*	La Farina
Nasrullah*	Nashua	Gundomar	Right Royal	Le Fabuleux
Fair Trial	Equipoise*	Bull Lea	Gallant Man	Dark Ronald
Fairway	Full Sail	Clarissimus	Graustark*	Donatello II
Nearco*	Nasrullah*	Hail to Reason	Rock Sand*	Massine
Never Bend*	Native Dancer*	Herbager*	Round Table	Mieuxce
Olympia	Never Bend*	Hyperion*	Sea-Bird	Ortello
Orby	Northern Dancer	Mahmoud*	Sunstar	Precipitation
Panorama	Petition	Midstream	Tantieme	Rabelais
Peter Pan	Pharos	Mossborough	Teddy	Ribot*
Phalaris	Polynesian	Native Dancer*	Vatout	Sardanapale
Pharis	Princequillo*	Navarro	Worden	Solario
Pompey	Roman*	Nearco*		Son-in-Law

Table 4. *Chefs-de-race* Used in the Initial Contemporary Dosage Studies, cont.

BRILLIANT	INTERMEDIATE	CLASSIC	SOLID	PROFESSIONAL
Raise a Native	Sir Ivor	Never Say Die		Spearmint
Reviewer	Star Kingdom	Persian Gulf		Sunny Boy
Roman*	Star Shoot	Pilate		Tom Rolfe*
Royal Charger	Sweep	Prince Bio		Tourbillon*
Sir Cosmo	T. V. Lark	Prince Chevalier		Vaguely Noble
Tudor Minstrel	The Tetrarch	Prince Rose		Vandale
Turn-to*	Ticino	Ribot*		Vatellor
Ultimus	Tom Fool*	Rock Sand*		Wild Risk
What a Pleasure	Traghetto	Sicambre		
	Turn-to*	Sideral		
		Sir Gallahad III		
		Swynford		
		Tom Fool*		
		Tom Rolfe*		
		Tourbillon*		
		Tracery		
		Vieux Manoir		
		War Admiral		

We used a counting system based on 16 points for each of the four generations, analogous to Vuillier's 4,096 points for each of his twelve generations. Like Vuillier, we halved the influence of *chefs-de-race* found in each receding generation. In this way, a first generation *chef-de-race* receives 16 points, each second-generation *chef-de-race* receives 8 points, each third-generation *chef-de-race* receives 4 points and each fourth-generation *chef-de-race* receives 2 points. We opted for the 16-8-4-2 pattern over the more obvious 8-4-2-1 pattern to accommodate *chefs-de-race* split between two groups. In this manner, a fourth generation split *chef-de-race* receives a full point in each aptitudinal category rather than a more cumbersome half point.

Finally, for simplicity we stayed with five aptitudinal groups instead of the ten ultimately proposed by Varola through the splitting of aptitudes. This required the combining of some categories and the repositioning of some *chefs-de-race*. We also used the nomenclature adopted by Hewitt for defining the aptitudinal groups; i.e., Brilliant-Intermediate-Classic-Solid-Professional.

With the key elements in place, the analysis proceeds in a manner similar to Varola's creation of a Dosage Diagram, the main difference being that the points tallied in each aptitudinal group depend on the generational position of the *chef-de-race*. Finally, the initial output of the analysis is called a Dosage Profile (DP) to differentiate it from the Varola Dosage Diagram.

The best way to illustrate the procedure is by example. For this purpose we will use the current *chef-de-race* list as of February 2015 displayed in Tables 4 and 5. Table 4 is an alphabetical listing while Table 5 is a listing by aptitudinal group and includes the year of birth for each *chef-de-race*. Again, sires split between two aptitudinal groups are displayed with an asterisk after their name in Table 5.

Table 5. *Chefs-de-race* (224) as of September 2015 Listed Alphabetically

Abernant (B)
Ack Ack (I/C)
Admiral Drake (P)
Alcantara II (P)
Alibhai (C)
Alizier (P)
Alycidon (P)
Alydar (C)
A.P. Indy (I/C)
Apalachee (B)
Asterus (S)
Aureole (C)
Awesome Again (I/C)
Bachelor's Double (S)
Bahram (C)
Baldski (B/I)
Ballymoss (S)
Bayardo (P)
Ben Brush (I)
Best Turn (C)
Big Game (I)
Black Toney (B/I)
Blandford (C)
Blenheim II (C/S)
Blue Larkspur (C)
Blushing Groom (B/C)
Bois Roussel (S)
Bold Bidder (I/C)
Bold Ruckus (I/C)
Bold Ruler (B/I)
Brantome (C)
British Empire (B)
Broad Brush (I/C)
Broomstick (I)
Bruleur (P)
Buckaroo (B/I)
Buckpasser (C)
Bull Dog (B)
Bull Lea (C)
Busted (S)
Cape Cross (C)
Caro (I/C)
Carson City (B/I)
Chateau Bouscaut (P)
Chaucer (S)
Chief's Crown (I/S)
Danzig (I/C)
Dark Ronald (P)
Discovery (S)
Djebel (I)
Donatello II (P)
Double Jay (B)
Dr. Fager (I)
Eight Thirty (I)
El Prado (B/I)
Ela-Mana-Mou (P)
Equipoise (I/C)
Exclusive Native (C)
Fair Play (S/P)
Fair Trial (B)
Fairway (B)
Fappiano (I/C)
Forli (C)
Foxbridge (P)
Full Sail (I)
Gainsborough (C)
Gallant Man (B/I)
Giant's Causeway (C)
Gone West (I/C)
Graustark (C/S)
Grey Dawn II (B/I)
Grey Sovereign (B)
Gundomar (C)
Habitat (B)
Hail To Reason (C)
Halo (B/C)
Havresac II (I)
Heliopolis (B)
Herbager (C/S)
High Top (C)
His Majesty (C)
Hoist The Flag (B/I)
Hurry On (P)
Hyperion (B/C)
Icecapade (B/C)
Indian Ridge (I)
In Reality (B/C)
Intentionally (B/I)
In The Wings (C/S)
Key To The Mint (B/C)
Khaled (I)
King Salmon (I)
Midstream (C)
Mieuxce (P)
Mill Reef (C/S)
Monsun (C/S)
Montjeu (C/S)
Mossborough (C)
Mr. Prospector (B/C)
My Babu (B)
Nashua (I/C)
Nasrullah (B)
Native Dancer (I/C)
Navarro (C)
Nearco (B/C)
Never Bend (B/I)
Never Say Die (C)
Nijinsky II (C/S)
Niniski (C/P)
Nodouble (C/P)
Noholme II (B/C)
Northern Dancer (B/C)
Nureyev (C)
Oleander (S)
Olympia (B)
Orby (B)
Ortello (P)
Panorama (B)
Persian Gulf (C)
Peter Pan (B)
Petition (I)
Phalaris (B)
Pharis II (B)
Pharos (I)
Pia Star (S)
Pilate (C)
Pleasant Colony (I)
Polynesian (I)
Pompey (B)
Precipitation (P)
Pretense (C)
Prince Bio (C)
Prince Chevalier (C)
Prince John (C)
Princequillo (I/S)
Prince Rose (C)
Promised Land (C)
Pulpit (I/C)
Rock Sand (C/S)
Roman (B/I)
Rough'n Tumble (B/C)
Round Table (S)
Royal Academy (B/I)
Royal Charger (B)
Run The Gantlet (P)
Sadler's Wells (C/S)
Sardanapale (P)
Sea-bird (S)
Seattle Slew (B/C)
Secretariat (I/C)
Sharpen Up (B/C)
Shirley Heights (C/P)
Sicambre (C)
Sideral (C)
Sir Cosmo (B)
Sir Gallahad III (C)
Sir Gaylord (I/C)
Sir Ivor (I/C)
Smart Strike (I/C)
Solario (P)
Son-in-law (P)
Speak John (B/I)
Spearmint (P)
Spy Song (B)
Stage Door Johnny (S/P)
Star Kingdom (I/C)
Star Shoot (I)
Sunny Boy (P)
Sunstar (S)
Sweep (I)
Swynford (C)
T.v. Lark (I)
Tantieme (S)
Teddy (S)
The Tetrarch (I)
Ticino (C/S)
Tom Fool (I/C)
Tom Rolfe (C/P)
Tourbillon (C/P)
Tracery (C)
Traghetto (I)
Tudor Minstrel (B)
Turn-to (B/I)
Ultimus (B)

Table 5. *Chefs-de-race* (224) as of February 2015 Listed Alphabetically, cont.

Cicero (B)	Kingmambo (C/S)	Rabelais (P)	Unbridled (B/I)
Clarissimus (C)	King's Bishop (B/I)	Rainbow Quest (C/S)	Vaguely Noble (C/P)
Codex (I/C)	La Farina (P)	Raise A Native (B)	Vandale (P)
Colorado (I)	Le Fabuleux (P)	Reliance II (S/P)	Vatellor (P)
Congreve (I)	Lost Code (B/I)	Relko (S)	Vatout (S)
Count Fleet (C)	Luthier (C)	Reviewer (B/C)	Vieux Manoir (C)
Court Martial (B)	Lyphard (C)	Ribot (C/P)	War Admiral (C)
Creme Dela Creme (C/S)	Mahmoud (I/C)	Right Royal (S)	What A Pleasure (B)
Crepello (P)	Man O' War (S)	Riverman (I/C)	Wild Risk (P)
Damascus (I/C)	Massine (P)	Roberto (C)	Worden (S)

Table 6. *Chefs-de-race* (223) as of February 2015 Listed by Aptitudinal Group

BRILLIANT	INTERMEDIATE	CLASSIC	SOLID	PROFESSIONAL
Abernant 1946	A.P. Indy* 1989	A.P. Indy* 1989	Asterus 1923	Admiral Drake 1931
Apalachee 1971	Ack Ack* 1966	Ack Ack* 1966	Bachelor's Double 1906	Alcantara II 1908
Baldski* 1974	Awesome Again* 1994	Alibhai 1938	Ballymoss 1954	Alizier 1947
Black Toney* 1911	Baldski* 1974	Alydar 1975	Blenheim II* 1927	Alycidon 1945
Blushing Groom* 1974	Ben Brush 1893	Aureole 1950	Bois Roussel 1935	Bayardo 1906
Bold Ruler* 1954	Big Game 1939	Awesome Again* 1994	Busted 1963	Bruleur 1910
British Empire 1937	Black Toney* 1911	Bahram 1932	Chaucer 1900	Chateau Bouscaut 1927
Buckaroo* 1975	Bold Bidder* 1962	Best Turn 1966	Chief's Crown* 1982	Crepello 1954
Bull Dog 1927	Bold Ruckus* 1976	Blandford 1919	Creme Dela Creme* 1963	Dark Ronald 1905
Carson City* 1987	Bold Ruler* 1954	Blenheim II* 1927	Discovery 1931	Donatello II 1934
Cicero 1902	Broad Brush* 1983	Blue Larkspur 1926	Fair Play* 1905	Ela-Mana-Mou 1976
Court Martial 1942	Broomstick 1901	Blushing Groom* 1974	Graustark* 1963	Fair Play* 1905
Double Jay 1944	Buckaroo* 1975	Bold Bidder* 1962	Herbager* 1956	Foxbridge 1930
El Prado* 1989	Caro* 1967	Bold Ruckus* 1976	In The Wings* 1986	Hurry On 1913
Fair Trial 1932	Carson City* 1987	Brantome 1931	Kingmambo* 1990	La Farina 1911
Fairway 1925	Chief's Crown* 1982	Broad Brush* 1983	Man O' War 1917	Le Fabuleux 1961
Gallant Man* 1954	Codex* 1977	Buckpasser 1963	Mill Reef* 1968	Massine 1920
Grey Dawn II* 1962	Colorado 1923	Bull Lea 1935	Monsun* 1990	Mieuxce 1933
Grey Sovereign 1948	Congreve 1924	Cape Cross 1994	Montjeu* 1996	Niniski* 1976
Habitat 1966	Damascus* 1964	Caro* 1967	Nijinsky II* 1967	Nodouble* 1965
Halo* 1969	Danzig* 1977	Clarissimus 1913	Oleander 1924	Ortello 1926
Heliopolis 1936	Djebel 1937	Codex* 1977	Pia Star 1961	Precipitation 1933
Hoist The Flag* 1968	Dr. Fager 1964	Count Fleet 1940	Princequillo* 1940	Rabelais 1900
Hyperion* 1930	Eight Thirty 1936	Creme Dela Creme* 1963	Rainbow Quest* 1981	Reliance II* 1962
Icecapade* 1969	El Prado* 1989	Damascus* 1964	Reliance II* 1962	Ribot* 1952
In Reality* 1964	Equipoise* 1928	Danzig* 1977	Relko 1960	Run The Gantlet 1968
Intentionally* 1956	Fappiano* 1977	Equipoise* 1928	Right Royal 1958	Sardanapale 1911
Key To The Mint* 1969	Full Sail 1934	Exclusive Native 1965	Rock Sand* 1900	Shirley Heights* 1975
King's Bishop* 1969	Gallant Man* 1954	Fappiano* 1977	Round Table 1954	Solario 1922
Lost Code* 1984	Gone West* 1984	Forli 1963	Sadler's Wells* 1981	Son-in-law 1911
Mr. Prospector* 1970	Grey Dawn II* 1962	Gainsborough 1915	Sea-bird 1962	Spearmint 1903
My Babu 1945	Havresac II 1915	Giant's Causeway 1997	Stage Door Johnny* 1965	Stage Door Johnny* 1965
Nasrullah 1940	Hoist The Flag* 1968	Gone West* 1984	Sunstar 1908	Sunny Boy 1944
Nearco* 1935	Indian Ridge 1985	Graustark* 1963	Tantieme 1947	Tom Rolfe* 1962
Never Bend* 1960	Intentionally* 1956	Gundomar 1942	Teddy 1913	Tourbillon* 1928

Table 6. *Chefs-de-race* (224) as of September 2015 Listed by Aptitudinal Group, cont.

BRILLIANT	INTERMEDIATE	CLASSIC	SOLID	PROFESSIONAL
Noholme II* 1956	Khaled 1943	Hail To Reason 1958	Ticino* 1939	Vaguely Noble* 1965
Northern Dancer* 1961	King Salmon 1930	Halo* 1969	Vatout 1926	Vandale 1943
Olympia 1946	King's Bishop* 1969	Herbager* 1956	Worden 1949	Vatellor 1933
Orby 1904	Lost Code* 1984	High Top 1969		Wild Risk 1940
Panorama 1936	Mahmoud* 1933	His Majesty 1968		
Peter Pan 1904	Nashua* 1952	Hyperion* 1930		
Phalaris 1913	Native Dancer* 1950	Icecapade* 1969		
Pharis II 1936	Never Bend* 1960	In Reality* 1964		
Pompey 1923	Petition 1944	In The Wings* 1986		
Raise A Native 1961	Pharos 1920	Key To The Mint* 1969		
Reviewer* 1966	Pleasant Colony 1978	Kingmambo* 1990		
Roman* 1937	Polynesian 1942	Luthier 1965		
Rough'n Tumble* 1948	Princequillo* 1940	Lyphard 1969		
Royal Academy* 1987	Pulpit* 1994	Mahmoud* 1933		
Royal Charger 1942	Riverman* 1969	Midstream 1933		
Seattle Slew* 1974	Roman* 1937	Mill Reef* 1968		
Sharpen Up* 1969	Royal Academy* 1987	Monsun* 1990		
Sir Cosmo 1926	Secretariat* 1970	Montjeu* 1996		
Speak John* 1958	Sir Gaylord* 1959	Mossborough 1947		
Spy Song 1943	Sir Ivor * 1965	Mr. Prospector* 1970		
Tudor Minstrel 1944	Smart Strike* 1992	Nashua* 1952		
Turn-to* 1951	Speak John* 1958	Native Dancer* 1950		
Ultimus 1906	Star Kingdom* 1946	Navarro 1931		
Unbridled* 1987	Star Shoot 1898	Nearco* 1935		
What A Pleasure 1965	Sweep 1907	Never Say Die 1951		
	T. V. Lark 1957	Nijinsky II* 1967		
	The Tetrarch 1911	Niniski* 1976		
	Tom Fool* 1949	Nodouble* 1965		
	Traghetto 1942	Noholme II* 1956		
	Turn-to* 1951	Northern Dancer* 1961		
	Unbridled* 1987	Nureyev 1977		
		Persian Gulf 1940		
		Pilate 1928		
		Pretense 1963		
		Prince Bio 1941		
		Prince Chevalier 1943		
		Prince John 1953		
		Prince Rose 1928		
		Promised Land 1954		
		Pulpit* 1994		
		Rainbow Quest* 1981		
		Reviewer* 1966		
		Ribot* 1952		
		Riverman* 1969		
		Roberto 1969		
		Rock Sand* 1900		
		Rough'n Tumble* 1948		
		Sadler's Wells* 1981		
		Seattle Slew* 1974		
		Secretariat* 1970		

Table 6. Chefs-de-race (224) as of September 2015 Listed by Aptitudinal Group, cont.

BRILLIANT	INTERMEDIATE	CLASSIC	SOLID	PROFESSIONAL
		Sharpen Up* 1969		
		Shirley Heights* 1975		
		Sicambre 1948		
		Sideral 1948		
		Sir Gallahad III 1920		
		Sir Gaylord* 1959		
		Sir Ivor * 1965		
		Smart Strike* 1992		
		Star Kingdom* 1946		
		Swynford 1907		
		Ticino* 1939		
		Tom Fool* 1949		
		Tom Rolfe* 1962		
		Tourbillon* 1928		
		Tracery 1909		
		Vaguely Noble* 1965		
		Vieux Manoir 1947		
		War Admiral 1934		

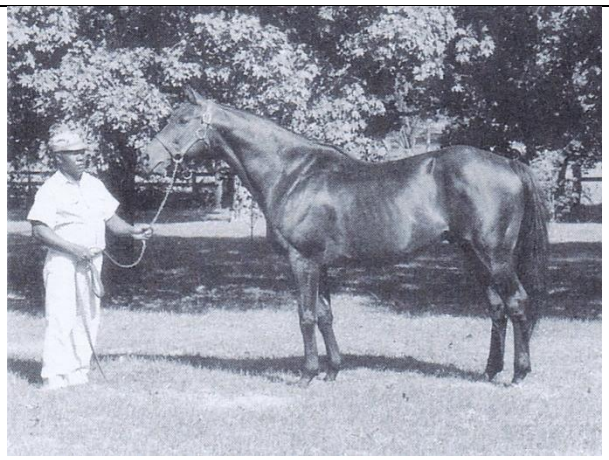


Photo Courtesy of The Thoroughbred Times

Round Table

DP 12-8-10-8-2, DI 1.67, CD 0.50

Round Table, b.c., 1954	**Princequillo (I/S)**	**Prince Rose (C)**	Rose Prince	Prince Palatine
				Eglantine
			Indolence	Gay Crusader
				Barrier
		Cosquilla	Papyrus	**Tracery (C)**
				Miss Matty
			Quick Thought	White Eagle
				Mindful
	Knight's Daughter	**Sir Cosmo (B)**	The Boss	**Orby (B)**
				Southern Cross II
			Ayn Hali	Desmond
				Lalla Rookh
		Feola	Friar Marcus	**Cicero (B)**
				Prim Nun
			Aloe	**Son-in-Law (P)**
				Alope

	DP Contribution	Equivalent to:	
Sire	0- 8-10- 8- 0	DI 1.00	CD 0.00
Dam	12- 0- 0- 0- 2	DI 6.00	CD 1.43

Solid *chef-de-race* Round Table, b.c., 1954 (Princequillo-Knight's Daughter, by Sir Cosmo) is an example of breeding classicity to speed. His sire, Intermediate/Solid c*hef-de-race* Princequillo, contributes a balanced pattern of aptitudinal influences while his dam contributes sheer brilliance. The result is DP 12-8-10-8-2, DI 1.67 and CD 0.50, with representation in all five aptitudinal groups and significant representation in four. Thus, there are strong elements of both speed and endurance. He had the speed to win stakes at two, ranking eight pounds below the Experimental Free Handicap topweight, Barbizon. He also had the speed to win the Hollywood Gold Cup the next year in 1:58.3, the fastest time ever by a three-year-old to that point in racing history. Round Table's ability to carry speed over a range of distances is exemplified by a mile in 1:33.2 under 130 pounds, nine furlongs in world record time of 1:46.4 also under 130 pounds, nine and a half furlongs in American record time of 1:53.2, and ten furlongs on the turf in world record time of 1:58.2 while toting 132 pounds.

Chapter 6

Dosage Calculations

In order to better understand Dosage figures, it is useful to go through the actual mechanics of doing the calculations. Even though there are computer software programs, computerized databases and even online databases for accessing Dosage figures, seeing how the numbers are generated provides a deeper insight into the interplay of those elements comprising the DP and related figures for a particular Thoroughbred. The analogy would be knowing how to do addition, subtraction, multiplication and division even though calculators are universally available to perform those functions. There is always value in understanding the fundamentals.

The subject of the analysis is Hero's Honor, b.c., 1980 (Northern Dancer-Glowing Tribute, by Graustark). His four-generation pedigree follows, with *chefs-de-race* highlighted in bold type.

Photo Courtesy of the Thoroughbred Times

Hero's Honor, b.c., 1980

Northern Dancer	Nearctic	**Nearco**	**Pharos**
			Nogara
		Lady Angela	**Hyperion**
			Sister Sarah
	Natalma	**Native Dancer**	**Polynesian**
			Geisha
		Almahmoud	**Mahmoud**
			Arbitrator
Glowing Tribute	**Graustark**	**Ribot**	Tenerani
			Romanella
		Flower Bowl	**Alibhai**
			Flower Bed
	Admiring	**Hail To Reason**	**Turn-to**
			Nothirdchance
		Searching	**War Admiral**
			Big Hurry

The first-generation sire, Northern Dancer, is a *chef-de-race* split between the Brilliant and Classic categories (see Table 5 for this and the remaining *chef-de-race* assignments). With 16 points reserved for a *chef-de-race* in generation one, he is assigned 8 points in Brilliant and 8 points in Classic. In the second generation, worth 8 points for each *chef-de-race*, Nearctic is not a *chef-de-race* while Graustark is a *chef-de-race* split between Classic and Solid. No points are added for Nearctic while Graustark is assigned 4 points each in Classic and Solid. We use the same procedure for generations three and four, leading to the distribution of points found in Table 7.

All four third generation sires are *chefs-de-race*. These receive a total of four points each: 2 Brilliant and 2 Classic for Nearco; 2 Intermediate and 2 Classic for Native Dancer; 2 Classic and 2 Professional for Ribot; and 4 Classic for Hail to Reason. In the fourth generation, where each *chef-de-race* is assigned two points, there are seven *chefs-de-race* out of the eight sires. There are 2 Intermediate points assigned to Pharos; 1 Brilliant and 1 Classic to Hyperion; 2 Intermediate to Polynesian; 1 Intermediate and 1 Classic to Mahmoud; 2 Classic to Alibhai; 1 Brilliant and 1 Intermediate to Turn-to; and 2 Classic to War Admiral. Tenerani is the only fourth generation sire that is not a *chef-de-race*.

Table 7. Calculation of the Dosage Profile (DP) for Hero's Honor

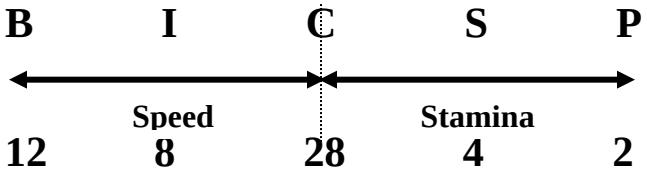
GENERATION (PTS)	SIRES (APTITUDINAL GROUP(S))	B	I	C	S	P
1st Generation (16):	**Northern Dancer** (Brilliant/Classic)	8		8		
2nd Generation (8):	Nearctic (N/A)					
	Graustark (Classic/Solid)			4	4	
3rd Generation (4):	**Nearco** (Brilliant/Classic)	2		2		
	Native Dancer (Intermediate/Classic)		2	2		
	Ribot (Classic/Professional)			2		2
	Hail to Reason (Classic)			4		
4th Generation (2):	**Pharos** (Intermediate)		2			
	Hyperion (Brilliant/Classic)	1		1		
	Polynesian (Intermediate)		2			
	Mahmoud (Intermediate/Classic)		1	1		
	Tenerani (N/A)					
	Alibhai (Classic)			2		
	Turn-to (Brilliant/Intermediate)	1	1			
	War Admiral (Classic)			2		
	DP:	**12**	**8**	**28**	**4**	**2**

After accounting for all fifteen sires within four generations, we add the points in each column: Brilliant, Intermediate, Classic, Solid and Professional. In the example, we are left with a DP having 12 points under Brilliant, 8 points under Intermediate, 28 points under Classic, 4 points under Solid and 2 points under Professional. The distribution is normally displayed as DP 12-8-28-4-2.

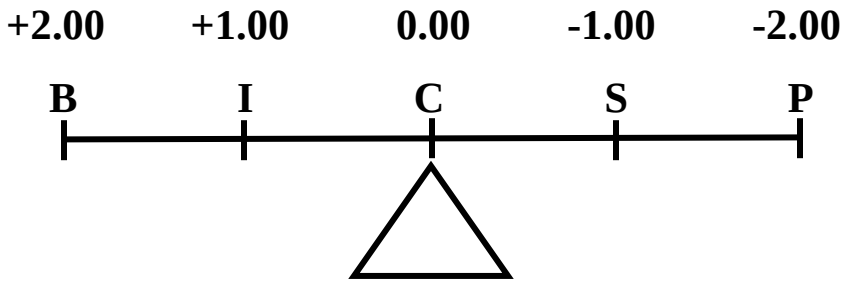
Hero's Honor's DP has representation in each of the five aptitudinal groups. This is not always the case. Quite often horses will lack representation in one or more categories and their point totals can vary widely. The 54 points out of a possible 64 assigned to Hero's Honor indicate the presence of numerous *chefs-de-race* among the fifteen four-generation sires. Within the Thoroughbred population we find considerable variation in DP point totals as well as in the distribution of points in the DP. The many possible configurations lend themselves to other calculations based on the DP that capture the differences in a readily visible form. These are alternative

expressions of the aptitudinal characteristics in a pedigree. In combination with the DP they provide a more complete picture of aptitudinal type.

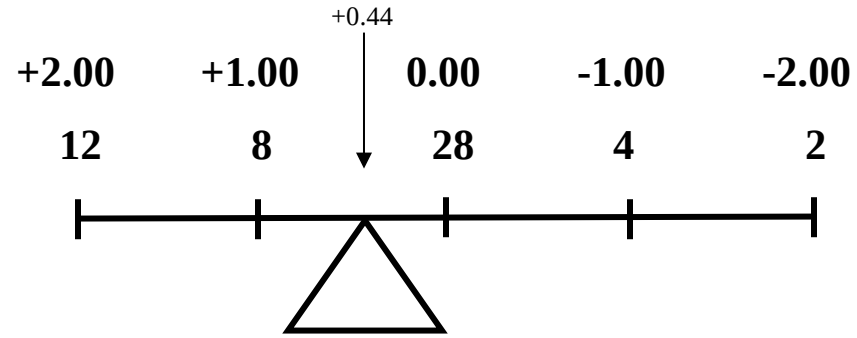
The first of these expressions is the Dosage Index (DI). The DI is a ratio of inherited prepotent speed to stamina. It is derived first by dividing the DP into separate speed and stamina components. The speed component is defined as the Brilliant points plus the Intermediate points plus one-half the Classic points found in the DP. Similarly, the stamina component is defined as one-half the Classic points plus the Solid points plus the Professional points. In effect, we've split the DP down the middle. For Hero's Honor, the speed component is 12 plus 8 plus one-half of 28, or 34. The stamina component is one-half of 28 plus 4 plus 2, or 20. The DI is simply the ratio of the speed component over the stamina component. In this case it is 34 over 20, or 1.70.



If we imagine the five aptitude groups as points spaced equally along a linear scale where Brilliant is assigned a value of +2.00, Intermediate is assigned a value +1.00, Classic is assigned a value 0.00, Solid is assigned a value of -1.00, and Professional is assigned a value of -2.00, the DP allows for the calculation of the second expression, the Center of Distribution (CD). Think of the scale as you would a seesaw where the aptitudinal groups are evenly spaced and the assigned values represent distances to the left and right of center. Now consider that the seesaw is pivoted in the middle and that the points in the DP are weights placed on the seesaw at the location corresponding to their aptitudinal group. Depending on the "weights", the seesaw will tip to the left or to the right. The CD is that position along the seesaw where the pivot must be moved to bring the system back into balance. In a sense, it is a similar to a center of gravity where all of the weighted aptitudes supplied by *chefs-de-race* in the four generations merge into a single point. A graphical representation of the concept is shown below.



The CD is calculated by adding twice the Brilliant points plus the Intermediate points minus the Solid points minus twice the Professional points and dividing that number by the total points in the DP. For Hero's Honor, the numerator is 24 plus 8 minus 4 minus 4, or 24. The denominator is 12 plus 8 plus 28 plus 4 plus 2, or 54. The CD is then 24 divided by 54, or +0.44. In the following graphic we can see that the pivot point has moved 0.44 units to the left to rebalance the "weights".



Summarizing Hero's Honor's Dosage figures, he has DP 12-8-28-4-2, DI 1.70 and CD 0.44. By themselves, these numbers mean very little. Their significance will become clear when we compare them to the figures of other Thoroughbreds. With these calculations available, we can evaluate runners with similar performance characteristics in an attempt to identify patterns linking aptitudinal type to track performance. For the record, Hero's Honor was a Grade 1 winner at up to 11 furlongs on the grass.

As another example we will use a horse with distinctly different aptitudinal characteristics, Mr. Greeley.

Photo Courtesy of Susie Oldham

Mr. Greeley, ch.c., 1992

Gone West	**Mr. Prospector**	**Raise a Native**	**Native Dancer**	
			Raise You	
		Gold Digger	**Nashua**	
			Sequence	
	Secrettame	**Secretariat**	**Bold Ruler**	
			Somethingroyal	
		Tamerett	Tim Tam	
			Mixed Marriage	
Long Legend	**Reviewer**	**Bold Ruler**	**Nasrullah**	
			Miss Disco	
		Broadway	Hasty Road	
			Flitabout	
	Lianga	Dancer's Image	**Native Dancer**	
			Noors Image	
		Leven Ones	Sailor	
			Olympia Dell	

Table 8 displays the contributions of the *chefs-de-race* within four generations and the distribution of points for Mr. Greeley. In this case, the first generation sire, Gone West, is a split I/C *chef-de-race*. There are two second-generation *chefs-de-race* (Mr. Prospector (B/C) and Reviewer (B/C)), three third-generation *chefs-de-race* (Raise a Native (B), Secretariat (I/C) and Bold Ruler (B/I)) and five fourth-generation *chefs-de-race* (Native Dancer (I/C, twice), Nashua (I), Bold Ruler (B/I) again and Nasrullah (B)).

Table 8. Calculation of the Dosage Profile (DP) for Mr. Greeley

GENERATION (PTS)	SIRES (APTITUDINAL GROUP(S))	B	I	C	S	P
1st Generation (16):	**Gone West** (Intermediate/Classic)		8	8		
2nd Generation (8):	**Mr. Prospector** (Brilliant/Classic)	4		4		
	Reviewer (Brilliant/Classic)	4		4		
3rd Generation (4):	**Raise a Native** (Brilliant)	4				
	Secretariat (Intermediate Classic)		2	2		
	Bold Ruler (Brilliant/Intermediate)	2	2			
	Dancer's Image (N/A)					
4th Generation (2):	**Native Dancer** (Intermediate/Classic)		1	1		
	Nashua (Intermediate/Classic)		1	1		
	Bold Ruler (Brilliant/Intermediate)	1	1			
	Tim Tam (N/A)					
	Nasrullah (Brilliant)	2				
	Hasty Road (N/A)					
	Native Dancer (Intermediate/Classic)		1	1		
	Sailor (N/A)					
	DP:	**17**	**16**	**21**	**0**	**0**

Mr. Greeley's DP 17-16-21-0-0 obviously is arranged quite differently from that of Hero's Honor. Rather than exhibiting points in all five aptitudinal groups, Mr. Greeley's DP is void of any contributions from the extremes of the stamina wing in the Solid and Professional groups. His highest representation is in the very speedy Brilliant group. Mr. Greeley's DP translates to DI 4.14 ((17 + 16 + 10.5) / (10.5 + 0 + 0) = 43.5 / 10.5) and CD 0.93 ((2 x 17) + 16 – 0 – (2 x 0))/(17 + 16 + 21 + 0 + 0) = 50 / 54). These figures vividly contrast with those of Hero's Honor and suggest an individual of substantially different type. In fact, Mr. Greeley was a multiple graded stakes winner at six and seven furlongs, finishing second by a neck in the 1995 Breeders' Cup Sprint (Gr. 1).

	HERO'S HONOR	MR. GREELEY
DI	1.70	4.14
CD	0.44	0.93
Type	Classic distances, grass	Sprinter, dirt

The observed contrast in type between Hero's Honor and Mr. Greeley is a dramatic example of how classification using Dosage figures can differentiate pedigrees and capture the expression of real-world performance.

A useful consequence of Dosage calculations is the ability to separate the contribution of the sire from the contribution of the dam. With a maximum of 64 possible Dosage points in a DP, 40 can come from the sire's side of the pedigree and 24 from the dam's side, the difference of 16 attributed to the fact that the direct sire himself can be a *chef-de-race*. In the case of Hero's Honor, the sire, Northern Dancer, contributes 11 Brilliant points, 7 Intermediate points, 14 Classic points, 0 Solid points and 0 Professional points, better expressed as 11-7-14-0-0. This is equivalent to DI 3.57. The dam, Glowing Tribute, contributes 1-1-14-4-2, equivalent to DI 0.69. When combined, we have Hero's Honor's previously derived DP 12-8-28-4-2 and DI 1.70. What we see from this perspective, however, is the result of breeding modest speed (DI 3.57) to strong stamina (0.69), thereby offering a deeper insight into the nature of the mating that produced Hero's Honor.
A couple of other examples show the result of breeding speed to speed and stamina to stamina. The former is represented by Gene's Lady, 1981, a high-class sprinting mare by Brilliant *chef-de-race* What a Pleasure and out of Lady T. V., by Intermediate *chef-de-race* T. V. Lark. Gene's Lady's earned almost $950,000, winning stakes from ages three to six. Her Dosage figures are DP 27-15-5-3-0 and DI 8.09, obviously shifted toward great speed. She receives 25-6-4-3-0 (equivalent to DI 6.60) from What a Pleasure and 2-9-1-0-0 (equivalent to DI 21.00) from Lady T. V. In this example, breeding speed to speed produced primarily a sprinter, although on occasion Gene's Lady's class enabled her to stretch out as far as a mile and a sixteenth.

The stamina to stamina example is Bien Bien, 1989, a multiple Grade 1-winning turf performer up to a mile and three-quarters. Bien Bien is by champion Manila who contributes 5-1-10-0-6 (equivalent to DI 1.00) to Bien Bien's DP 5-3-22-6-8 and DI 0.76. He is out of Stark Winter, by Classic/Solid *chef-de-race* Graustark. Stark Winter contributes 0-2-12-6-2 (equivalent to DI 0.57). Bien Bien is clearly the product of endurance on top and endurance on the bottom and the outcome is what we would expect from a mating of this type.

Table 9 presents the contributions of the 50 leading North American sires of 2014 on the general sire list to the DP of their progeny.

Table 9. Dosage Contribution and AWD of Leading Sires of 2014

LEADING SIRE	B	I	C	S	P	DI	CD	PTS	AWD
Afleet Alex	1 -	0 -	3 -	0 -	0	1.67	0.50	4	8.61
Any Given Saturday	2 -	3 -	5 -	0 -	0	3.00	0.70	10	7.96
Bernardini	2 -	6 -	8 -	0 -	0	3.00	0.63	16	8.53
Bernstein	1 -	1 -	4 -	2 -	0	1.00	0.13	8	7.39
Broken Vow	7 -	6 -	7 -	2 -	2	2.20	0.58	24	8.19
Candy Ride (ARG)	1 -	1 -	3 -	1 -	0	1.40	0.33	6	7.80
City Zip	10 -	4 -	4 -	0 -	0	8.00	1.33	18	7.38
Congrats	7 -	5 -	10 -	0 -	0	3.40	0.86	22	7.35
Curlin	4 -	4 -	6 -	0 -	0	3.67	0.86	14	8.33
Distorted Humor	5 -	2 -	6 -	0 -	1	2.50	0.71	14	8.46
Elusive Quality	5 -	6 -	9 -	0 -	0	3.44	0.80	20	7.40
English Channel	4 -	4 -	8 -	0 -	0	3.00	0.75	16	9.03
Exchange Rate	3 -	4 -	7 -	0 -	0	3.00	0.71	14	7.14
Flatter	7 -	5 -	10 -	0 -	0	3.40	0.86	22	7.75
Ghostzapper	2 -	4 -	6 -	0 -	0	3.00	0.67	12	8.02
Giant's Causeway	6 -	1 -	25 -	0 -	0	1.56	0.41	32	8.82
Hard Spun	2 -	4 -	10 -	0 -	0	2.20	0.50	16	7.88
Harlan's Holiday	1 -	0 -	3 -	0 -	0	1.67	0.50	4	7.88
Indian Charlie	0 -	1 -	1 -	0 -	0	3.00	0.50	2	7.10
Jump Start	3 -	5 -	8 -	0 -	0	3.00	0.69	16	8.01
Kitten's Joy	5 -	5 -	6 -	2 -	0	2.60	0.72	18	8.59
Langfuhr (CAN)	2 -	4 -	6 -	0 -	0	3.00	0.67	12	8.46
Lemon Drop Kid	6 -	0 -	12 -	4 -	0	1.20	0.36	22	8.69
Lucky Pulpit	2 -	7 -	9 -	0 -	0	3.00	0.61	18	8.75
Macho Uno	3 -	0 -	3 -	0 -	0	3.00	1.00	6	8.02
Malibu Moon	6 -	5 -	9 -	0 -	0	3.44	0.85	20	8.03
Medaglia d'Oro	5 -	6 -	5 -	2 -	0	3.00	0.78	18	8.46
More Than Ready	4 -	0 -	6 -	0 -	0	2.33	0.80	10	7.79
Northern Afleet	5 -	0 -	7 -	0 -	0	2.43	0.83	12	7.93
Offlee Wild	4 -	2 -	6 -	0 -	0	3.00	0.83	12	7.92
Pulpit	6 -	13 -	17 -	0 -	0	3.24	0.69	36	8.31
Rockport Harbor	2 -	4 -	2 -	0 -	0	7.00	1.00	8	7.72
Scat Daddy	4 -	0 -	3 -	1 -	0	2.20	0.88	8	8.13
Sharp Humor	1 -	1 -	2 -	0 -	0	3.00	0.75	4	7.50
Sky Mesa	2 -	6 -	8 -	0 -	0	3.00	0.63	16	7.93
Smart Strike	6 -	8 -	12 -	0 -	0	3.33	0.77	26	8.44
Speightstown	4 -	5 -	7 -	0 -	0	3.57	0.81	16	6.74
Stormy Atlantic	3 -	1 -	4 -	0 -	0	3.00	0.88	8	7.78
Street Cry (IRE)	5 -	1 -	4 -	0 -	0	4.00	1.10	10	8.31
Street Sense	2 -	0 -	4 -	0 -	0	2.00	0.67	6	7.71
Successful Appeal	3 -	1 -	2 -	0 -	0	5.00	1.17	6	7.35
Tale of the Cat	5 -	1 -	4 -	0 -	0	4.00	1.10	10	7.62
Tapit	4 -	9 -	10 -	1 -	0	3.00	0.67	24	8.44
Tiz Wonderful	1 -	0 -	1 -	0 -	0	3.00	1.00	2	7.38
Tiznow	2 -	0 -	4 -	0 -	0	2.00	0.67	6	8.51

Table 9. Dosage Contribution and AWD of Leading Sires of 2014, cont.

LEADING SIRE	B	I	C	S	P	DI	CD	PTS	AWD
Tribal Rule	1 -	1 -	3 -	1 -	0	1.40	0.33	6	6.93
Unbridled's Song	5 -	8 -	6 -	0 -	2	3.20	0.67	21	7.96
War Front	2 -	5 -	9 -	0 -	0	2.56	0.56	16	7.98
Wildcat Heir	0 -	1 -	1 -	0 -	0	3.00	0.50	2	6.64
Yes It's True	2 -	1 -	1 -	0 -	0	7.00	1.25	4	6.98

In some cases we see a disparity between the contribution of a sire and what we know about the performance traits of his runners. This can be especially instructive when considering relatively young stallions since large differences between the Dosage figures and the real-world performance of their progeny could be a signal that we are dealing with an unacknowledged source of aptitudinal prepotence. Take, for example, former Eclipse Award champion sprinter Midnight Lute, one of North America's more promising young sires through his third crop which raced in 2014. Midnight Lute twice captured the Breeders' Cup Sprint (G1) at six furlongs and never won a major race beyond seven furlongs. Despite this, the AWD of his runners in major North American stakes races through 2014 is 8.04 furlongs, a figure that may be artificially low because of the emphasis on shorter races for two-year-olds over the first three crops. Midnight Lute's Dosage contribution is a scant 1-0-1-0-0, equivalent to DI 3.00 and CD 1.00. This suggests a speed orientation that may not accurately describe reality. In fact, through those three crops, 75% of the major wins by Midnight Lute's runners were at a mile or more. His AWD is longer than those of well-known middle distance and "staying" sires such as Ghostzapper, Unbridled's Song and even Midnight Lute's own sire, Kentucky Derby (G1) and Preakness Stakes (G1) winner Real Quiet. Only time will reveal whether Midnight Lute is himself a source of prepotent type or if one or more of his own ancestors are contributing prepotent stamina, but it appears his progeny thus far have outrun his present aptitudinal orientation. Similar arguments were made for A.P. Indy and Kingmambo, stallions that infused distance capability in excess of what was expected from their Dosage contributions prior to their selection as *chefs-de-race*. The selection of *chef-de-race* is discussed in detail in Chapter 19.

Photo Courtesy of Martin King Sportpix

Thunder Gulch

DP 10-2-8-0-0, DI 4.00, CD 1.10

Thunder Gulch, b.c., 1992	Gulch	**Mr. Prospector (B/C)**	**Raise a Native (B)**	**Native Dancer (I/C)**
				Raise You
			Gold Digger	**Nashua (I/C)**
				Sequence
		Jameela	Rambunctious	Rasper II
				Danae II
			Asbury Mary	Seven Corners
				Snow Flyer
	Line of Thunder	**Northern Dancer (B/C)**	Storm Bird	Nearctic
				Natalma
			South Ocean	New Providence
				Shining Sun
		Shoot a Line	High Line	High Hat
				Time Call
			Death Ray	Tamerlane
				Luminant

	DP Contribution	**Equivalent to:**
Sire	8- 2- 6- 0- 0	DI 4.33 CD 1.13
Dam	2- 0- 2- 0- 0	DI 3.00 CD 1.00

Thunder Gulch, b.c., 1992 (Gulch-Line of Thunder, by Storm Bird) annexed two-thirds of the Triple Crown despite Dosage figures suggesting better suitability as a sprinter-miler. His sire was a Breeders' Cup Sprint (G1) winner and an Eclipse champion sprinter who, not surprisingly, transmits significant speed to Thunder Gulch's DP. His dam's contribution to his DP is marginal and with a slight shift toward speed as well. However, Thunder Gulch is a good example of a horse with possible unacknowledged aptitudinal influences that contribute to his performance. The sire of his second dam is the Hyperion-line English stallion High Line, foaled in 1972. High Line was successful on the track at up to two miles and at stud consistently sired runners capable of staying classic distances and well beyond. Among them is Shoot a Line, a dual Oaks winner and second dam of Thunder Gulch. By the late 1980's, the average winning distance of High Line's progeny was listed as 13.0 furlongs, which is long

even by European standards. One could easily make a case for High Line as a source of stamina. As a third-generation sire in Thunder Gulch's pedigree, High Line would make a four point contribution to Thunder Gulch's DP, which would lower his Dosage figures into the more traditional classic range.

Chapter 7

The Original Research Results as Published in Daily Racing Form

In our original research conducted between 1977 and 1980, we examined several categories of performance by distance, surface and age, grouping the average Dosage figures of the winners. The results are summarized in Tables 10, 11 and 12.

Even in this relatively small study, obvious distinctions are seen between juveniles and older runners, between sprinters and stayers, between dirt horse and turf horses, and even by racing era. Two-year-olds, racing primarily at sprint distances, display the higher average Dosage numbers consistent with the greater speed expressed in shorter races. The same difference is not observed between three-year-olds and older runners where the average competitive distances are closer. We see similar trends among sprinters, middle distance types and routers on both dirt and grass. Here the figures reflect the less speed and more stamina required with increasing distance. The uniformly higher figures observed for the various champions of the 1970's compared to those of the 1940's parallels what many believe is an ever-increasing infusion of speed into the Thoroughbred over time. The ability of Dosage to detect these changes makes it a powerful tool for monitoring the evolutionary trends within the breed.

Table 10. Dosage Figures by Distance and Surface, Stakes Winners of 1980

RACE CATEGORY	AVERAGE DI	AVERAGE CD
Sprints on dirt (less than 8f)	5.52	0.91
Middle distances on dirt (8-10f)	4.05	0.71
Routes on dirt (greater than 10f)	1.74	0.29
All races on dirt	4.62	0.79
Sprints on grass (less than 8f)	5.90	0.90
Middle distances on grass (8-10f)	4.22	0.70
Routes on grass (greater than 10f)	3.48	0.39
All races on grass	4.23	0.66
ALL RACES	**4.53**	**0.76**

Table 11. Dosage Index by Age, Stakes Winners of 1980 and Graded Stakes Winners of 1978-9

AGE	AVG DI, N. A. SWs (1980)	AVG DI, N.A. GSWs (1978-9)
Two-year-olds	5.59	5.71
Three-year-olds	4.16	4.06
Older horses	4.41	4.07
ALL HORSES	**4.53**	**4.30**

Table 12. Dosage Figures of Champions by Decade

RACE CATEGORY	AVERAGE DI	AVERAGE CD
Two-year-old colt champions (1941-1980)	2.20	
Two-year-old colt champions (1941-1950)	1.63	0.15
Two-year-old colt champions (1971-1980)	2.84	0.84
Three-year-old colt champions (1941-1980)	1.98	
Three-year-old colt champions (1941-1950)	1.43	0.24
Three-year-old colt champions (1971-1980)	2.46	0.70
Handicap champions (1942-1980)	1.87	
Handicap champions (1942-1950)	1.52	0.27
Handicap champions (1971-1980)	2.65	0.78
Sprint champions (1971-1980)	3.85	0.72
Grass champions (1971-1980)	2.06	0.32
Kentucky Derby winners (1971-1980)	2.68	0.89
Belmont Stakes winners (1971-1980)	2.37	0.60

Chapter 8

Contemporary Dosage Data

Table 13 presents a more complete picture based on Dosage data accumulated between 1983 and 2014 from almost 30,000 North American open stakes races. We examined races of all types and arranged the data by racing category including distance, surface, age and class of race. The Table shows the number of races in each category, the average distance of the races, the average DP of the winners, the average number of points in the DP, the average Dosage Index (ADI), the average CD (ACD), the composite Dosage Index (CDI) and the composite CD (CCD). Composite figures represent the DI and CD as calculated directly from the average DP rather than the average of all of the individual DIs and CDs in the sample. In a sense, the average DP describes the complete distribution of aptitudes within the entire population being examined. The composite figures also attenuate the impact of outliers as illustrated below

Horse 1: DP 10-7-1-0-0, DI 35.00, CD 1.50
Horse 2: DP 6-6-12-2-0, DI 2.25, CD 0.62
Horse 3: DP 2-4-12-4-2, DI 1.00, CD 0.00
Average DP 6.00-5.67-8.33-2.00-0.67
Average DI 12.75, Average CD 0.71
Composite DI 2.32, Composite CD 0.63

In this example, the dramatic effect on the averages of Horse 1's DI of 35.00 and CD of 1.50 is attenuated in the composite numbers.

Table 13. Dosage Data for North American Open Stakes Races Between 1983 and 2014

CATEGORY	RACES	AWD	DP	PTS	ADI	ACD	CDI	CCD
All Races	29394	8.09	7.22-4.38-9.75-1.33-0.74	23.42	3.17	0.70	2.37	0.68
Dirt Races	18870	7.76	7.59-4.59-9.16-1.16-0.66	23.16	3.51	0.77	2.62	0.75
Turf Races	9351	8.78	6.69-4.06-10.99-1.75-0.95	24.44	2.53	0.58	1.98	0.56
AWS Races	1173	7.77	5.44-3.58-9.27-0.69-0.33	19.31	2.75	0.69	2.41	0.68
<8 Furlongs	9271	6.27	7.64-4.37-8.34-0.95-0.47	21.77	3.89	0.83	2.89	0.82
8-10 Furlongs	18494	8.67	7.08-4.41-10.28-1.43-0.81	24.01	2.90	0.66	2.25	0.65
>10 Furlongs	1629	11.79	6.41-3.99-11.66-2.39-1.44	25.89	2.09	0.46	1.68	0.45
2-Year-Olds	3841	7.22	7.28-4.28-8.89-1.05-0.52	22.02	3.56	0.78	2.66	0.76
3-Year-Olds	8634	8.15	7.22-4.40-9.79-1.26-0.68	23.35	3.17	0.72	2.42	0.69

Table 13. Dosage Data for North American Open Stakes Races Between 1983 and 2014, cont.

CATEGORY	RACES	AWD	DP	PTS	ADI	ACD	CDI	CCD
Older Runners	16919	8.25	7.20-4.39-9.92-1.43-0.82	23.76	3.08	0.68	2.30	0.66
G1 Races	3492	9.03	7.43-4.51-11.12-1.52-0.94	25.52	2.77	0.64	2.18	0.63
G2 Races	4804	8.55	7.24-4.33-10.50-1.41-0.80	24.28	2.92	0.66	2.25	0.65
G3 Races	7163	8.25	7.18-4.31-10.10-1.33-0.73	23.65	3.04	0.69	2.33	0.67
Ungraded Races	13935	7.61	7.18-4.39-8.96-1.26-0.67	22.46	3.42	0.74	2.50	0.72
Races for males	17011	8.20	7.22-4.41-9.76-1.31-0.76	23.46	3.18	0.70	2.38	0.68
Races for females	12383	7.93	7.22-4.34-9.73-1.36-0.71	23.36	3.16	0.70	2.37	0.68
5.50 Furlongs	588	5.50	7.20-4.10-8.23-1.01-0.44	20.98	3.95	0.81	2.77	0.79
6.00 Furlongs	4349	6.00	7.78-4.43-8.05-0.90-0.42	21.58	4.17	0.86	3.04	0.85
6.50 Furlongs	1231	6.50	7.29-4.05-8.17-1.05-0.50	21.05	3.62	0.80	2.74	0.79
7.00 Furlongs	2440	7.00	7.85-4.64-8.96-1.00-0.56	23.00	3.66	0.81	2.81	0.79
8.00 Furlongs	3814	8.00	7.05-4.25-10.15-1.38-0.68	23.50	2.93	0.68	2.30	0.66
8.32 Furlongs	424	8.32	7.28-4.50-8.87-1.24-0.89	22.78	3.23	0.73	2.47	0.70
8.50 Furlongs	6906	8.50	7.11-4.44-10.00-1.34-0.75	23.65	3.01	0.69	2.33	0.67
9.00 Furlongs	5718	9.00	7.05-4.47-10.49-1.47-0.85	24.33	2.84	0.65	2.22	0.63
9.50 Furlongs	371	9.50	6.97-4.33-10.69-1.88-1.15	25.02	2.52	0.58	1.99	0.56
10.00 Furlongs	1252	10.00	7.12-4.49-11.61-1.76-1.25	26.21	2.50	0.57	1.98	0.55
11.00 Furlongs	601	11.00	6.62-3.98-11.79-2.43-1.39	26.20	2.11	0.48	1.70	0.46
12.00 Furlongs	866	12.00	6.22-3.93-11.70-2.43-1.43	25.71	2.02	0.43	1.65	0.43

Table 13 clearly reveals dramatic differences among the figures within the various categories. These data provide the strongest evidence of Dosage's ability to correlate pedigree type with racetrack performance.

Differences by Racing Surface: The average numbers for open stakes winners on dirt (DI 3.51, CD 0.77) are significantly higher than those for open stakes winners on grass (DP 2.53, CD 0.58). These results indicate that the pedigrees of the winners on the respective surfaces are configured differently from one another with regard to the specific *chefs-de-race* influencing each performance category. At the same time, note the significant difference in the average distance of the races on the main track and on turf. The dirt races at an average distance of 7.76 furlongs are over a furlong shorter than the turf races at an average distance of 8.78 furlongs. Considering that the DI and the CD reflect a ratio of inherited speed over stamina, it is entirely consistent that the higher average Dosage figures are associated with the shorter races while the lower average Dosage figures are associated with the longer races. Also note the presence of over twice the number of Dosage points in the Solid and Professional aptitudinal groups for the turf winners compared to the winners on the dirt. This raises the question of whether Solid and Professional *chefs-de-race* contribute not only stamina to a pedigree, but an additional, yet undefined "turf" component as well.

It is interesting that races on all-weather surfaces (AWS) have essentially the same AWD as those on dirt while their Dosage figures fall between those on dirt and turf. Here, as well, there may be a similar undefined "synthetic" component contributing to an affinity for synthetic surfaces. In any case, the Dosage numbers for winners on AWSs suggest a pedigree configuration somewhat different from that found for winners either on dirt or turf.

As a result, we shouldn't be surprised that individual sires may enhance the capabilities of their runners on different surfaces. In other words, some stallions are better at getting dirt horses, some at getting turf horses and still others at getting AWS horses. Whatever the preference, those sires contribute to differentiating the pedigree type of the horses successful on the various surfaces.

Differences by Distance Range: We observe a similar pattern here where the races are split between sprints (less than eight furlongs), middle distances (between eight and ten furlongs) and routes (greater than ten furlongs). As the average distance of the races in each group increases from 6.27 to 8.67 to 11.79 furlongs, the DI and CD numbers decrease proportionately and as expected. The precision of the analysis is vividly demonstrated by the patterns found within the DP itself. Note that in transitioning from sprints to middle distances to routes, the average number of points decreases in the Brilliant group and increases in the Classic, Solid and Professional groups. Again, we observe the smooth shift from speed influences to stamina influences as the distances grow longer. We observe a slight anomaly in the Intermediate group where there is a marginal increase in points between sprints and middle distances before dropping off as we get to the marathon distances.

Differences by Age: In the age category we find a greater difference between the figures for juveniles and those for three-year-olds and for older runners than we find between the three-year-olds and the older horses. The two-year-olds compete at an average distance that is almost a furlong shorter than the average for the three-year-olds and just over a furlong shorter than the average for older runners. On the other hand, the difference in average distance between three-year-olds and their elders is quite small. It should come as no surprise, then, that the Dosage figures for the juveniles are higher than those for the three-year-olds and older runners while the figures for the latter two groups are closer together. Even here, though, we observe that the differences in the figures are in the right direction with the three-year-old figures being marginally higher than those for the older runners who compete at a slightly longer distance.

Differences by Sex:

Males and females have almost identical Dosage figures consistent with their respective AWDs being within a small fraction of a furlong apart.

Differences by Class of Race: The data indicate a direct correlation between the class of races and their average distance, with the highest-class races being the longest and the lowest-class races being the shortest. In moving from Grade 1 races through Grade 2 and Grade 3 races to ungraded events, the average distance declines from 9.03 furlongs to 8.55 furlongs to 8.25 furlongs to 7.61 furlongs. Consistent with this progression is the gradual increase in the Dosage figures with declining class. We also find a drop in the average point contributions in the Brilliant, Classic, Solid and Professional aptitudinal categories, resulting in a modestly lower DP point total with each successive level below Grade 1.

Differences by Specific Distance: The final set of figures in Table 13 is for races at specific distances between five and twelve furlongs. The trends are similar to those seen in the other performance categories with the Dosage figures inversely correlating with the average distance. We can capture the significance of the differences from one distance to another by using simple statistical techniques such as a Student's T-Test. This method can determine the likelihood that the figures for winners at one distance are truly different from those for winners at another distance and not simply the result of random chance. For example, we can compare the Dosage numbers for the six-furlong winners with those for the seven-furlong winners and we can establish a level of confidence that the two groups are not the same. In the analysis, we generate what is known as a P value. If the P value is less than 0.05 we can be confident that the two populations are indeed different from one another. Table 14 displays the P values resulting from a comparison of the average CD of populations at specific distances.

Table 14. Statistical Analysis Comparing the Average CD at Different Distances

DISTANCES BEING COMPARED	P VALUE
6f and 7f	0.0000000003
7f and 8f	0.0000000000
8f and 9f	0.00001
9f and 10f	0.0000000001
10f and 12f	0.0000000000

The results are striking. For the distances analyzed, the probability that the respective populations represented by the average CDs are the same is essentially zero, as the P values in all cases are well below 0.05. Said another way, Dosage analysis is precise enough to differentiate the pedigrees of horse populations that win at distances as little as one furlong apart in many cases. In particular, the differences observed between the winners at seven furlongs and a mile and between ten furlongs and 12 furlongs are exceptional and represent the logical breaks between sprinters and middle distance horses on the one hand and between middle distance horses and marathoners on the other.

Chapter 9

The Fundamental Relationship Between Dosage Figures and Distance

Plotting the average DIs and average CDs listed in Table 13 against the corresponding average distance for each performance category affords the graphical outputs shown in Charts 4 and 5.

Chart 4. Average DI vs. Average Winning Distance for Racing Categories in Table 13

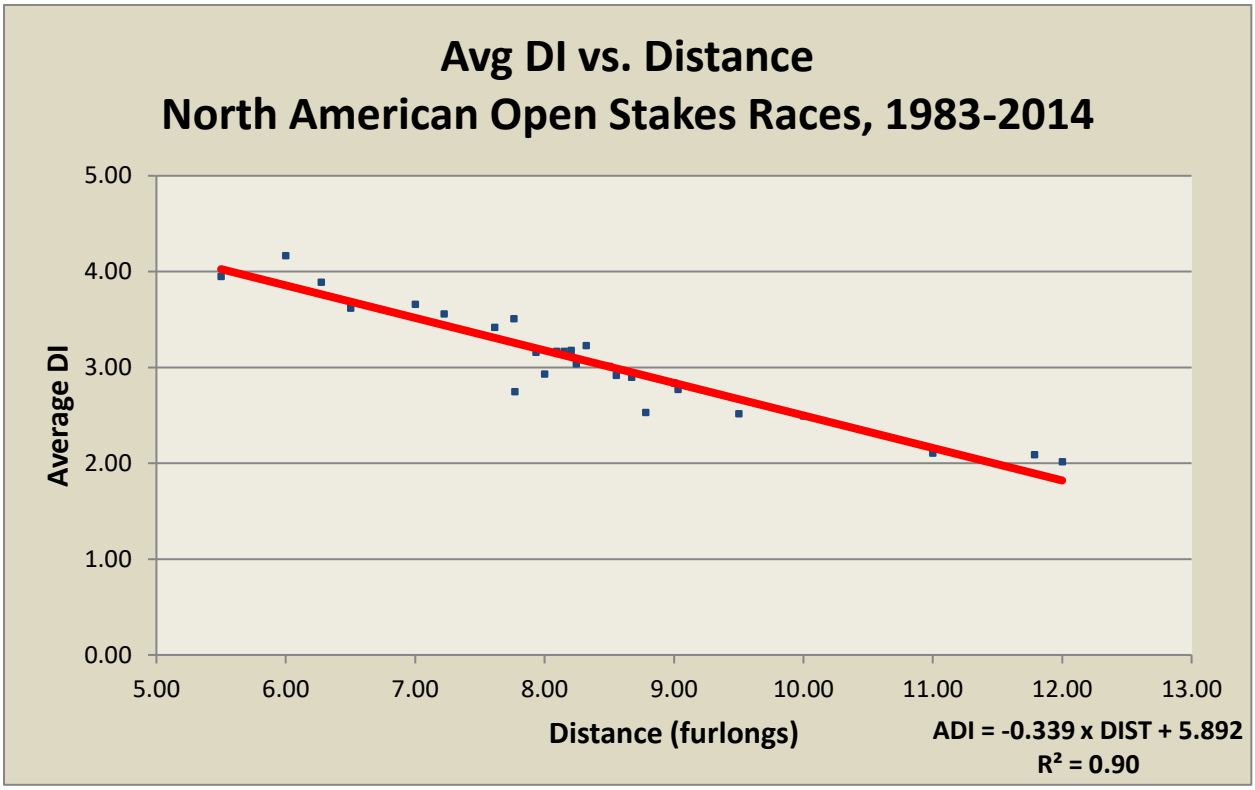
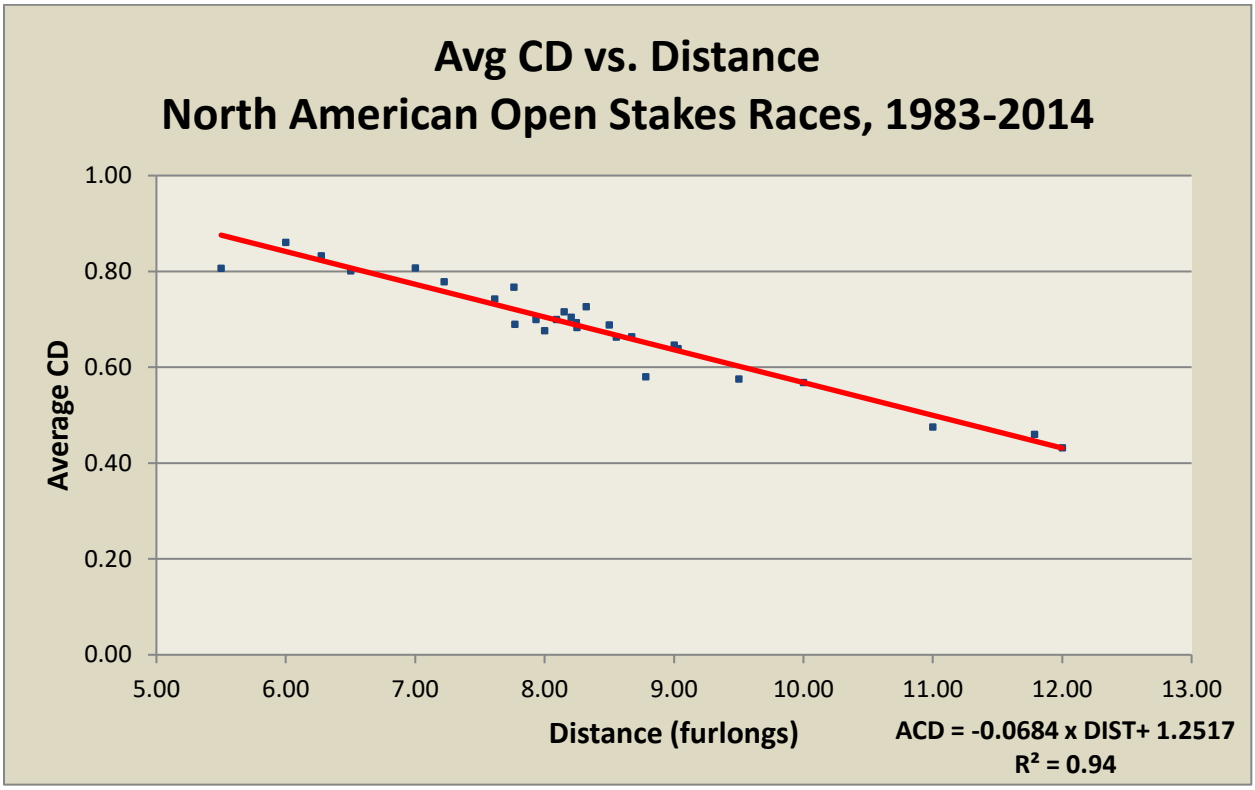


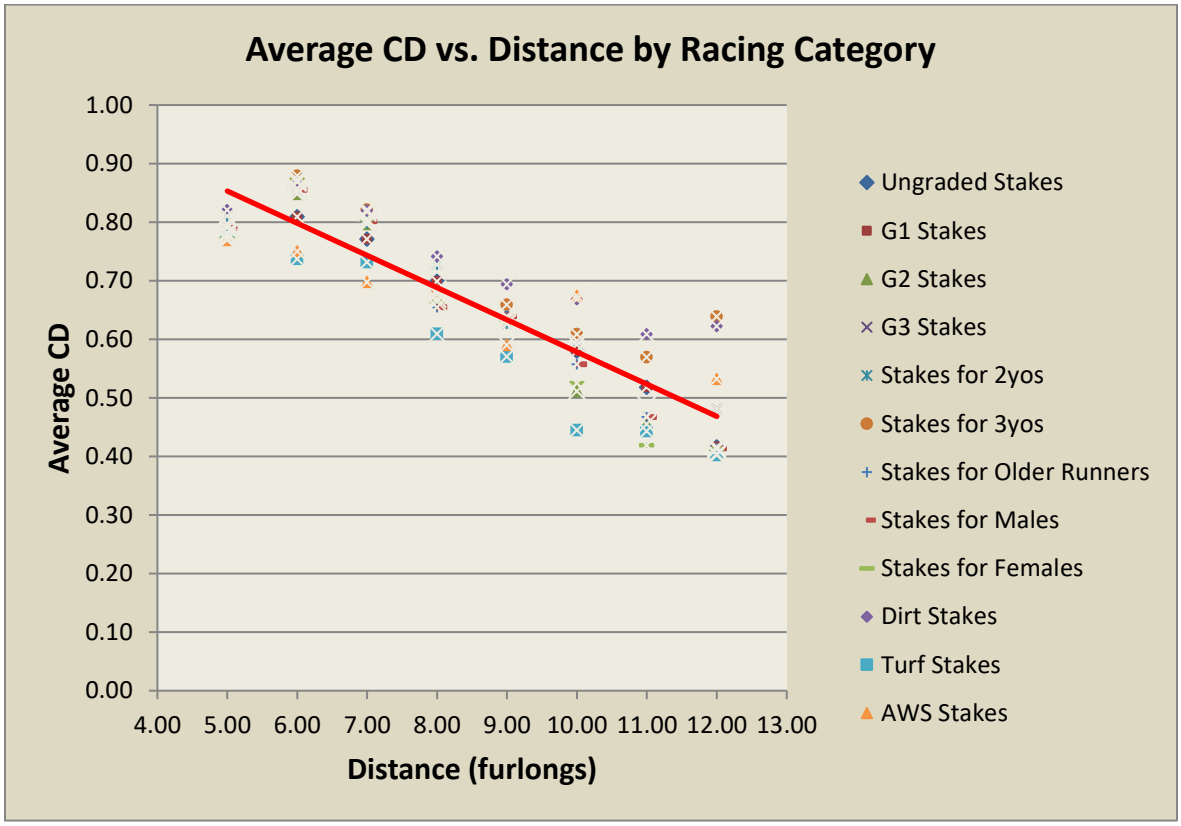
Chart 5. Average CD vs. Average Distance for Racing Categories in Table 13



Subjecting the data to the statistical technique called linear regression confirms that both the DI and the CD values are inversely related to the distance over the range from five to twelve furlongs. This relationship is easily visible in the trend lines generated from the data and which run from the upper left to the lower right. In other words, both the DI and the CD decrease as the distances increase. It is also noteworthy that virtually all of the data points fall very close to the straight line created by the regression. This is significant because the closeness of the individual data points to the line is a measure of the strength of the correlation. The R^2 values on the charts quantify the correlations. As discussed earlier, if every data point fell directly on the linear regression line, R^2 would be exactly 1.0000. The closer R^2 is to 1.0000, the better the fit. In Chart 4, the R^2 value of 0.90 indicates that over 90% of the variability in DI (or aptitudinal type) is explained by changes in distance. The result is even better in Chart 5 where over 94% of the variability in CD (an alternative expression of aptitudinal type) is explained by those same distance changes. The remaining variability is attributable to other, undefined factors. It is evident that despite Varola's insistence that no such relationship exists in his methodology, the correlation between modern Dosage methodology and the distance of races is extremely strong. Furthermore, Charts 4 and 5, in their display of the effects of distance on aptitudinal type, provide the most definitive graphical expression of the contemporary Dosage model.

The generality of the model is captured in Chart 6. It breaks down the CD vs. distance relationship even further by displaying the correlations within each separate performance category.

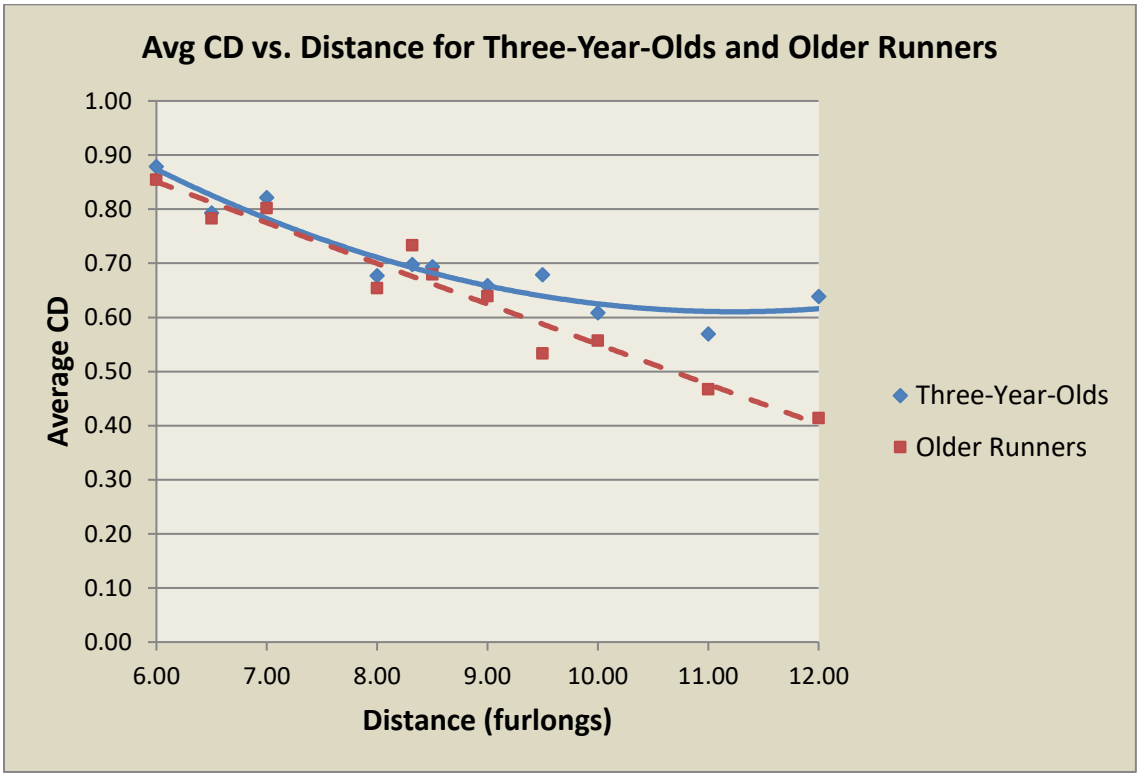
Chart 6. The Dosage Model Applied to Each Racing Category



The data sets follows the same trend of higher CD values at the shorter end of the distance spectrum to lower CD values at the longer end. The consistent patterns confirm a fundamental relationship between the aptitudinal type of a pedigree and its correlation with distance suitability. This is true regardless of age, sex, surface or class of race. One data point that deviates appreciably is that for three-year-olds at a mile and a half, where the average CD is somewhat higher than the model suggests. The reason for this is unclear, although the number of races at twelve furlongs for three-year-olds is the smallest found in any category in which there are mile and a half races. It could be that the relatively small sample size is having an effect. On the other hand, the deviation may point to an inherent pedigree property of three-year-olds racing the marathon distance. It may well be the result implies that American three-year-olds are not ideally suited as a group to mile and a half racing, although certainly we have seen many individuals that are. If we plot the average CD vs. distance for three-year-old races, the chart (Chart 6) displays a trend line (solid line) that follows the model very well through ten furlongs and then flattens

out. Recognizing that the trend line provides a graphical overview of the aptitudinal profile of the population, one could argue that, apart from the performances by exceptions like Secretariat or A.P. Indy or Easy Goer or Point Given, most mile and a half races for three-year-olds are won by horses better suited to shorter distances. On the other hand, the trend line for older runners (dashed line) as seen on Chart 7 fits the general model very well, indicating that older runners successful at 12 furlongs come from a different part of the population in terms of pedigree and may be later maturing.

Chart 7. Three-Year-Olds vs. Older Runners



Chapter 10

The Relationship Between the DI and the CD: DP Patterns

The core of contemporary Dosage methodology is the Dosage Profile, or DP. It is the series of five numbers that summarize the aptitudinal contributions from *chefs-de-race* in the first four generations of a pedigree. Quite often, much useful information can be derived from the DP alone. For example, and as we will see shortly, regardless of the DI or the CD, a horse with a DP having double-digit representation in the Brilliant group is often a candidate to win sprints. To illustrate the main point, among horses with a DI of exactly 3.00, those with at least 10 points in the Brilliant category of their DP have won 39% of their races in sprints. Those with less than 10 points in the Brilliant category have won only 33% of their races in sprints. Not surprisingly, a large component of inherited speed is an asset in shorter races. Although the average DI is the same for both groups, we do see real differences in the average CD. The first group, with at least ten Brilliant points in their DP, has an average CD of 0.89. The second group, with less than ten points in their DP, has an average DI of 0.81. The principle here is that the relationship between DI and CD is the direct consequence of how the aptitudinal points are distributed within the DP.

There are numerous examples demonstrating the critical nature of point distribution within the DP. As a basis for analysis we have used our database of North American open stakes. Table 15 presents several variations on how DP configuration affects average winning distance (AWD), the percentage of stakes wins in sprints (%SPR), the percentage of stakes wins on grass (%TURF) and the percentage of stakes wins for juveniles (%2YO) for the population falling within each DP distribution category.

Table 15. The Effects of Various DP Point Distributions on Performance Traits

PATTERN	SYMBOL	%SW	AWD	B	I	C	S	P	ADI	ACD	PTS	%SPR	%TURF	%2YO
DOMINANT APTITUDE	B>I,C,S,P	25.9%	7.71	10.58	4.24	5.99	1.18	0.52	5.19	1.06	22.51	42.7%	22.3%	15.4%
	I>B,C,S,P	5.1%	7.95	5.14	9.25	6.08	1.01	0.56	4.70	0.81	22.04	34.8%	23.5%	12.0%
	C>B,I,S,P	57.7%	8.27	6.08	4.05	12.38	1.31	0.76	2.19	0.55	24.58	26.0%	37.3%	12.2%
	S>B,I,C,P	1.2%	8.82	4.43	2.97	4.55	8.69	0.68	0.83	0.03	21.32	14.2%	48.7%	9.4%
	P>B,I,S,C	0.6%	8.98	4.12	2.48	5.11	1.12	11.16	0.65	-0.56	23.99	14.5%	55.2%	7.6%
BRILLIANT (B) PTS	B=0	1.2%	8.28	0.00	2.59	6.61	1.53	1.34	1.59	-0.02	12.07	28.6%	33.2%	11.3%
	B<=5	37.5%	8.17	3.38	3.55	8.63	1.26	0.78	2.40	0.50	17.60	29.3%	35.8%	13.0%
	B>5,<=10	43.4%	8.09	7.75	4.43	10.05	1.29	0.73	3.29	0.77	24.25	30.9%	31.1%	13.0%
	B>10,<=15	15.8%	7.93	12.41	5.67	11.19	1.47	0.68	4.21	0.93	31.42	36.1%	27.0%	12.8%
	B>15,<=20	2.5%	7.72	17.39	6.82	11.11	1.45	0.64	5.42	1.08	37.41	45.4%	19.4%	16.0%
	B>20	0.8%	7.83	23.40	6.92	12.79	3.47	1.04	4.55	1.03	47.62	37.2%	19.7%	13.4%
CLASSIC (C) PTS	C=0	1.0%	7.69	6.13	3.05	0.00	0.70	0.57	4.39	1.32	10.45	44.0%	31.6%	15.6%
	C<=5	22.8%	7.76	6.41	3.56	3.39	1.18	0.53	5.16	0.91	15.07	41.7%	25.2%	15.0%
	C>5,<=10	38.6%	7.98	6.90	4.15	7.96	1.20	0.67	2.94	0.72	20.88	33.9%	27.9%	14.0%
	C>10,<=15	24.5%	8.26	7.71	4.81	12.72	1.37	0.82	2.40	0.61	27.43	26.2%	36.6%	12.1%
	C>15,<=20	9.6%	8.49	8.10	5.36	17.67	1.82	1.06	2.04	0.50	34.01	19.9%	42.2%	9.6%
	C>20	4.4%	8.83	9.53	6.10	24.56	2.02	1.27	1.91	0.46	43.48	13.2%	51.4%	8.1%
HIGH B/C PTS	B>10,C>10	9.4%	8.10	13.57	6.08	16.27	1.47	0.86	2.91	0.80	38.25	30.6%	29.7%	13.2%
"DOWN-THE-LADDER"	B>I>C>S>P	2.0%	7.73	12.19	7.46	4.83	2.07	0.12	5.29	1.11	26.67	45.0%	19.2%	15.1%
"DOUBLE ZERO"	S=0,P=0	39.1%	7.79	6.99	4.11	8.79	0.00	0.00	4.48	0.93	19.89	39.2%	25.2%	15.5%
"TRIPLE ZERO"	C=0,S=0,P=0	0.7%	7.67	6.36	2.95	0.00	0.00	0.00		1.68	9.31	45.1%	28.2%	16.4%
	I=0,S=0,P=0	2.7%	7.90	4.96	0.00	6.56	0.00	0.00	2.84	0.90	11.52	36.5%	31.1%	15.4%
PTS IN ALL 5 GROUPS	B,I,C,S,P>0	14.0%	8.50	7.43	4.82	11.72	3.06	2.42	1.77	0.39	29.45	21.0%	39.7%	9.1%
DOMINANT CLASSICITY	S=0,P=0, C>(B+I)	9.9%	8.17	5.10	2.96	12.94	0.00	0.00	2.25	0.62	21.00	26.9%	38.5%	14.2%
	C>(B+I+S+P)	22.3%	8.36	5.07	2.95	14.57	0.99	0.54	1.86	0.46	24.12	22.4%	43.3%	11.3%
DOMINANT C PTS W/O DOMINANT CLASSICITY	C>B, I, S, or P but not C>(B+I+S+P)	35.3%	8.21	6.72	4.75	10.99	1.51	0.90	2.40	0.60	24.87	28.2%	33.5%	12.7%
TOTAL PTS	PTS<=10	8.5%	7.80	2.80	1.54	3.38	0.36	0.23	3.55	0.77	8.31	39.6%	28.0%	15.4%
	PTS>10,<=20	34.9%	7.90	5.47	3.07	6.71	0.80	0.45	3.57	0.75	16.50	36.4%	27.8%	15.1%
	PTS>20,<=30	37.4%	8.15	7.90	4.83	10.64	1.50	0.79	3.00	0.69	25.67	29.2%	33.9%	12.1%
	PTS>30,<=40	14.1%	8.38	10.12	6.42	14.90	2.17	1.28	2.63	0.63	34.89	24.2%	35.6%	10.2%
	PTS>40,<=50	3.8%	8.53	12.72	8.76	18.95	3.00	1.51	2.60	0.63	44.94	21.6%	40.7%	9.7%
	PTS>50	1.4%	8.39	15.55	9.89	23.93	3.06	2.14	2.48	0.62	54.56	24.7%	38.8%	12.3%
"WING" BREEDING	B,P>I,C,S	0.4%	8.46	7.60	2.45	2.88	0.36	7.44	1.51	0.18	20.73	26.7%	41.7%	7.5%
ALL PATTERNS		**100.0%**	**8.09**	**7.22**	**4.38**	**9.75**	**1.33**	**0.74**	**3.17**	**0.70**	**23.42**	**31.5%**	**31.8%**	**13.1%**

The first column in Table 15 lists the general category of the pattern. For example, "Dominant Aptitude" refers to the situation in which the most points are found in one particular aptitudinal group; Brilliant (B), Intermediate (I), Classic (C), Solid (S) or Professional (P). This category is subsequently divided according to which aptitudinal group dominates and shows how Dosage figures and performance characteristics can vary from pattern to pattern. The next category focuses on the Brilliant group exclusively and shows the effects of total Brilliant points in the DP. The following category does the same for the Classic group and so on.

The second column displays the actual DP patterns themselves and shows the relationships among the various elements within the DP. For example, the first pattern under Dominant Aptitude is designated B>I, C, S or P, indicating a DP in which there are more points found in the Brilliant category than in any other. Similarly, under Wing Breeding, B, P>I, C or S means that more points are found in both the Brilliant and Professional categories than in Intermediate, Classic or Solid.

Next, %SW's indicates what percentage of the general population of open stakes winners between 1983 and 2014 have that particular DP pattern. This is followed by columns showing the average winning distance (AWD), average points in each of the aptitudinal groups (or average DP), the average DI (ADI), the average CD (ACD), the average total points in the DP, the %SPR, %TURF and %2YO for stakes winners representing the pattern. The bottom row highlights the data for all of the stakes winners in the database and may be considered the average for the breed, suitable as a standard for comparing the various DP patterns.

Within the "Dominant Aptitude" category we observe dramatic and consistent trends in the data. Stakes winners whose DPs have their highest representation in the Brilliant group also have the lowest AWD and %TURF as well as the highest %SPR and %2YO. As we proceed through the speed/stamina spectrum where the most points in the DP are located, successively, in Intermediate, Classic, Solid and Professional, we find an increasing AWD and %TURF and a generally decreasing %SPR and %2YO. Similarly, the ADI and ACD decrease regularly as the emphasis shifts from speed to endurance in the pedigrees. These observations are expected, as we have shown earlier that lower Dosage figures are consistent with increased stamina resulting in more wins at route distances and greater suitability to turf. In fact, horses with a DP where the most points are in the Professional aptitude group have the longest AWD (8.98f), highest %TURF (55.2%) and second lowest %SPR (14.5%) and second lowest %2YO of any in the Table. They constitute a very small percentage of the population (0.6%), but one can be confident that when they show up they will be ideally suited to long-distance grass races. We may also note that between 80% and 85% of all the stakes winners are characterized by a DP with the most points in either the Brilliant or Classic category.

Of all the races in the database, 31.5% are sprints. The highest percentages of sprint winners are found among those runners having a DP with between 15 and 19 points in the Brilliant category, a “triple zero” configuration with no points in the Classic, Solid or Professional categories or a “down-the-ladder” pattern, all between 45% and 46%. “Down-the-ladder” is a term describing a DP distribution with more Brilliant than Intermediate points, more Intermediate than Classic points, more Classic than Solid points, and more Solid than Professional points. DP 8-6-4-2-0 fits the definition. Horses bred on this pattern also express their speed orientation with a double-digit average of Brilliant points. At the same time, they are the least successful on grass, winning only 19.2% of their races on that surface, well below the database average of 31.8%.

The “triple zero” pattern results in a horse having no DI because the calculation involves a division by zero, a forbidden mathematical operation. Notionally, however, this pattern indicates the absence of any prepotent stamina influences within four generations. The emphasis on speed results in the aforementioned high %SPR (45.1%), lower than average %TURF (28.2%) and higher than average %2YO (16.4%).

Similarly, horses with zero points in either the Solid or the Professional category account for less than 40% of the population and win just under 40% of their races at sprint distances. This, too, exceeds the average percentage found for all stakes winners in the database. However, when these "double zero" horses also show more points in the Classic category than in the Brilliant and Intermediate categories together, their %SPR drops below the average to 26.9% while their %TURF shifts from well below average (23%) to substantially above (38.5%). Thus, the effect of "Dominant Classicity" is profound. The term Dominant Classicity was coined by Leon Rasmussen, former Bloodlines columnist for Daily Racing Form, to describe a DP in which the Classic points exceed the total number of points in all of the other categories combined. This is a situation found among only 22% of the population and its effect on performance can be dramatic, as noted for the "double zero" horses in particular. The overall impact of high point totals in the Classic category cannot be overstated, especially in the context of distance ability. Runners with at least 20 points in Classic (just 4.4% of the population) have the lowest percentage of wins in sprints (13.2%) and, except for the very small group with the most points in Professional, the highest percentage of wins on grass (51.4%). Their AWD of 8.83 furlongs is exceeded only by the 8.98 furlong AWD of that same group dominated by Professional points.

At the other end of the distance spectrum are horses with double-digits in the Brilliant category. These horses run shorter than average with %SPR values in the mid-30% to mid-40% range depending on how many points are present. Not surprisingly, their %TURF figures are below average, spanning the mid-20 to high teen percent range. When double digits in Brilliant are combined with double digits in Classic (9.4% of the population), the effect on distance is dramatically different as the %SPR drops to below the average. However, the %TURF increases only to

a small degree and remains also marginally below average. Apparently, the negative effect of a large Brilliant contribution on turf performance is significant and cannot easily be overcome by an equally large Classic influence.

One of the more unusual DP patterns is that in which no points are present in either the Classic, Solid or Professional groups – a "triple zero" pattern. This is a rare situation, occurring in less than 1% of stakes winners. However, the pattern is characterized by the shortest AWD and highest ACD in Table 14, consistent with an absence of stamina contributions. It has associated with it the second highest %SPR behind runners with 16 to 20 Brilliant points in their DP, as well as a below average %TURF. Most notable is the absence of a DI figure. This results from previously mentioned fact that division by zero is a forbidden mathematical operation. A DP with no points in Classic, Solid or Professional, must have a denominator of zero in the DI calculation. Since dividing by zero is not allowed, there is no such thing as a DI in those cases. For descriptive purposes only, no DI occasionally has been referred to as a DI of infinity. This is not mathematically correct, although it does convey the image of a DP devoid of aptitudinally prepotent stamina.

The total points in a DP also correlate with performance type. First, by grouping DP point totals according to ranges of 0 to10, 11 to 20, 21 to 30, 31 to 40, 41 to 50, and 51 to a possible maximum of 64, we can observe how the point totals are distributed within the population. We can also identify several major differences and trends. Relatively few horses (8.5%) have 10 or fewer DP points while even fewer (5.2%) have over 40. Most horses fall within the 11 to 40 range with 34.9% from 11 to 20, 37.4% from 21 to 30 and 14.1% from 31 to 40. As the point total increases, the ADI and CD generally decrease, suggesting that more DP points enhance the probability of staying a route of ground. For example, runners with 20 or fewer DP points have an AWD in between 7.8 and 7.90 furlongs. Those with greater than 40 points have an AWD from about 8.4 to 8.5 furlongs. Not surprisingly, the lower point total runners (with 20 points or less) have a higher than average %SPR (36-40%) and a lower than average %TURF (~28%). At the other end of the point spectrum (i.e., runners with more than 40 points) we find the reverse is true. Here the horses have a lower than average %SPR (22-25%) and a higher than average %TURF (39-41%).

Photo Courtesy of the ThoroughbredTimes

Kelso

DP 2-2-27-6-1, DI 0.85, CD –0.05

		Alibhai (C)	**Hyperion (B/C)**	**Gainsborough (C)**
				Selene
			Teresina	**Tracery (C)**
	Your Host			Sister Sarah
		Boudoir II	**Mahmoud (I/C)**	**Blenheim II (C/S)**
				Mah Mahal
Kelso, dkb/br.g., 1957			Kampala	**Clarissimus (C)**
				La Soupe II
		Count Fleet (C)	Reigh Count	Sunreigh
				Contessina
	Maid of Flight		Quickly	Haste
				Stephanie
		Maidoduntreath	**Man o' War (S)**	**Fair Play (S/P)**
				Mahubah
			Mid Victorian	Victorian
				Black Betty

	DP Contribution	Equivalent to:
Sire	2- 2-19- 1- 0	DI 1.29 CD 0.21
Dam	0- 0- 8- 5- 1	DI 0.40 CD –0.50

Five-time Horse of the Year Kelso, dkb/br.g., 1957 (Your Host-Maid of Flight, by Count Fleet) is the product of breeding classic stamina to extreme stamina. The result is a well-balanced DP 2-2-27-6-1, DI 0.85 and CD –0.05, consistent with five consecutive victories in the two-mile Jockey Club Gold Cup from 1960 to 1964. His American record of 3:19.1 for two miles, set in 1964, still stands. Although superior on dirt, Kelso also won on the grass at distances up to a mile and a half. His performance correlates well with the Dominant Classicity of his DP and the significant representation in its Solid-Professional wing. A winner on class in juvenile and early three-year-old sprints, after his initial start at four he never again won a sprint in four tries, even at the allowance level. Showing the versatility often associated with Dominant Classicity, Kelso could win from the front, while pressing the lead, or from far back.

Photo Courtesy of the Blood-Horse

Ruby Tiger

DP 0-0-0-0-0, DI (none), CD (none)

Ruby Tiger (IRE), gr.f., 1987	Ahonoora (GB)	Lorenzaccio (GB)	Klairon (FR)	Clarion (FR)
				Kalmia (FR)
			Phoenissa (GB)	The Phoenix (GB)
				Erica Fragrans (GB)
		Helen Nichols (GB)	Martial (IRE)	Hill Gail
				Discipliner (GB)
			Quaker Girl (GB)	Whistler (GB)
				Mayflower (GB)
	Hayati (IRE)	Hotfoot (GB)	Firestreak (GB)	Pardal (FR)
				Hot Spell (GB)
			Pitter Patter (GB)	Kingstone (GB)
				Rain (GB)
		Silecia (GB)	Sky Gipsy (IRE)	Skymaster (IRE)
				Tudor Gipsy (GB)
			Blue Sash (GB)	Djebe (FR)
				Star of India (GB)

	DP Contribution					Equivalent to:	
Sire	0-	0-	0-	0-	0	DI (none)	CD (none)
Dam	0-	0-	0-	0-	0	DI (none)	CD (none)

Ruby Tiger, gr.f., 1987 (Ahonoora-Hayati, by Hotfoot) won graded/group stakes in Canada, England, Ireland, Italy and Germany and was a champion in all but Canada at middle distances. She is unusual in not having any *chefs-de-race* appearing within her first four generations, a pattern found in no other North American graded stakes winner. Consequently, she has neither a DI nor a CD figure because of the mathematically forbidden operation of dividing by zero during the Dosage calculations. Nevertheless, there is no implication that Ruby Tiger lacks prepotent aptitudinal influences. Her pedigree is relatively obscure for a contemporary North American stakes winner, with few of her close up ancestors having generated a consistent pattern of data in American racing. This pedigree illustrates the opportunity for internationalizing Dosage research, a process that is ongoing.

Table 13 showed that DP point totals also vary progressively by grade of race, with Grade 1 winners having the highest average and listed stakes winners having the lowest. This highlights the issue of whether more points in a DP correlate with higher potential class. On the one hand we have a correlation between class and points, and on other, between winning distance and points. Consequently there is a similar correlation between class and winning distance. These data are reproduced in Table 16. The difficulty arises when trying to isolate the true cause and effect relationship. Is it distance and points or class and points?

Table 16. DP Point Variations by Class of Race and Distance of Race

	CLASS	AWD	PTS		DISTANCE	PTS
By Class:	G1	9.03	25.52	**By Distance (f):**	12.00	25.71
	G2	8.55	24.28		11.00	26.50
	G3	8.25	23.65		10.00	26.21
	Ungraded	7.61	22.46		9.50	25.02
					9.00	24.33
					8.50	23.65
					8.32	22.78
					8.00	23.50
					7.00	23.00
					6.50	21.05
					6.00	21.58
					5.50	20.98

One approach to the problem is to isolate each class of race and observe how point totals are distributed within that class. As we have seen in Table 13, the distributions by point total range have already been determined for the population at large. The analogous distributions by racing class are presented in Table 17.

Table 17. % Winners Within DP Point Total Ranges by Class of Race

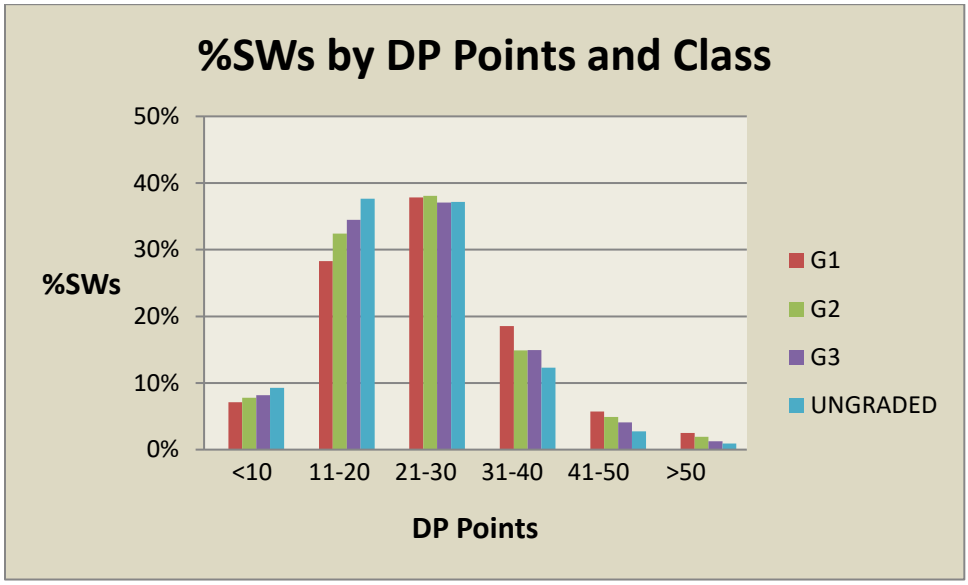
	CLASS OF RACE				
PTS	G1	G2	G3	UNGRADED	ALL
0-10	7.1%	7.8%	8.2%	9.3%	8.5%
11-20	28.3%	32.4%	34.5%	37.6%	34.9%
21-30	37.8%	38.1%	37.1%	37.2%	37.4%
31-40	18.5%	14.9%	14.9%	12.3%	14.1%
41-50	5.7%	4.9%	4.1%	2.7%	3.8%
>50	2.5%	1.9%	1.3%	0.9%	1.4%

Decreasing class →

On the surface the distributions are similar, having a maximum between 21 and 30 points and trending lower as you shift to lower or higher point totals. However, there are some subtle trends that differentiate the classes of race and that provide useful clues. Note, for example, that the percentages increase smoothly in the 0 to 10 and 11 to 20

point ranges with a decrease in class. By contrast, the percentages decrease just as smoothly in the 41 to 50 and 50 to 64 point ranges with a decrease in class. The result is that we observe more runners with lower point totals in the lower-class races and more runners with higher point totals in the higher-class races. These patterns are displayed in Chart 8.

Chart 8. DP Point Total Ranges by Racing Class



The skewed nature of the distributions is readily apparent when the distribution data are displayed as in Chart 8. Here the shift toward higher point totals as the class of race increases is unmistakable. We observe similar transitions in point totals at comparable distances between seven furlongs and ten furlongs. The point range distribution data at seven, eight, eight and one half, nine and ten furlongs are displayed in Table 18 followed by a graphical representation of the distributions in Chart 9. These distributions are similar to those seen for the various classes of races. Therefore we may conclude that the relationship between Dosage points and class is not easily distinguishable from the relationship between Dosage points and distance because higher class races tend to be run at longer distances.

Chart 9. DP Point Total Distributions by Racing Class

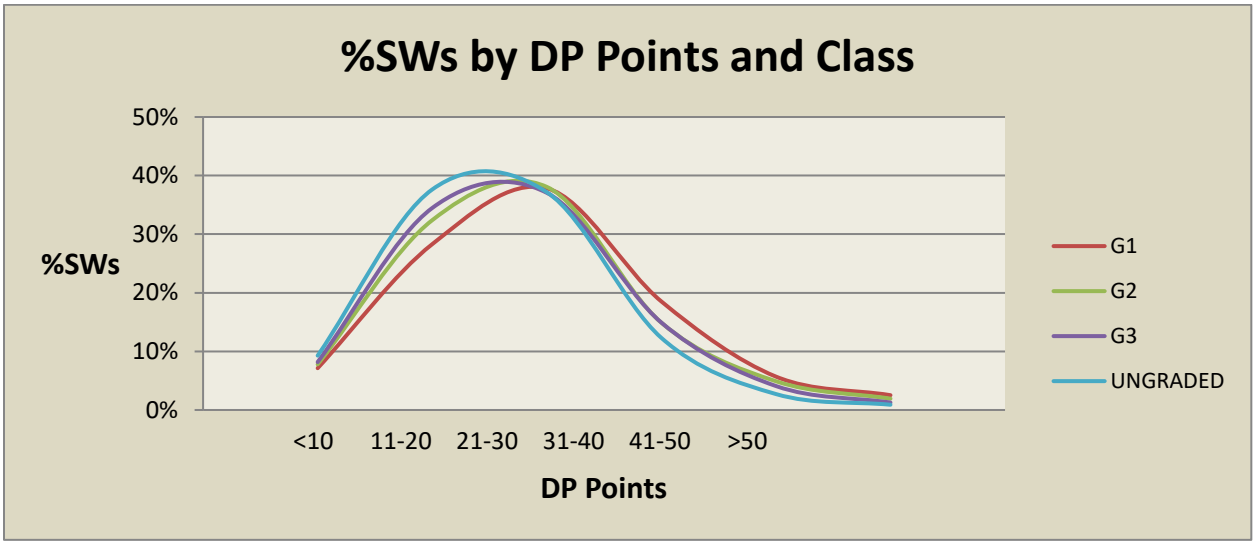
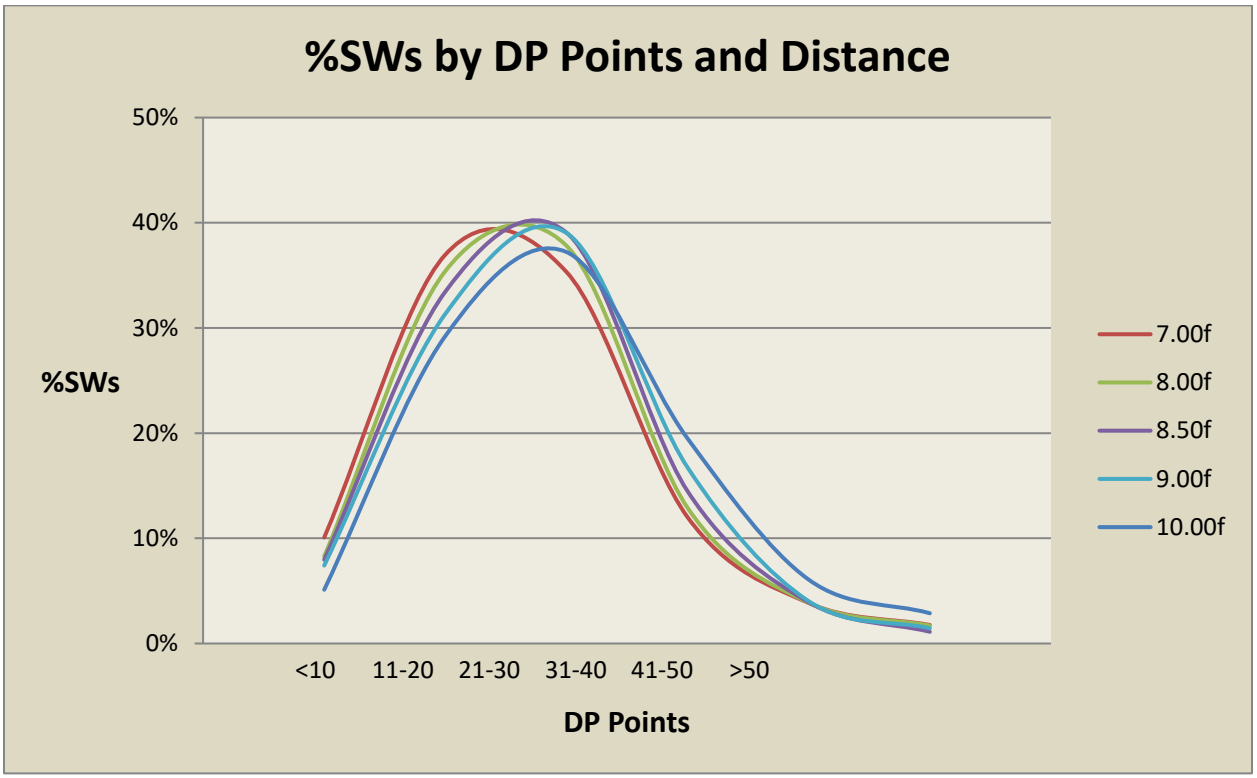


Table 18. % Winners Within DP Point Total Ranges by Distance

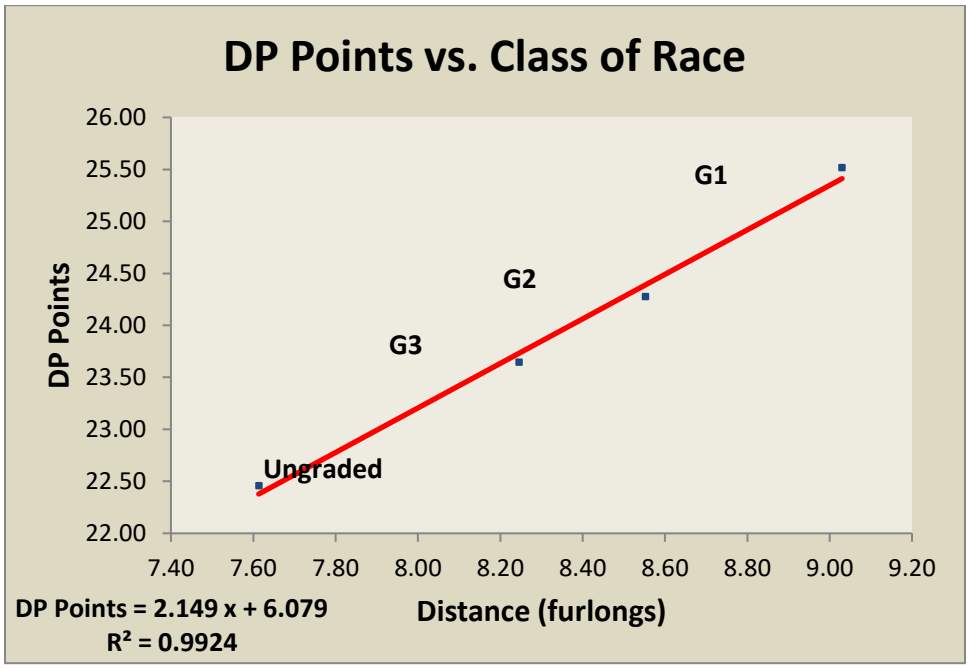
	DISTANCE (furlongs)				
PTS	7.00	8.00	8.50	9.00	10.00
0-10	10.1%	8.3%	8.0%	7.4%	5.1%
11-20	37.0%	35.4%	33.4%	31.3%	29.2%
21-30	35.3%	37.8%	39.1%	39.0%	37.2%
31-40	12.0%	12.9%	14.5%	16.7%	19.5%
41-50	3.9%	3.9%	3.9%	4.0%	6.1%
>50	1.8%	1.7%	1.1%	1.5%	2.9%

Chart 10. DP Point Total Distributions by Distance



The observed relationship between DP points and racing class is highly linear, with the distance increasing by 19% from listed stakes to Grade 1 stakes and the DP point totals increasing by 14%. The extraordinary degree of linearity is expressed in the R-squared value greater than 0.99 as shown in Chart 11. We may reasonably conclude that more points in a DP imply higher class within the general population. Since the difference in total DP points between ungraded stakes winners and Grade 1 stakes winners is on the order of 14%, the effect is not a dramatic one, yet appears to be real. We can readily explain the phenomenon by recalling that DP point totals capture both the position and number of *chefs-de-race* in a four-generation pedigree.

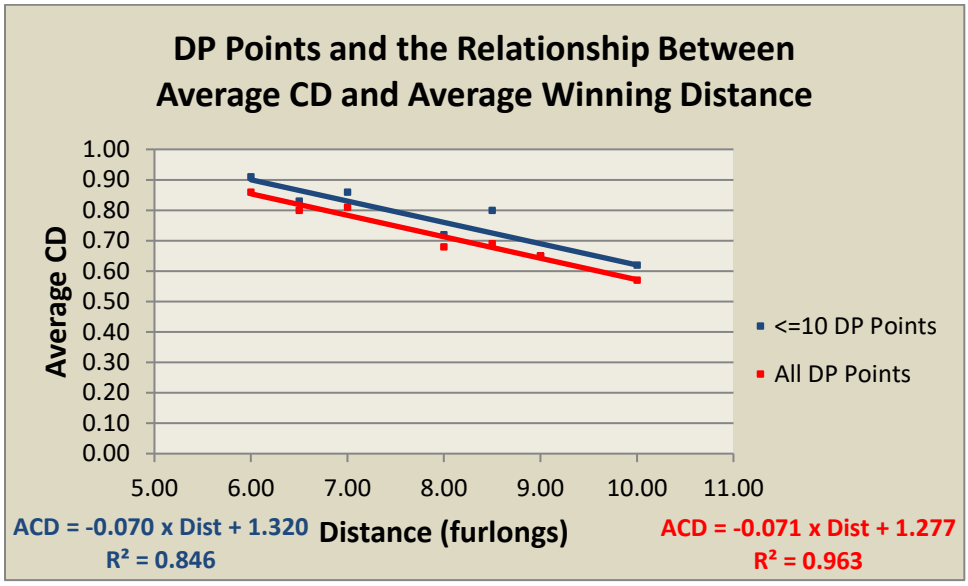
Chart 11. The Linear Relationship Between DP Point Totals and Racing Class



Another aspect of point totals directly relates to the accuracy of the resultant Dosage figures. Of particular interest are those cases where the DP point total is ten or less. Some refer to these small point totals as "trivial" points. It has been suggested that when the point total in a DP is very low, the correlation between the Dosage figures and performance is compromised. To test this idea, we have determined how well Dosage figures derived from DPs with ten or less points fit the established Dosage model relating those figures to distance. Chart 12 presents the data for two groups. One is for stakes winners encompassing all DP point totals. The other is for stakes winners with "trivial" point totals as defined earlier. The correlation examined is between the average CD of those stakes winners and their average winning distance. The distance range used is between six and ten furlongs only. The limited distance range is necessary to ensure a large enough sample size for the stakes winners with low DP point totals. Since these horses constitute only 8.5% of the population, there are but a few examples of such stakes winners below six furlongs and beyond ten furlongs.

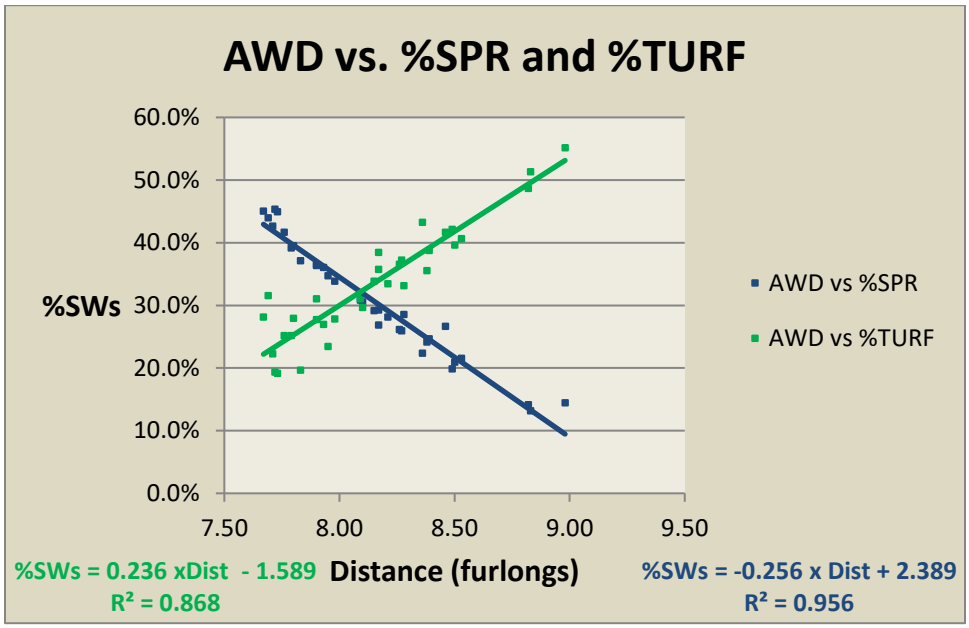
The obvious result is that stakes winners with "trivial" DP point totals do follow the general Dosage model to the extent that decreasing average CD values correlate with increasing distance in linear fashion. However, although the correlation is excellent, it is not as strong as it is for the general population of stakes winners. This is seen in the lower R^2-value of 0.846 for the low point total stakes winners compared to the R^2-value of 0.963 for all stakes winners. That said, both R^2-values afford a correlation coefficient (also a measure of linearity) exceeding 0.9. There is also a slight shift toward a higher average CD at each distance for the lower point total stakes winners. The data do suggest that Dosage figures derived from DPs with low point totals cannot arbitrarily be.

Chart 12. "Trivial" DP Points and Average Winning Distance



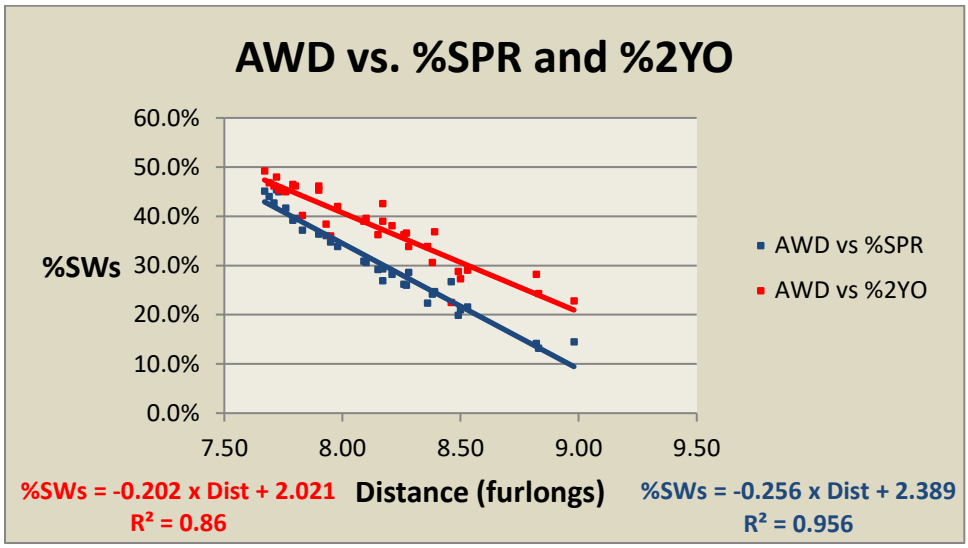
With regard to the relationship between performance in sprints and on grass, Table 15 suggests that in those cases where DP patterns correlate with high %SPR figures, the associated %TURF figures tend to be low, and vice versa. For example, horses with the most points in the Brilliant category display %SPR and %TURF values of 42.7% and 22.3%, respectively. Conversely, horses with the most points in the Professional category display an opposite pattern of 14.5 %SPR and 55.2 %TURF. This phenomenon appears to be general and applies across all DP distributions. Chart 13 shows the relationship in graphical terms for all of the DP configurations listed in Table 15. The associated trend lines are virtually mirror images, indicating that sprinting ability and an affinity for the turf are inversely related. The correlations are also very strong as reflected in high R^2-values. Of course there are turf sprinters as well as dirt stayers, but for the most part, horses bred to sprint are less successful on the grass than are horses bred to stay a route of ground. Similarly, horses bred for the turf are less successful in sprints than are horses bred for dirt.

Chart 13. The Relationship Between Average Winning Distance in Turf Races and Sprints



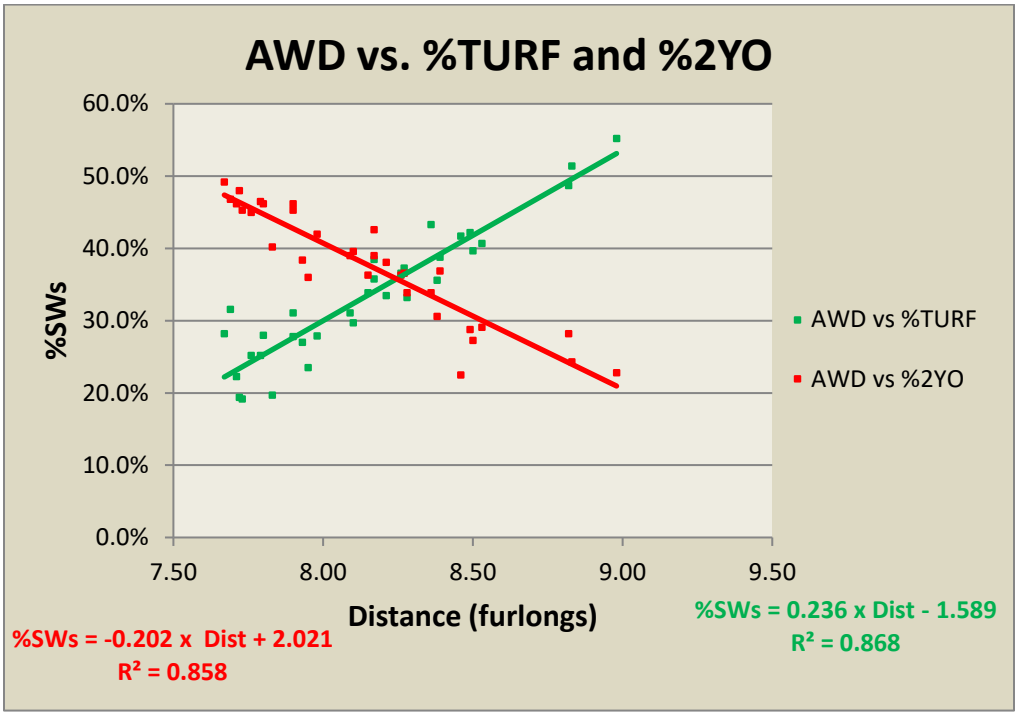
A comparison of %SPR and %2YO presents a different pattern as displayed in Chart 14. For convenience, the %2YO figures have been multiplied by 3 to put them on the same scale as the %SPR figures. Here we find a pattern in which the two lines are almost parallel, indicating s direct correlation between sprinting speed and success in two-year-old races. This is not surprising since the vast majority of juvenile races are at sprint distances.

Chart 14. The Relationship Between Average Winning Distance in Sprints and Juvenile Races



Finally, the correlation between %TURF and %2YO reverts back to the pattern seen for %TURF and %SPR where the relationship is an inverse one, again with %2YO converted to the %TURF scale. This is expected because of the positive correlation between %SPR and %2YO and the negative correlation between %SPR and %TURF.

Chart 15. The Relationship Between Average Winning Distance in Turf Races and Juvenile Races



We can explore in greater detail how DP distributions can affect overall type by examining several DP configurations for a given DI. The DPs in Table 19 are all equivalent to a DI of 3.00. Note, however, the wide range of possible CD values associated with the DP patterns depending on how the DP is configured.

Table 19. Variation in CD for DI 3.00 Depending on the DP Distribution

DP	CD
0-3-0-0-1	0.25
0-3-0-1-0	0.50
0-2-2-0-0	0.50
2-0-2-0-0	1.00
3-0-0-0-1	1.00
3-0-0-1-0	1.25

In all cases, the CD range for any DI spans one full CD unit. For DI 3.00, the median CD is 0.75, and the range is from 0.25 to 1.25. It is reasonable to suspect that a horse with DI 3.00 and CD 0.25 may be quite different in type

from a horse with DI 3.00 and CD 1.25. In fact, we find differences even between those horses with DI 3.00 and CDs greater than and less than 0.75. In the former case, 37% of the races won are sprints and the average distance is 7.88 furlongs. In the latter case, the percentage falls to 34% sprint wins and the average distance rises to 8.03 furlongs. Statistical analysis applied to these two groups affords a P value of 0.03, well within the limit of 0.05 indicating that the two groups (DI 3.00 and CD <0.75 or CD >0.75) are indeed different from each other in terms of AWD and that the difference is not simply a random event. Thus, we confirm that horses with the same DI are not necessarily identical in terms of performance attributes.

For reference, the general equation to find the median CD for any given DI is:

$$\text{Median CD} = \frac{3 \text{ X } (\text{DI} - 1)}{2 \text{ X } (\text{DI} + 1)}$$

The median, maximum and minimum CDs for some common DI values are displayed in Table 20.

Table 20. Median, Maximum and Minimum CDs for a Range of DI Values

DI	MEDIAN CD	MAXIMUM CD	MINIMUM CD
0.00	-1.50	-1.00	-2.00
0.50	-0.50	0.00	-1.00
1.00	0.00	0.50	-0.50
2.00	0.50	1.00	0.00
3.00	0.75	1.25	0.25
4.00	0.90	1.40	0.40
5.00	1.00	1.50	0.50
6.00	1.07	1.57	0.57
7.00	1.13	1.63	0.63
8.00	1.17	1.67	0.67
9.00	1.20	1.70	0.70
10.00	1.23	1.73	0.73
20.00	1.36	1.86	0.86
30.00	1.40	1.90	0.90

Some important observations emerge from this analysis. First, differences in DI at the lower end of the DI range are more significant than they are at the higher end. For example, the difference in the median CD for DIs 1.00 and 2.00 is 0.50 CD units. In contrast, the difference in the median CDs for DIs 10.00 and 20.00 is only 0.14 CD units. Doubling the DI at the lower end has a far greater effect on the median CD than it does at the higher end. Second, and most important, neither the DI alone nor the CD alone is sufficient for an adequate aptitudinal evaluation of a

pedigree. The critical component remains the DP, and its configuration is responsible for the interplay between the DI and the CD. Consequently, all of the Dosage figure components - the DP, the DI and the CD - are complementary and all are necessary for the best and most accurate interpretation.

Photo Courtesy of the ThoroughbredTimes

Citation

DP 12-0-24-6-8, DI 0.92, CD 0.04

		Teddy (S)	Ajax
	Bull Dog (B)		Rondeau
		Plucky Liege	**Spearmint (P)**
Bull Lea (C)			Concertina
		Ballot	Voter
	Rose Leaves		Cerito
		Colonial	Trenton
Citation, b.c., 1945			Thankful Blossom
		Gainsborough (C)	**Bayardo (P)**
	Hyperion (B/C)		Rosedrop
		Selene	**Chaucer (S)**
Hydroplane II			Serenissima
		Hurry On (P)	Marcovil
	Toboggan		Tout Suite
		Glacier	St. Simon
			Glasalt

	DP Contribution	**Equivalent to:**
Sire	8- 0-16- 4- 2	DI 1.14 CD 0.27
Dam	4- 0- 8- 2- 6	DI 0.67 CD –0.30

A son of Classic *chef-de-race* Bull Lea, the premier classic sire of the mid-20th century, Triple Crown winner Citation, b.c., 1945 (Bull Lea-Hydroplane II, by Hyperion) has Dosage figures entirely consistent with his performance characteristics. Bred on the pattern of classic speed from his sire to stamina from his dam, the result is an almost ideally balanced DP 12-0-24-6-8, DI 0.92 and CD 0.04. Citation won at two miles, a mile and five-eighths and five times at a mile and a quarter. He also won eleven sprints, although his overall record below a mile (19-12-4-2), even though outstanding and representative of his exceptional class, was not as strong as his record in routes where he never finished worse than second while accumulating twenty wins and six seconds in twenty-six starts.

Photo Courtesy of the ThoroughbredTimes

Spend a Buck

DP 14-15-18-1-0, DI 3.80, CD 0.88

Spend a Buck, b.c., 1982	**Buckaroo (B/I)**	**Buckpasser (C)**	**Tom Fool (I/C)**	Menow
				Gaga
			Busanda	**War Admiral (C)**
				Businesslike
		Stepping High	No Robbery	Swaps
				Bimlette
			Bebop II	**Prince Bio (C)**
				Cappellina
	Belle de Jour	**Speak John (B/I)**	**Prince John (C)**	**Princequillo (I/S)**
				Not Afraid
			Nuit de Folies	Tornado
				Folle Nuit
		Battle Dress	Jaipur	**Nasrullah (B)**
				Rare Perfume
			Armorial	Battlefield
				Tellaris

	DP Contribution	Equivalent to:
Sire	8- 10-14- 0- 0	DI 3.57 CD 0.81
Dam	6- 5- 4- 1- 0	DI 4.33 CD 1.00

1985 Horse of the Year Spend a Buck, b.c.., 1982 (Buckaroo-Belle de Jour, by Speak John) was a tepid second choice in the 1985 Kentucky Derby because of concerns about his on-the-lead racing style and the tremendous speed he had exhibited in earlier races at two and three. As it turned out, he established himself as a classic horse of the highest order with a facile wire-to-wire romp, winning by 5¼ lengths in 2:00.1, third fastest in Derby history to that time behind only Secretariat and Northern Dancer. His six-furlong fraction of 1:09.3 remains the standard. He did this while defeating one of the strongest Derby fields in history that included two future Breeders' Cup Classic winners, the future Preakness Stakes record setter, and the previous year's two-year-old champion. Prior to the Derby, Spend a Buck won the nine-furlong Garden State Stakes by 9½, again on the front end, in 1:45.4. This is quite possibly the fastest mile and an eighth ever run by a three-year-old around two turns. Following the Kentucky Derby, Spend a Buck went wire-to-wire in the mile and a quarter Jersey Derby, this time challenged head-to-head through six furlongs in 1:09 flat by a rabbit named Huddle Up, and then holding safe through the entire stretch the future Belmont Stakes winner and confirmed closer Creme Fraiche, whose time for the mile and a half classic has

been bettered by only seven other Belmont Stakes winners.

Spend a Buck is the result of breeding speed through both his sire and his dam moderated by elements of classic stamina on both sides. Despite expressing exceptional speed on the track, his Dosage figures (DP 14-15-18-1-0, DI 3.80 and CD 0.88) are within historical classic guidelines and suggest the ability to carry that speed over classic distances, which he did in grand style.

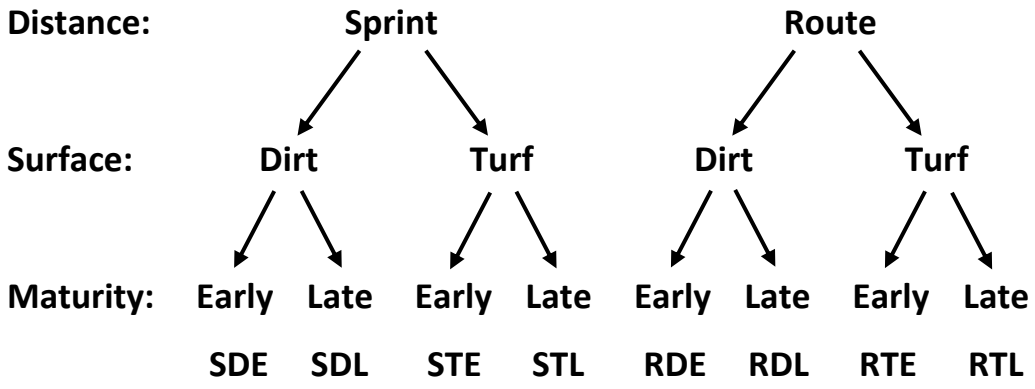
Chapter 11

What is Aptitudinal Type?

The fundamental hypothesis of contemporary Dosage theory is that a relationship exists between aptitudinal type and performance on the track. Said differently, the hypothesis proposes that the inherited characteristics of a horse as expressed by its pedigree should correlate with the horse's competitive profile.

When we talk about a horse's "inherited characteristics", what do we mean? We'll begin by dividing a runner's traits into three broad categories. These are not meant to be exclusive, and within each there is a wide distribution of attributes. For our purposes, however, we will limit ourselves to this simplified model because on the one hand it does address the issue while on the other it avoids the impossibility of dealing with the infinite potential variations. The first category is distance preference. Is the horse more successful running short or does it do better running long? Second is surface preference. Does the horse have a greater affinity for dirt racing or for turf racing? Third is maturation rate. Is the horse precocious or is it late developing?

The following illustration shows the eight possible combinations of these traits. The symbols used in the drawing include, in the distance category, S for sprint and R for route. In the surface category, D is for dirt and T is for turf. The maturation rate category is divided into E for early maturing and L for late developing.



With this technique we can visualize how the variations relate to one another and distinguish, for example, an early-developing dirt sprinter (SDE) from a late-developing turf router (RTL). The designations in the graphic are summarized below.

APTITUDINAL TYPE	CODE
Early-maturing dirt sprinters	SDE
Late-maturing dirt sprinters	SDL
Early-maturing turf sprinters	STE
Late-maturing turf sprinters	STL
Early-maturing dirt routers	RDE
Late-maturing dirt routers	RDL
Early-maturing turf routers	RTE
Late-maturing turf routers	RTL

Next we employ a Dosage metric in order to determine if there really is a difference between the Dosage characteristics of a horse and its aptiitudinal type as defined in the illustration. The metric we use is the Center of Distribution (CD) which, because it is a linear scale, is the most statistically useful and most accurate Dosage figure. Our approach is to determine the average CD for each variation (i.e., aptitudinal type) to see how the specific combinations of traits are reflected in the Dosage figures.

We calculate the average CD using data from Table 15 in the Chapter 10, "The Relationship Between the DI and the CD: DP Patterns", based on 29,394 North American open stakes races since 1983. We then rank order the categories of distance, surface and maturity corresponding to the columns %SPR, %TURF and %2YO in the table. The highest percentage in each category is considered most representative of that trait and the average CD associated with it is noted. A high %SPR means a higher percentage of wins at shorter distances. A high %TURF means a higher percentage of wins on grass. A high %2YO means a higher percentage of juvenile wins. Conversely, the lowest percentage in each category is considered most unrepresentative of that trait and the average CD associated with it is noted as well. In the SDE case, for example, we use the average CD for the categories with the highest %SPR, lowest %TURF and highest %2YO. Knowing how many examples there are associated with the average CD in each category we are able to calculate an overall average CD for the SDE aptitudinal type. The details follow Table 21 which shows the highest and lowest values for %SPR, %TURF and %2YO. They represent the extremes of aptitudinal type in the distance, surface and maturity sub-categories.

Table 21. Extreme DP Patterns

DP PATTERN	SYMBOL	EXAMPLES	ACD	%SPR	%TURF	%2YO
DOMINANT APTITUDE	P>B,I,S,C	176	-0.56	14.5%	**55.2%**	7.6%
CLASSIC (C) PTS	C>20	1293	0.46	**13.2%**	51.4%	8.1%
"DOWN-THE-LADDER"	B>I>C>S>P	588	1.11	45.0%	**19.2%**	15.1%
"TRIPLE ZERO"	C=0,S=0,P=0	206	1.68	**45.1%**	28.2%	**16.4%**
"WING" BREEDING	B,P>I,C,S	118	0.18	26.7%	41.7%	**7.5%**
ALL PATTERNS		**29394**	**0.70**	**31.5%**	**31.8%**	**13.1%**

Thus, by example for the SDE aptitudinal type:

Highest %SPR: sample size = 206, average CD = 1.11

Lowest %TURF: sample size = 588, average CD = 1.11

Highest %2YO: sample size = 206, average CD = 1.68

The average CD for the SDE aptitudinal type is 1.34 (206*1.11+588*1.11+206*1.68)/(206+588+206).

By the same method, the average calculated CD for each of the eight aptitudinal types is:

APTITUDINAL TYPE		TRAITS	#	ACD	
EARLY-DEVELOPING DIRT SPRINTERS	(SDE)	%SPR↑	206	1.68	
		%T↓	588	1.11	**Avg CD = 1.34**
		%2YO↑	206	1.68	
LATE-DEVELOPING DIRT SPRINTERS	(SDL)	%SPR↑	206	1.68	
		%T↓	588	1.11	**Avg CD = 1.12**
		%2YO↓	118	0.18	
EARLY-DEVELOPING TURF SPRINTERS	(STE)	%SPR↑	206	1.68	
		%T↑	176	-0.56	**Avg CD = 1.01**
		%2YO↑	206	1.68	
LATE-DEVELOPING TURF SPRINTERS	(STL)	%SPR↑	206	1.68	
		%T↑	176	-0.56	**Avg CD = 0.54**
		%2YO↓	118	0.18	
EARLY-DEVELOPING DIRT ROUTERS	(RDE)	%SPR↓	1293	0.46	
		%T↓	588	1.11	**Avg CD = 0.76**
		%2YO↑	206	0.94	
LATE-DEVELOPING DIRT ROUTERS	(RDL)	%SPR↓	1293	0.46	
		%T↓	588	1.11	**Avg CD = 0.63**
		%2YO↓	118	0.18	
EARLY-DEVELOPING TURF ROUTERS	(RTE)	%SPR↓	1293	0.46	
		%T↑	176	-0.56	**Avg CD = 0.50**
		%2YO↑	206	0.94	
LATE-DEVELOPING TURF ROUTERS	(RTL)	%SPR↓	1293	0.46	
		%T↑	176	-0.56	**Avg CD = 0.33**
		%2YO↓	118	0.18	

Immediately we note how Dosage figures are able to capture distinctions in aptitudinal type. The difference between early-maturing dirt sprinters (SDE, average CD 1.34) and late-maturing turf routers (RTL average CD 0.33) is especially dramatic. Even within overlapping aptitudinal types we can see significant separation. For example, in all cases where the only difference is between sprint and route, the sprint type has the higher CD (SDE>RDE; SDL>RDL; STE>RTE; STL>RTL). When the only difference is between dirt and turf we observe SDE>STE, SDL>STL, RDE>RTE and RDL>RTL where the dirt type always has the higher CD. Finally, when the only difference is between early maturing and late developing we find SDE>SDL, STE>STL, RDE>RDL and RTE>RTL and the early-maturing type always has the higher CD. From this we conclude that shorter distances, dirt

and early maturity are associated with speed in a pedigree as captured by the Dosage figures. Similarly, we conclude that longer distances, turf and late maturity are associated with stamina in a pedigree. Each of the other combinations, or aptitudinal types, expresses a unique balance of inherited speed and stamina.

These results confirm that Dosage methodology does indeed capture the relationship between a Thoroughbred's aptitudinal type and how that type is expressed in the real world of racing. We can demonstrate the relationship with a couple of specific examples, Fortunate Prospect (SDE) and Cetewayo (RTL).

Note the %SPR, %TURF and %2YO for the respective sires and broodmare sires. In both cases they accurately anticipate the aptitudinal type of the pedigrees in question.

Fortunate Prospect, dkb/br.h., 1981 (a model SDE type)
DP 12-2-10-0-0, DI 3.80, CD 1.08; Won sprint stakes at 2, 3, 4 and 5

Northern Prospect 76 **88% SPR, 4% TURF, 27% 2YO**	**Mr. Prospector 70 (B/C)**	**Raise a Native 61 (B)**	**Native Dancer 50 (I/C)**
			Raise You 46
		Gold Digger 62	**Nashua 52 (I/C)**
			Sequence 46
	Sleek Dancer 68	**Northern Dancer 61 (B/C)**	Nearctic 54
			Natalma 57
		Victorine 62	**My Babu 45 (B)**
			Pandora 47
Fortunate Bid 71	Lucky Debonair 62 **64% SPR, 5% TURF, 9% 2YO**	Vertex 54	The Rhymer 38
			Kanace 45
		Fresh As Fresh 57	**Count Fleet 40 (C)**
			Airy 45
	Biddy Big 66	Palestinian 46	Dolly Whisk 36
			Gemma
		Spoony 52	Devil Diver 39
			Bimlette 44

Cetewayo, b.h., 1994 (a model RTL type)
DP 3-0-29-1-7, DI 0.78, CD -0.23; Won turf marathon stakes at 4, 5, 6 and 8

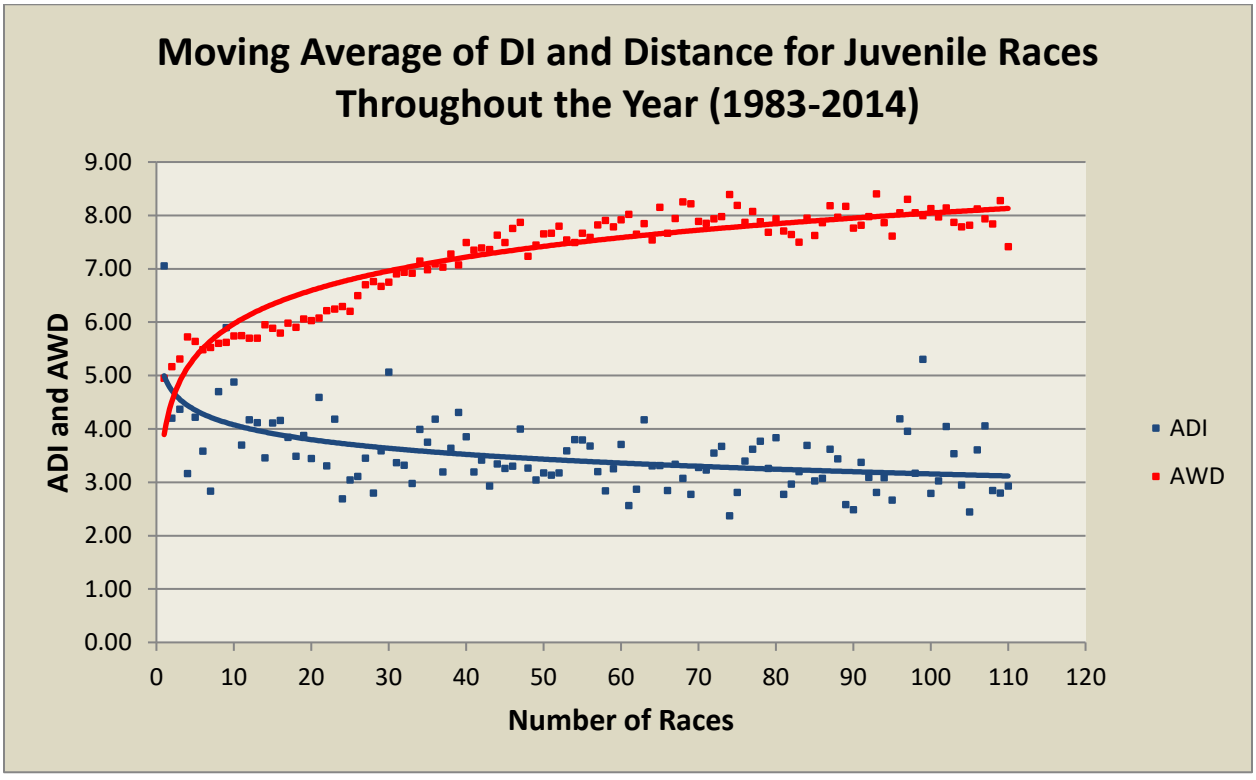
		Tenerani 44	Bellini 37
	Ribot 52 (C/P)		Tofanella 31
		Romanella 43	El Greco 34
His Majesty 68 (C)			Barbara Burrini 37
4% SPR, 63% TURF, 4% 2YO		**Alibhai 38 (C)**	**Hyperion 30 (B/C)**
	F lower Bowl 52		Teresina 20
		Flower Bed 46	Beau Pere 27
			Boudoir 38
		Sharpen Up 69 (B/C)	Atan 61
	Diesis 80		Rocchetta 61
	11% SPR, 89% TURF, 0% 2YO	Doubly Sure 71	**Reliance 62 (S/P)**
Aletta Maria 85			Soft Angels 63
		Pharly 74	**Lyphard 69 (C)**
			Comely 66
	Pharlette 80	Gantlette 74	**Run The Gantlet 68 (P)**
			Her Honor 54

Chapter 12

Pedigree and Performance: Two-Year-Olds

A fascinating and illustrative use of Dosage as a tool for understanding aptitudinal trends is revealed in its application to the analysis of two-year-old racing. Specifically, we can monitor the moving average of the DI for winners of juvenile stakes throughout the year. A moving average is simply a shifting average over a series of successive events. The moving average changes with each additional data point. In our example, we arranged the two-year-old stakes winners in chronological order for each of the years 1983 through 2014. We then determined the average DI for each of the races in sequence through the year. In other words, we calculated the average DI for all of the first juvenile stakes from 1983 through 2014 then did the same for the second, the third and so on. We then plotted the change in the average DI from race 1 through race 110, encompassing over 3500 races in all. The result of the plot is displayed in Chart 16.

Chart 16. Dosage Applied to Two-Year-Old Racing



Although there is considerable but not unexpected scatter within the data, the computer-generated trend line is unequivocal and exactly as one would expect. The average DI drops continuously throughout the year as the average distance of the races increases. The analysis graphically captures the progression from the 4½-furlong

"baby" races at Keeneland in April through the 8½ to 9 furlong races leading up to and beyond the Breeders' Cup, with speed-bred high DI horses dominating the early season races and more stamina-bred lower DI horses taking over in the fall. Occasionally an April Keeneland juvenile such as Summer Squall will win a classic race, and another, such as Horse of the Year Favorite Trick, may go on to great things. More often than not, however, the fall two-year-old races and the following year's three-year-old route races tend to be dominated by colts and fillies that come out in late spring and into the fall.

Chapter 13

Pedigree and Performance: "Elite" Thoroughbreds

Table 22 includes Dosage figures for selected groups of "elite" Thoroughbreds since 1983. We define "elite" Thoroughbreds for this exercise as superior performers either on the racetrack or in the breeding shed. They include winners of the Kentucky Derby, Horses of the Year, Annual Leading Earners, Annual Leading Sires by Progeny Earnings, Annual Leading Broodmare Sires by Progeny Earnings, and Kentucky Broodmares of the Year. The individual and combined figures are compared to those for open stakes winners over the same timeframe. Abbreviations in the table are ADI for average Dosage Index; ACD for average Center of Distribution; CDI for Composite Dosage Index; and CCD for Composite Center of Distribution. Recall that we derive composite figures by adding the points in each aptitude category for all members of the group and then calculating the DI and CD in the normal way.

Table 22. Dosage Figures for "Elite" Thoroughbreds

CATEGORY	DP	ADI	ACD	CDI	CCD	PTS
Kentucky Derby Winners, 1983-2014 (32)	7.72 - 4.66 - 11.72 - 1.31 - 1.09	2.84	0.66	2.21	0.63	26.50
Horse Of The Year, 1983-2014 (32)	7.97 - 3.91 - 10.75 - 1.59 - 0.16	2.77	0.74	2.42	0.74	24.38
Leading Earners, 1983-2014 (32)	7.50 - 4.78 - 13.34 - 1.38 - 0.25	2.71	0.68	2.28	0.66	27.25
PERFORMANCE HORSES (96)	7.73 - 4.42 - 11.91 - 1.44 - 0.51	2.77	0.69	2.29	0.67	26.00
Leading Sires, 1983-2014 (32)	12.34 - 8.22 - 16.72 - 1.78 - 0.69	3.04	0.77	2.67	0.75	39.75
Leading Broodmare Sires, 1983-2014 (32)	12.22 - 9.06 - 16.22 - 3.75 - 1.50	2.75	0.63	2.20	0.63	42.75
Kentucky Broodmares Of The Year, 1983-2013 (31)	10.52 - 6.71 - 15.55 - 2.48 - 1.45	3.33	0.63	2.13	0.61	36.71
BREEDING HORSES (95)	11.70 - 7.89 - 16.15 - 2.70 - 1.22	3.03	0.67	2.31	0.66	39.66
TOTAL ELITE (191)	**9.71 - 6.20 - 14.02 - 2.05 - 0.85**	**2.90**	**0.68**	**2.31**	**0.67**	**32.83**
OPEN STAKES WINNERS, 1983-2014 (29,394)	**7.22 - 4.38 - 9.75 - 1.33 - 0.74**	**3.17**	**0.70**	**2.37**	**0.68**	**23.42**

Several differences between the "elite" horses and typical stakes winners are immediately obvious. Although there is some variation from group to group, all of the "elite" groups show double-digit representation in the Classic aptitudinal category. The typical stakes winners do not. All of the "elite" groups have more total Dosage points than the stakes winners, mainly concentrated in the breeding stock (sires, broodmares, and broodmare sires). The "elite" runners have fewer Dosage points than the "elite" breeding animals. The "elite" horses as a group have more representation in the stamina wing of the DP (Solid and Professional aptitudinal categories). The leading sires possess far more Brilliant *and* Classic points than do the stakes winners, while the broodmares and broodmare sires are most heavily weighted toward stamina, having the largest Solid and Professional representation of any "elite" groups. The Dosage figures are generally lower for the "elite" horses, again with variation from group to group. Note that the ADI of the Kentucky Broodmare of the Year group is heavily influenced by one representative with very high numbers. This is not as obvious in the CDI. The conclusion one might draw from these data is that we

can differentiate the pedigrees of superior Thoroughbreds from the pedigrees of typical Thoroughbred stakes winners by the magnitude and degree to which they have inherited prepotent elements of speed and endurance.

Chapter 14

Pedigree and Performance: The Breeders' Cup

Conceived as a championship event, the Breeders' Cup is a series of divisional races contested in the United States in the fall of each year. It includes races by age, distance and surface and often draws many foreign-based participants, particularly for the races on turf. An analysis of the Dosage figures of past Breeders' Cup winners reveals a conformance with the general model relating Dosage figures to average winning distance. As the distances increase, the Dosage figures trend toward lower numbers. Table 23 displays the average figures along with the average distance of the races in each division from the initial The Breeders' Cup in 1984 through 2014. Several divisions show unusual average distances because of occasional past changes in distance from year to year. Because races are occasionally added or removed from the schedule, the sample sizes for each vary from race to race as well. Following the table are Charts 17 and 18 which graphically display the relationship between distance and the average DI and average CD.

Table 23. The History of Dosage in the Breeders' Cup Through 2014

RACE	AWD	DP	ADI	ACD	PTS
Classic	10.00	8.10 - 4.61 - 12.71 - 1.32 - 1.13	2.56	0.65	27.87
Dirt Mile	8.04	5.00 - 2.00 - 8.38 - 0.63 - 0.25	2.17	0.61	16.25
Distaff	9.13	8.13 - 6.10 - 11.74 - 1.16 - 0.94	3.00	0.70	28.06
F&M Sprint	6.88	4.88 - 3.13 - 9.63 - 0.25 - 0.63	2.51	0.65	18.50
F&M Turf	10.44	5.31 - 4.19 - 13.69 - 2.56 - 1.00	1.80	0.39	26.75
Juvenile	8.45	9.29 - 5.65 - 11.65 - 0.71 - 0.90	3.30	0.78	28.19
Juvenile Fillies	8.47	7.26 - 4.81 - 11.48 - 1.10 - 1.03	2.82	0.65	25.68
Juvenile Fillies Turf	8.00	4.43 - 3.00 - 10.00 - 1.86 - 0.14	1.83	0.46	19.43
Juvenile Sprint	6.00	8.50 - 8.50 - 11.00 - 1.00 - 1.00	3.07	0.75	30.00
Juvenile Turf	8.00	5.00 - 2.88 - 11.38 - 2.38 - 0.88	1.79	0.45	22.50
Marathon	13.71	5.33 - 5.50 - 10.67 - 0.33 - 0.17	2.78	0.71	22.00
Mile	8.00	8.03 - 4.90 - 14.52 - 2.29 - 0.84	2.09	0.55	30.58
Sprint	6.00	9.19 - 4.90 - 9.19 - 1.16 - 0.58	4.00	0.82	25.03
Turf	12.00	6.16 - 3.59 - 12.78 - 3.88 - 1.59	1.63	0.35	28.00
Turf Sprint	6.07	6.00 - 3.29 - 10.14 - 1.14 - 0.29	2.47	0.63	20.86

Chart 17. Average DI vs. Average Distance for Breeders' Cup Races

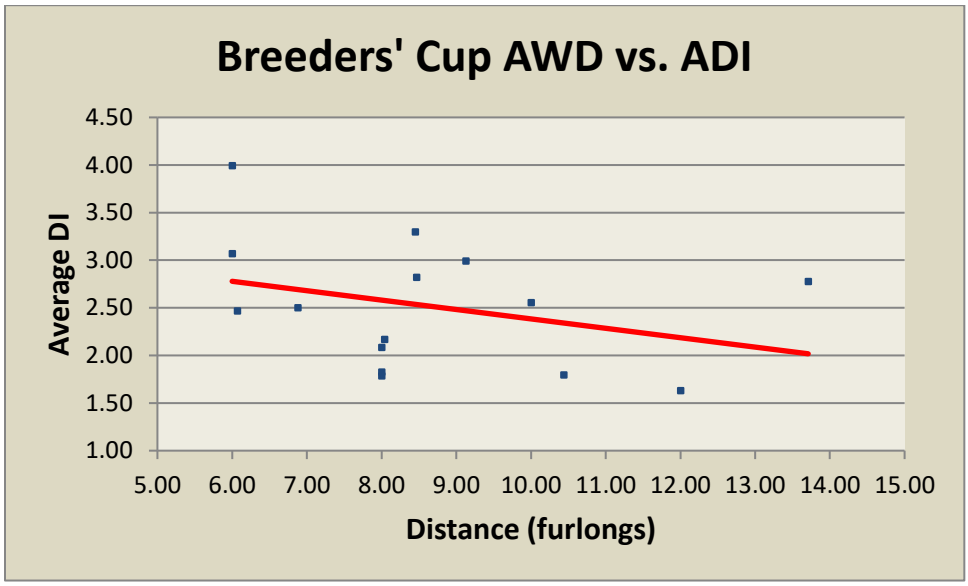
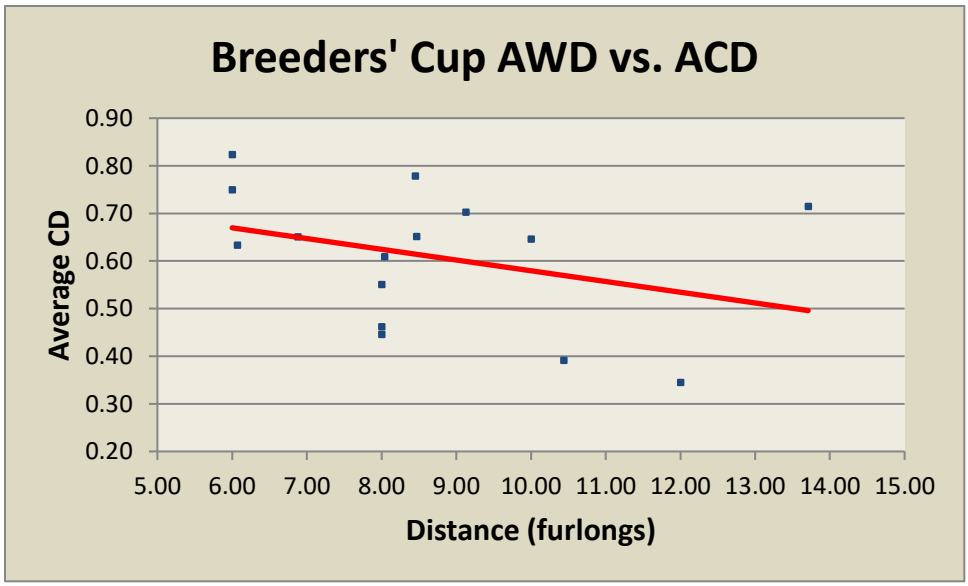


Chart 18. Average CD vs. Average Distance for Breeders' Cup Races



Most striking are the data for the Sprint and the Turf where the highest and lowest figures correlate with the shortest and longest distance. Also of note are the generally lower figures for the turf races compared to those on dirt. These results parallel those for the Thoroughbred population at large

Photo Courtesy of Serita Hult

Smile

DP 18-8-10-2-0, DI 4.43, CD 1.11

Smile, dkb/br..c., 1982	**In Reality (B/C)**	**Intentionally (B/I)**	Intent	*War Relic*
				Liz F.
			My Recipe	**Discovery (S)**
				Perlette
		My Dear Girl	Rough'n Tumble (B/C)	Free For All
				Roused
	Sunny Smile		Iltis	*War Relic*
				We Hail
		Boldnesian	**Bold Ruler (B/I)**	**Nasrullah (B)**
				Miss Disco
			Alanesian	**Polynesian (I)**
				Alablue
		Sunny Sal	Sunrise County	Summer Tan
				Bellerine
			San Salvador	First Landing
				Souffle

	DP Contribution				Equivalent to:	
Sire	14-	4-	10-	2- 0	DI 3.27	CD 1.00
Dam	4-	4-	0-	0- 0		CD 1.50

Winner of the Breeders' Cup Sprint (G1) at four, champion Smile, dkb/br.c., 1982 (In Reality-Sunny Smile, by Boldnesian) was produced by breeding the intermediate speed of Brilliant/Classic *chef-de-race* In Reality to the pure speed of his da, Sunny Smile. The resulting DP 14-4-10-2-0, DI 4.43 and CD 1.11 suggest a sprint-type pedigree with double digits in the Brilliant aptitudinal group but with a bit of stamina from the Classic and Solid aptitudinal groups. As a three-year-old Smile won the mile and an eighth Grade 1 Arlington Classic, expressing his speed throughout in a wire-to-wire romp. This is a classic example of a pedigree predisposed toward speed yet with enough residual stamina to rationalize carrying that speed beyond a sprint distance under advantageous conditions of pace.

Chapter 15

Pedigree and Performance: Steeplechasing

Table 24 displays the Dosage figures for American steeplechase champions since 1948 and through 2014. The relatively low DI and CD figures result from significant *chef-de-race* contributions to the Solid and Professional aptitude groups and are generally consistent with the longer distances of steeplechase races. However, the DI distribution of these champions reveals some unusual and surprising patterns.

The DI distribution is bimodal with the vast majority (68.7%) of the champions having a DI of less than 2.00. Among open SWs, only 30.1% have a DI below 2.00. Surprisingly, another 19.4% of the steeplechase champions have a DI above 4.00 (slightly more than open SWs at 18.5%) while only 11.9% have a DI in the typical middle distance range of 2.00 to 4.00. 51.4% of open SWs fall in the DI 2.00 to 4.00 range. Thus, there appear to be predominantly two types of pedigree associated with top-class performance in American steeplechasing. The first is the endurance-oriented pedigree in which strong stamina influences prevail, consistent with competitiveness over marathon distances. The second is the sprint type pedigree in which inherited speed is dominant. Although the latter at first may seem to contradict suitability for long-distance events, handicappers have observed the successful transition of many sprinters on the flat to racing over jumps. The rationale is that the typical pace of American steeplechase races is not so demanding that sprinters are inevitably at a huge disadvantage. It may be that their increased agility and quickness over the hurdles compensate for stamina limitations. Thus it appears the desirable qualities of stamina and jumping ability can be expressed individually, often shifted more to one trait than the other. The small number of middle distance pedigrees among these champions is certainly surprising considering over 50% of North American open stakes winners on the flat since 1983 have a DI between 2.00 and 4.00.

DI RANGE	%STEEPLECHASE CHAMPIONS	% OPEN SWs
<2	68.7	30.1
2 - 4	11.9	51.4
>4	19.4	18.5

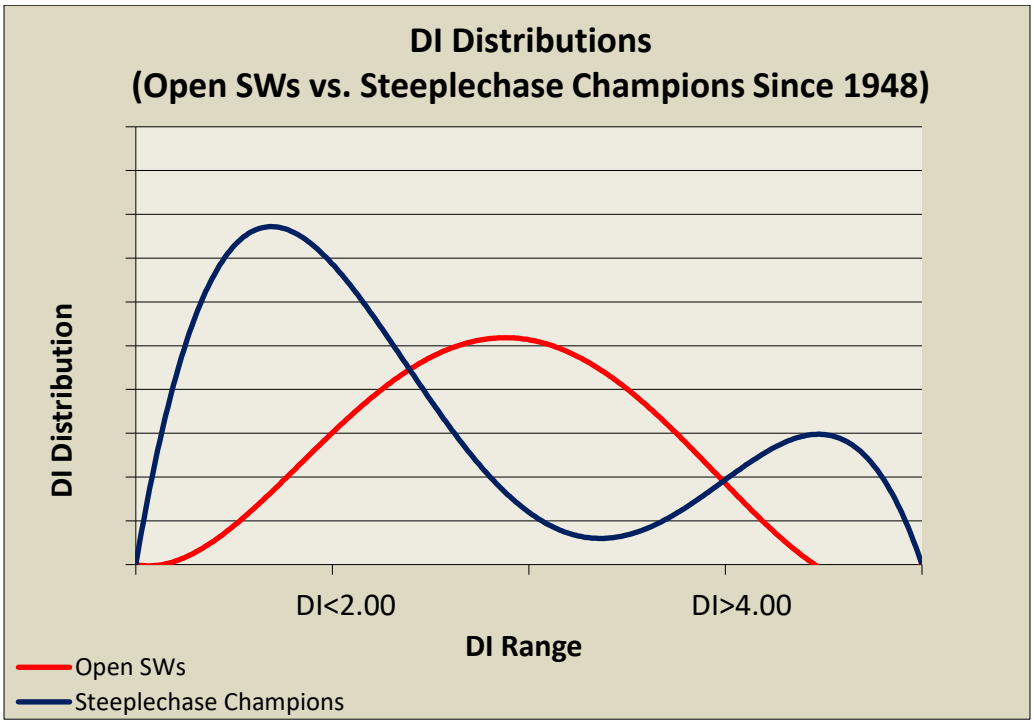
Table 24. Dosage Figures for Steeplechase Champions Since 1948

YEAR	HORSE	DP	DI	CD
1948	American Way	0- 4- 5- 3- 2	0.87	-0.21
1949	Trough Hill	0- 0- 4- 0-12	0.14	-1.50
1950	Oedipus	12- 4- 16- 6- 0	1.71	0.58
1951	Oedipus	12- 4- 16- 6- 0	1.71	0.58
1952	Jam	0- 0- 0- 3- 3	0.00	-1.50
1953	The Mast	4- 0- 1-11- 2	0.33	-0.39
1954	King Commander	2- 2- 0- 0- 0		1.50
1955	Neji	2- 2- 0- 6- 8	0.29	-0.89
1956	Shipboard	2- 0- 1-16- 5	0.12	-0.92
1957	Neji	2- 2- 0- 6- 8	0.29	-0.89
1958	Neji	2- 2- 0- 6- 8	0.29	-0.89
1959	Ancestor	1- 1- 16- 2- 0	1.00	0.05
1960	Benguala	18- 0- 7-14- 3	1.05	0.38
1961	Peal	0- 2- 2- 0- 6	0.43	-1.00
1962	Barnaby's Bluff	4- 0- 8- 4- 0	1.00	0.25
1963	Amber Diver	2- 4- 12- 2- 6	0.86	-0.23
1964	Bon Nouvel	9- 3- 0- 4- 0	3.00	1.06
1965	Bon Nouvel	9- 3- 0- 4- 0	3.00	1.06
1966	Tuscalee	4- 0- 6- 0- 0	2.33	0.80
1967	Quick Pitch	4- 4- 6- 6- 0	1.22	0.30
1968	Bon Nouvel	9- 3- 0- 4- 0	3.00	1.06
1969	L'escargot	0- 0- 2- 0- 2	0.33	-1.00
1970	Top Bid	28- 2- 8- 2- 0	5.67	1.40
1971	Shadow Brook	6- 4- 14- 4- 6	1.00	0.00
1972	Soothsayer	1- 1- 6- 6- 2	0.45	-0.44
1973	Athenian Idol	9- 0- 6- 1-14	0.67	-0.37
1974	Gran Kan	0- 0- 1- 5- 2	0.07	-1.13
1975	Life's Illusion	1- 3- 4- 2- 2	1.00	-0.08
1976	Fire Control	8-14- 10- 6- 4	1.80	0.38
1977	Café Prince	20- 2- 14-10- 0	1.71	0.70
1978	Café Prince	20- 2- 14-10- 0	1.71	0.70
1979	Martie's Anger	19- 3- 5- 1- 0	7.00	1.43
1980	Zaccio	2-12- 2- 0- 2	5.00	0.67
1981	Zaccio	2-12- 2- 0- 2	5.00	0.67
1982	Zaccio	2-12- 2- 0- 2	5.00	0.67
1983	Flatterer	9- 2- 3- 0- 0	8.33	1.43
1984	Flatterer	9- 2- 3- 0- 0	8.33	1.43
1985	Flatterer	9- 2- 3- 0- 0	8.33	1.43
1986	Flatterer	9- 2- 3- 0- 0	8.33	1.43
1987	Inlander	2- 0- 6- 8- 2	0.38	-0.44
1988	Jimmy Lorenzo	5- 2- 7- 0- 6	1.11	0.00
1989	Highland Bud	10- 3- 16- 5- 2	1.40	0.39
1990	Morley Street	8- 0- 8- 0- 4	1.50	0.40
1991	Morley Street	8- 0- 8- 0- 4	1.50	0.40
1992	Lonesome Glory	2- 3- 21- 4- 0	1.07	0.10

Table 24. Dosage Figures for Steeplechase Champions Since 1948, cont.

YEAR	HORSE	DP					DI	CD
1993	Lonesome Glory	2-	3-	21-	4-	0	1.07	0.10
1994	Warm Spell	6-	4-	7-	5-	0	1.59	0.50
1995	Lonesome Glory	2-	3-	21-	4-	0	1.07	0.10
1996	Correggio	9-	8-	26-	9-	0	1.36	0.33
1997	Lonesome Glory	2-	3-	21-	4-	0	1.07	0.10
1998	Flat Top	8-	5-	13-	1-	5	1.56	0.31
1999	Lonesome Glory	2-	3-	21-	4-	0	1.07	0.10
2000	All Gong	5-	1-	8-	4-	2	1.00	0.15
2001	Pompeyo	6-	2-	12-	0-	0	2.33	0.70
2002	Flat Top	8-	5-	13-	1-	5	1.56	0.31
2003	Mcdynamo	4-	4-	25-	0-	1	1.52	0.29
2004	Hirapour	5-	0-	5-	2-	0	1.67	0.67
2005	Mcdynamo	4-	4-	25-	0-	1	1.52	0.29
2006	Mcdynamo	4-	4-	25-	0-	1	1.52	0.29
2007	Good Night Shirt	6-	10-	8-	0-	0	5.00	0.92
2008	Good Night Shirt	6-	10-	8-	0-	0	5.00	0.92
2009	Mixed Up	10-	6-	7-	2-	1	3.00	0.85
2010	Slip Away	3-	2-	9-	0-	0	2.11	0.57
2011	Black Jack Blues	0-	9-	2-	0-	1	5.00	0.58
2012	Pierrot Lunaire	3-	4-	12-	1-	2	1.44	0.23
2013	Divine Fortune	4-	2-	16-	0-	0	1.75	0.45
2014	Demonstrative	7-	10-	17-	2-	0	3.00	0.71
	AVERAGE =	**5.87-**	**3.36-**	**8.81-**	**3.13-**	**2.06**	**2.21**	**0.28**
	MEDIAN =	**4.00-**	**3.00-**	**7.00-**	**2.00-**	**1.00**	**1.51**	**0.33**
	COMPOSITE =						**1.42**	**0.34**

Chart 19. DI Distributions of Steeplechase Champions and Open Stakes Winners



Thus, there appear to be predominantly two types of pedigrees associated with world-class performance in North American steeplechasing. The first is the strongly endurance-oriented pedigree in which stamina influences prevail, enabling the horse to be competitive over marathon distances. The second is the sprint type pedigree in which speed is dominant. Although the latter initially may seem contradictory, many handicappers have observed the successful transition of sprinters on the flat to races over jumps. The rationale is that the typical pace of steeplechase races is not so demanding that sprinters necessarily will falter. In fact, any fatigue characteristics may be compensated by increased agility and quickness over the jumps. The desired interaction between stamina and jumping ability seems to find its best expression when shifted more to one trait or the other. The paucity of middle distance pedigrees among these champions is certainly surprising considering that almost 50% of open stakes winners on the flat since 1983 have a DI between 2.00 and 4.00. In fact, until 2001 there hadn't been a steeplechase champion since 1968 with a pedigree that had fallen within the DI 2.00 to 4.00 range.

Chapter 16

Pedigree and Performance: The Racing Surface

The following table presents the Dosage figures for stakes winners at various race tracks in North America. The data are for stakes races since 1983 through 2014 and include tracks with at least 100 total stakes races, and at least 50 stakes races each at sprint (less than one mile) and route (greater than or equal to a mile) distances. The table displays the average winning distance, Dosage Profile (DP), Dosage Index (DI), Center of Distribution (CD) and average Dosage Profile (DP) points for the winners of all the races, followed by separate columns for the average winning distance, average DI (ADI) and average CD (ACD) of the winners in both sprints and routes. It is apparent that the tracks vary widely in the aptitudinal types that are successful. It is also apparent that tracks have different profiles in terms of sprint winner aptitudes versus route winner aptitudes. The track abbreviations include: AP (Arlington Park), AQU (Aqueduct), Bel (Belmont Park), CD (Churchill Downs), CRC (Calder), DEL (Delaware Park), DMR (Del Mar), ELP (Ellis Park), FG (Fair Grounds), FPX (Fairplex), GG (Golden Gate Fields), GP (Gulfstream Park), HAW (Hawthorne), KEE (Keeneland), LAD (Louisiana Downs), LRL (Laurel), LS (Lone Star), MED (The Meadowlands), MNR (Mountaineer Park), MTH (Monmouth Park), OP (Oaklawn Park), PHA (Philadelphia Park), PIM (Pimlico), PRM (Prairie Meadows), RP (Remington Park), SA (Santa Anita), SAR (Saratoga), SPT (Sportsmans Park), TP (Turfway) and WO (Woodbine).

Table 25. Dosage Figures by Racetrack

	ALL RACES						SPRINTS				ROUTES			
TRACK	RACES	AWD	DP	PTS	ADI	ACD	RACES	AWD	ADI	ACD	RACES	AWD	ADI	ACD
AP	748	8.63	6.98 - 4.13 - 10.40 - 1.51 - 0.86	23.88	3.01	0.65	128	6.37	4.32	0.87	620	9.09	2.74	0.61
AQU	1684	8.02	7.98 - 4.73 - 9.93 - 1.34 - 0.78	24.76	3.43	0.74	612	6.30	4.34	0.86	1072	9.01	2.91	0.67
BEL	2120	8.41	7.81 - 4.75 - 11.32 - 1.52 - 0.80	26.20	3.00	0.68	614	6.38	3.89	0.83	1506	9.24	2.64	0.62
CD	1268	8.08	7.44 - 4.49 - 10.34 - 1.26 - 0.72	24.25	3.07	0.71	329	6.20	3.77	0.84	939	8.74	2.83	0.67
CRC	1240	8.10	7.22 - 4.49 - 9.08 - 1.33 - 0.79	22.91	3.34	0.72	435	6.40	3.97	0.84	805	9.02	3.00	0.66
DEL	527	8.06	6.96 - 4.17 - 10.17 - 1.05 - 0.69	23.04	2.86	0.70	144	5.90	3.60	0.85	383	8.88	2.58	0.64
DMR	794	8.07	6.88 - 4.08 - 10.09 - 1.29 - 0.66	23.00	2.91	0.66	260	6.43	3.44	0.78	534	8.87	2.65	0.61
ELP	152	7.72	7.57 - 4.28 - 9.22 - 1.32 - 0.75	23.14	3.17	0.74	62	6.77	3.21	0.81	90	8.38	3.15	0.69
FG	626	7.83	7.19 - 4.49 - 10.18 - 1.08 - 0.83	23.77	2.98	0.70	195	6.02	3.39	0.80	431	8.65	2.79	0.65
FPX	152	7.94	6.89 - 4.49 - 8.85 - 1.18 - 0.62	22.03	3.27	0.73	52	6.42	3.80	0.83	100	8.73	3.00	0.67
GG	568	8.06	7.05 - 4.13 - 8.70 - 1.36 - 0.75	21.99	3.44	0.73	146	6.04	4.64	0.90	422	8.76	3.03	0.67
GP	1349	8.25	7.16 - 4.51 - 10.11 - 1.32 - 0.75	23.85	3.02	0.69	423	6.51	3.66	0.83	926	9.04	2.73	0.63
HAW	388	8.12	7.61 - 4.81 - 9.61 - 1.37 - 0.67	24.07	3.53	0.73	96	6.36	4.67	0.82	292	8.69	3.15	0.70
KEE	960	8.27	7.20 - 4.39 - 10.81 - 1.26 - 0.66	24.32	2.87	0.68	271	6.34	3.39	0.79	689	9.02	2.66	0.64
LAD	470	8.23	7.25 - 4.41 - 7.94 - 1.38 - 0.71	21.69	3.43	0.78	119	6.52	4.31	0.91	351	8.81	3.15	0.73
LRL	880	7.92	7.41 - 4.77 - 8.84 - 1.25 - 0.78	23.05	3.61	0.76	365	6.40	4.19	0.85	515	9.00	3.19	0.70
LS	236	7.62	6.37 - 3.64 - 9.66 - 1.05 - 0.50	21.22	2.81	0.68	89	6.24	3.17	0.75	147	8.46	2.59	0.65
MED	391	8.44	8.13 - 5.20 - 10.48 - 1.53 - 0.99	26.33	3.53	0.71	68	5.96	5.80	0.98	323	8.97	3.05	0.65
MNR	281	7.24	6.35 - 3.68 - 9.30 - 1.00 - 0.48	20.81	2.87	0.70	117	5.73	3.36	0.77	164	8.31	2.53	0.65
MTH	848	7.81	7.25 - 4.45 - 9.64 - 1.13 - 0.59	23.06	3.24	0.74	250	5.89	4.02	0.88	598	8.62	2.92	0.69
OP	599	7.72	7.79 - 4.40 - 9.28 - 1.02 - 0.65	23.14	3.44	0.79	180	5.95	4.16	0.89	419	8.48	3.13	0.75
PHA	364	7.55	6.99 - 4.37 - 9.36 - 0.94 - 0.55	22.21	3.29	0.75	169	6.10	3.64	0.80	195	8.81	2.99	0.71
PIM	704	7.90	7.70 - 4.86 - 9.41 - 1.33 - 0.71	24.01	3.57	0.77	229	5.78	4.64	0.90	475	8.92	3.06	0.70
PRM	170	7.75	6.31 - 3.76 - 9.27 - 0.93 - 0.48	20.75	2.83	0.72	56	5.91	3.09	0.76	114	8.65	2.70	0.70
RP	224	8.04	6.97 - 4.29 - 8.96 - 1.16 - 0.81	22.19	3.21	0.71	74	6.70	3.79	0.83	150	8.70	2.93	0.65
SA	2388	8.15	6.85 - 3.91 - 9.95 - 1.47 - 0.82	23.00	2.82	0.64	853	6.49	3.30	0.75	1535	9.07	2.56	0.58
SAR	1010	8.08	7.51 - 4.73 - 10.98 - 1.18 - 0.69	25.09	2.99	0.70	449	6.42	3.62	0.85	560	9.42	2.48	0.59
SPT	209	7.72	7.93 - 4.73 - 7.96 - 1.31 - 0.81	22.74	3.79	0.80	73	6.18	4.29	0.85	136	8.55	3.51	0.77
TP	349	7.87	7.50 - 4.47 - 9.62 - 1.03 - 0.59	23.21	3.53	0.76	106	6.22	4.23	0.85	243	8.58	3.23	0.72
WO	1706	8.00	6.61 - 3.88 - 9.43 - 1.18 - 0.65	21.75	3.06	0.69	685	6.25	3.74	0.82	1021	9.17	2.61	0.61

Table 26 examines more closely the relationship between the average CD at sprint and at route distances for each track. The last column shows the percentage decrease in average CD in going from sprints to routes. The tracks are sorted in order of decreasing % decrease. Those near the bottom, such as Sportsman's Park Prairie Meadows, display relatively small differences, while those near the top, such as the Meadowlands, Saratoga and Arlington Park, display relatively large differences. The reason for the variations in % decrease is not immediately obvious. However, the individual % decreases are characteristic of each track. In any case, the data tell us that sprinters at Prairie Meadows, for example, appear to have a much easier time moving up to routes than do sprinters at Saratoga, at least in terms of pedigree type. A relationship between speed and track surface may be implicated.

Table 26. Differences in Sprint and Route Average CD Values by Racetrack

TRACK	SPRINT ACD	ROUTE ACD	%DECREASE: SPRINTS TO ROUTES
MED	0.98	0.65	33.7%
SAR	0.85	0.59	30.6%
AP	0.87	0.61	29.9%
WO	0.82	0.61	25.6%
GG	0.90	0.67	25.6%
BEL	0.83	0.62	25.3%
DEL	0.85	0.64	24.7%
GP	0.83	0.63	24.1%
SA	0.75	0.58	22.7%
PIM	0.90	0.70	22.2%
AQU	0.86	0.67	22.1%
DMR	0.78	0.61	21.8%
RP	0.83	0.65	21.7%
MTH	0.88	0.69	21.6%
CRC	0.84	0.66	21.4%
CD	0.84	0.67	20.2%
LAD	0.91	0.73	19.8%
FPX	0.83	0.67	19.3%
KEE	0.79	0.64	19.0%
FG	0.80	0.65	18.8%
LRL	0.85	0.70	17.6%
OP	0.89	0.75	15.7%
MNR	0.77	0.65	15.6%
TP	0.85	0.72	15.3%
ELP	0.81	0.69	14.8%
HAW	0.82	0.70	14.6%
LS	0.75	0.65	13.3%
PHA	0.80	0.71	11.3%
SPT	0.85	0.77	9.4%
PRM	0.76	0.70	7.9%

Chapter 17

Pedigree and Performance: Claiming Horses

All of the data previously presented is derived from North American open stakes winners between 1983 and 2014. The emphasis on stakes winners is intentional, and with good reason. Stakes winners represent the highest level of Thoroughbred performance. Horses competing in stakes races are generally in better physical condition than those competing at lower levels. If physical problems do exist, the problems are likely better managed. Horses competing in stakes races are more consistent. If they stay healthy they can be expected to put in a competitive effort on a continual basis. Horses competing in stakes races will usually be suited to the particular race conditions. With larger purses on the line, and with a limited number of races in a horse's career, the connections of stakes horses tend to make management decisions that optimize opportunity. This isn't always the case at the lower end of the class structure. Cheaper horses are often raced into shape and their native talents easily can be obscured by chronic injury. Their form cycles are more erratic than those of their more gifted peers. Therefore, the intentions surrounding these runners are not always apparent. With stakes horses, on the other hand, there is an excellent probability that they belong in their race. By the time they are mature they will have found their best distance profile and most competitive racing class. They are in to win, or at least get a part of the purse. The result of superior talent that is well managed and purposefully intended is that the outcome of races involving those animals is a better reflection of their innate qualities. In other words, it is a reasonable assumption that stakes horses more accurately express their genetic potential than do horses running in claiming races. A secondary result is that the data obtained from their races is more reliable, and reliable data is absolutely critical if the objective is to develop a better appreciation of the relationship between pedigree and track performance. Nevertheless, it is instructive to see how well the Dosage model applies to the lower end of the racing spectrum.

Fortunately, such information is available through the efforts of Mr. John Denbleyker and his student research thesis in the Sports Management Program at St. Cloud State University in St. Cloud, Minnesota. Mr. Denbleyker investigated over 1500 claiming races in the years 2000 and 2001 at fourteen tracks: Arlington Park, Belmont Park, Calder, Churchill Downs, Del Mar, Ellis Park, Gulfsteam Park, Hollywood Park, Keeneland, Lone Star Park, Pimlico, Prairie Meadows, Santa Anita, and Saratoga. He calculated the Dosage figures for each of the winners and arranged the data according to racing category. His results, reproduced with his permission, are presented in Table 27. Included are the analogous data for just under 2000 open stakes races over the same time frame, allowing for a direct comparison.

Table 27. A Comparison of Claiming Horse and Stakes Horse Dosage Data (2000-2001)

CLAIMING HORSES (2000-2001):													
CATEGORY	RACES	DIST.	DP							PTS	ADI	ACD	CDI	CCD
ALL	1564	7.21	6.77	- 3.79 -	9.16	- 1.06 -	0.58			21.36	3.00	0.72	2.43	0.71
DIRT	1294	7.01	6.82	- 3.72 -	8.96	- 0.97 -	0.53			21.00	3.09	0.74	2.51	0.73
TURF	270	8.12	6.52	- 4.12 -	10.15	- 1.50 -	0.81			23.10	2.56	0.63	2.13	0.61
SPRINTS	857	6.21	6.99	- 3.76 -	8.64	- 0.89 -	0.48			20.76	3.23	0.77	2.65	0.77
ROUTES	707	8.42	6.51	- 3.83 -	9.79	- 1.27 -	0.71			22.11	2.73	0.66	2.22	0.64
TWO-YEAR-OLDS	71	6.32	5.68	- 3.06 -	7.94	- 0.92 -	0.54			18.14	2.71	0.69	2.34	0.68
THREE-YEAR-OLDS	514	7.12	6.50	- 3.81 -	9.17	- 0.93 -	0.50			20.91	2.99	0.72	2.48	0.71
OLDER RUNNERS	979	7.31	6.99	- 3.84 -	9.25	- 1.13 -	0.63			21.84	3.03	0.72	2.42	0.71
5.00 FURLONGS	40	5.00	7.08	- 3.18 -	7.98	- 0.93 -	0.25			19.42	3.83	0.86	2.76	0.82
5.50 FURLONGS	50	5.50	6.80	- 3.24 -	7.94	- 1.00 -	0.72			19.70	3.06	0.76	2.46	0.73
6.00 FURLONGS	447	6.00	7.11	- 3.68 -	8.38	- 0.88 -	0.40			20.45	3.26	0.79	2.74	0.79
6.50 FURLONGS	167	6.50	6.68	- 3.90 -	9.06	- 0.89 -	0.57			21.10	3.11	0.74	2.52	0.72
7.00 FURLONGS	141	7.00	7.21	- 4.13 -	9.42	- 0.86 -	0.61			22.23	3.18	0.75	2.60	0.74
8.00 FURLONGS	299	8.00	6.43	- 3.77 -	9.59	- 1.12 -	0.71			21.62	2.75	0.67	2.26	0.65
8.50 FURLONGS	291	8.50	6.49	- 3.79 -	9.77	- 1.34 -	0.67			22.06	2.77	0.66	2.20	0.64
9.00 FURLONGS	98	9.00	6.41	- 4.08 -	10.36	- 1.22 -	0.85			22.92	2.55	0.62	2.16	0.61
STAKES HORSES (2000-2001):														
CATEGORY	RACES	DIST.	DP							PTS	ADI	ACD	CDI	CCD
ALL	1999	8.01	6.92	- 3.88 -	10.42	- 1.17 -	0.68			23.07	2.81	0.67	2.27	0.66
DIRT	1332	7.65	7.20	- 3.85 -	9.70	- 0.98 -	0.57			22.29	3.08	0.74	2.49	0.72
TURF	667	8.75	6.37	- 3.93 -	11.85	- 1.56 -	0.91			24.62	2.26	0.54	1.93	0.54
SPRINTS	658	6.16	7.31	- 3.72 -	8.79	- 0.98 -	0.44			21.24	3.39	0.80	2.65	0.78
ROUTES	1341	8.92	6.73	- 3.95 -	11.22	- 1.26 -	0.80			23.97	2.52	0.61	2.12	0.61
TWO-YEAR-OLDS	259	7.01	6.69	- 3.46 -	8.45	- 0.80 -	0.46			19.85	3.36	0.77	2.62	0.76
THREE-YEAR-OLDS	590	8.14	7.07	- 3.99 -	10.82	- 1.14 -	0.59			23.61	2.79	0.69	2.31	0.67
OLDER RUNNERS	1150	8.17	6.90	- 3.91 -	10.66	- 1.27 -	0.78			23.52	2.69	0.65	2.19	0.63
5.50 FURLONGS	54	6.00	6.52	- 3.89 -	8.09	- 1.22 -	0.50			20.22	3.56	0.72	2.51	0.73
6.00 FURLONGS	325	6.50	7.80	- 3.94 -	9.70	- 0.97 -	0.41			22.82	3.56	0.82	2.66	0.78
6.50 FURLONGS	66	7.00	7.52	- 3.81 -	9.11	- 0.81 -	0.44			21.68	3.33	0.82	2.74	0.79
7.00 FURLONGS	140	8.00	6.50	- 3.84 -	10.64	- 1.19 -	0.66			22.83	2.57	0.63	2.19	0.63
8.00 FURLONGS	254	8.50	6.84	- 3.93 -	10.72	- 1.10 -	0.69			23.30	2.65	0.66	2.25	0.65
8.50 FURLONGS	458	9.00	6.92	- 4.04 -	11.33	- 1.27 -	0.79			24.34	2.52	0.62	2.15	0.62
9.00 FURLONGS	391	10.00	6.96	- 4.00 -	13.77	- 1.41 -	0.95			27.09	2.16	0.52	1.93	0.54
10.00 FURLONGS	79	11.00	6.31	- 3.90 -	13.15	- 2.15 -	1.42			26.92	2.12	0.47	1.66	0.43
12.00 FURLONGS	58	12.00	5.43	- 4.00 -	12.10	- 2.14 -	1.50			25.17	1.82	0.37	1.60	0.39

Data from Table 27 are shown graphically in Charts 20 and 21. Chart 20 plots the average DI for the winning claiming horses and the stakes winners against the average winning distance. Chart 21 does the same for the average CD. Again, the Dosage figure versus distance graph is a visual display of the fundamental Dosage model.

Chart 20. Average DI vs. Distance for Claimers and Stakes Winners

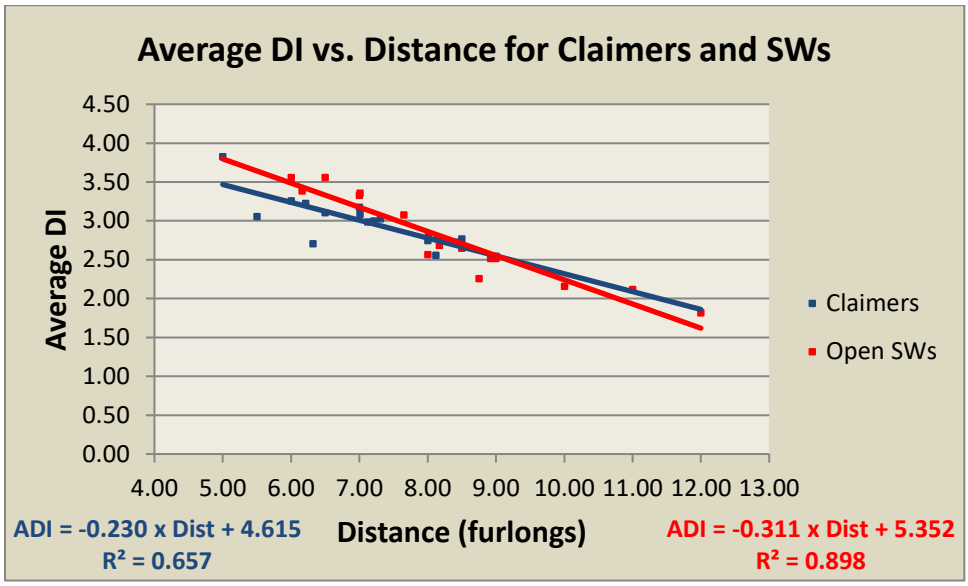
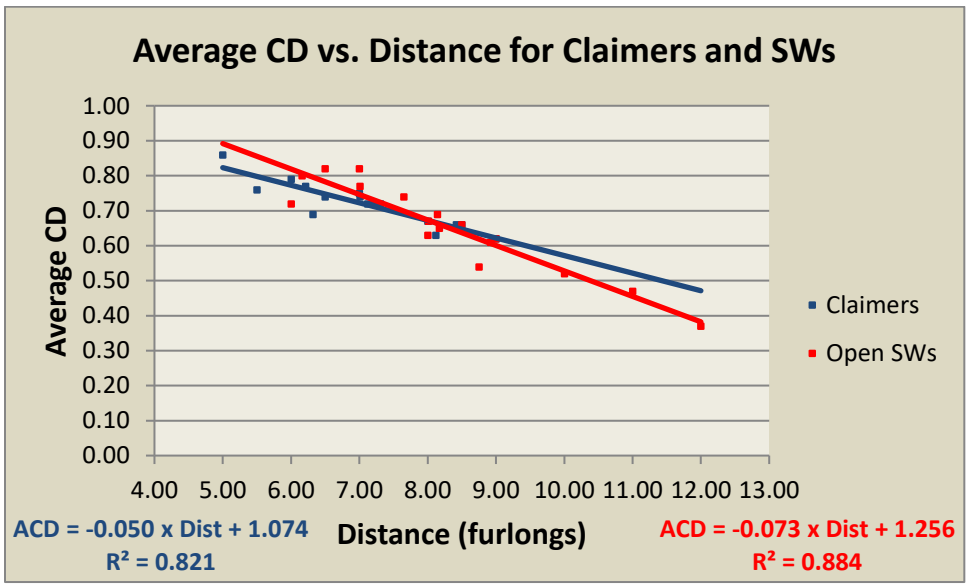


Chart 21. Average CD vs. Distance for Claimers and Stakes Winners



The graphical output of the data is unequivocal. The general Dosage model applies to runners at the lower end of the class ladder as it does to stakes winners. Also as expected, for reasons outlined above, we find a better fit of the data for the stakes winners. This observation is confirmed by their higher R-squared values, both in the DI and the CD plot.

As Mr. Denbleyker summarizes in his thesis, "the claiming-level race winners' relationship between DI or CD and average winning distance measures up well to that of open stakes winners. The statistically significant negative linear correlation holds up for the claiming horses…as well with respect to pedigree/performance. While expected to have more scatter and less associative strength than open stakes winners, the claiming-level race winners R-squares…for the DI and CD establish that such a pedigree/performance relationship holds also for a wider population of racehorses than just a highly selected subset of it."

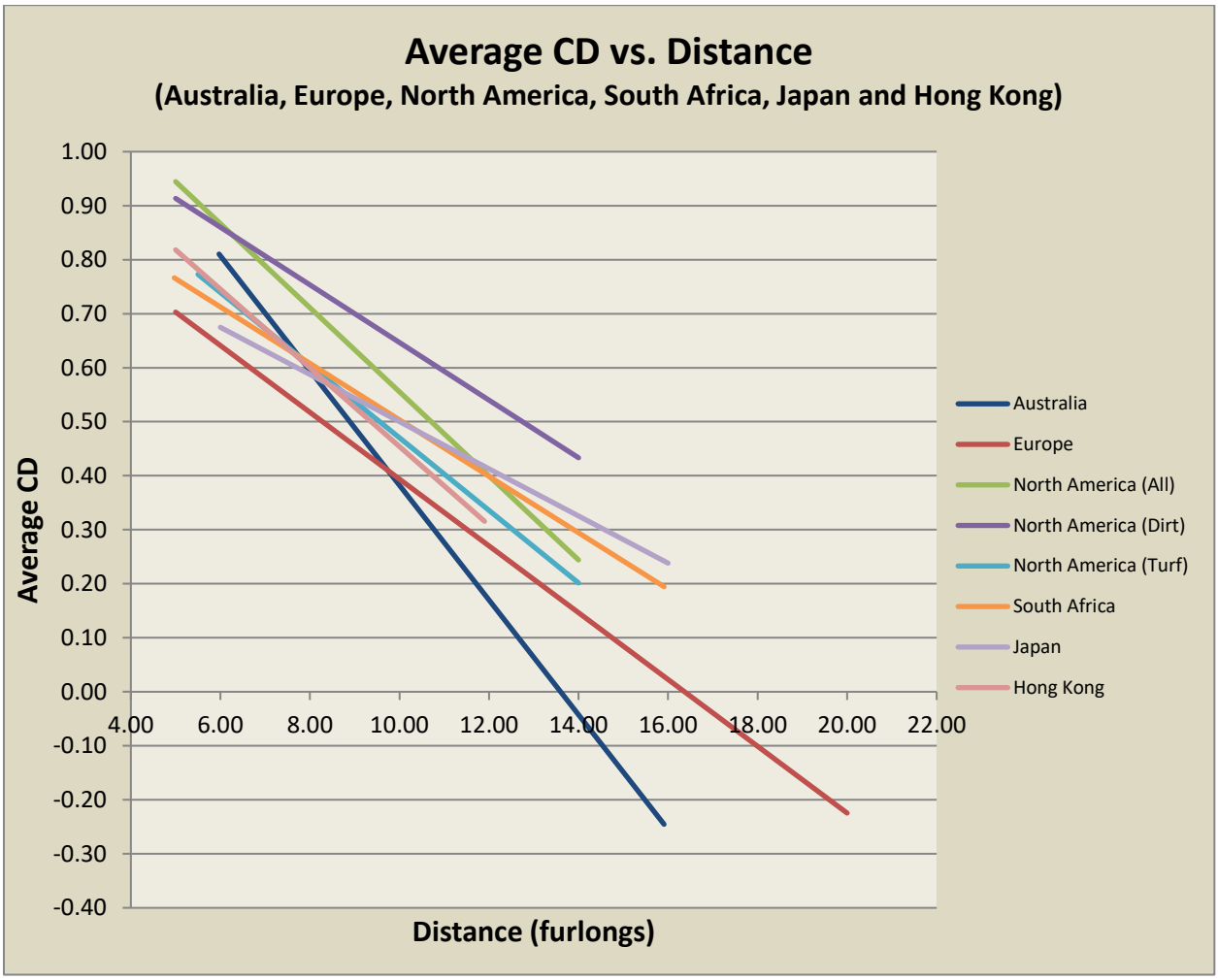
Chapter 18

The Universality of Dosage

Contemporary Dosage methodology has its largest following in North America, with the vast majority of data collected in support of Dosage coming from races run in the United States and Canada. The analysis and interpretation of that data built the foundation for most of Dosage's applications. Nevertheless, the general utility of Dosage as a pedigree classification technique requires a broader geographic scope, especially as borders and oceans no longer present barriers to international competition. As it happens, there are Thoroughbred pedigree researchers in other parts of the world who have an intense interest in the subject and whose contributions have increased our understanding of Dosage's universality. Among them is Mr. Steve Miller from the UK who has been instrumental in identifying modern day European-based sires for inclusion on the *chef-de-race* list. Mr. John Hutchinson in Australia has gone so far as to create a supplementary *chef-de-race* list specifically for racing in Australia and New Zealand. Similar efforts are under way in other parts of the world as well, including South America.

In order to demonstrate the relevance of Dosage across a range of racing venues, it is necessary to generate data for other locations similar to those generated in North America. This task involves the calculation of Dosage figures for the winners of races over a range of distances in other countries and on other continents, followed by an analysis to determine whether the data fit the model already established for North America. The results of such a study conducted in the year 2001 are presented in Chart 21. The chart graphically displays the relationship between the average CD of major race winners in North America, Europe, Australia, Japan, Hong Kong and South Africa with the average distance of the races won. The model holds for every venue with some variation in the slope of the lines. This variation is probably due to differences in the character of the racing surfaces throughout the racing world. Nevertheless, the direct relationship between Dosage and distance is confirmed on a global basis. Undoubtedly the data would improve if regional *chefs-de-race* were identified and included in the calculations. As noted below, this is the case for the Australian racing data. Otherwise, the data were generated using only the North American list of *chefs-de-race* at the time the data were generated in 2001. We will shortly see the value of applying regional *chefs-de-race* in a more advanced study of South African racing.

Chart 22. Dosage in North America, Europe, Australia, Japan, Hong Kong and South Africa



The North American data (additionally separated by racing surface) include Grade 1 stakes between 1990 and 2001. The European data come from 38 annual Group events in England, Ireland and France also from 1990 to 2001. The Australian data were obtained from John Hutchinson and include data for five Group 1 races through 2001, three since 1960 and two since 1980. In this particular case, the CDs were calculated using Mr. Hutchinson's amended *chef-de-race* list. The Hong Kong data include five Group 1 races between 2000 and 2010. Finally, the Japanese data are for all Group 1 races between 1990 and 2001 while the South African data include 20 Group 1 races, also between 1990 and 2001. The plot shows the relationship between the average CD of the winners and the average distance of the races over the timeframes involved. The straight lines were generated by linear regression performed on each data series.

One aspect of the South African study is particularly enlightening because it confirms the principle that Dosage is directly related to the distance influence of individual sires in the pedigree, despite the contrary view espoused by

Varola. The data series for South African racing as illustrated in Chart 22 was based on the published current *chef-de-race* list as of 2002. However, data available from South Africa allowed us to modify the *chef-de-race* list to include influential sires from that region of the world as provisional *chefs-de-race*. The South African Thoroughbred journal, Racing Record, publishes a document called "Stamina Influence of Sires" in their Sires Handbook. This document lists scores of South African sires along with the winning distance ranges of their successful progeny. Five distance ranges are defined: 1000 to 1300 meters, 1400 and 1500 meters, 1600 to 1800 meters, 1900 to 2200 meters and 2300 meters or more. For this exercise we may consider these ranges as areas along the speed/stamina spectrum. Consequently we associated the 1000 to 1300 meter range with the Brilliant aptitudinal group within a DP. In similar fashion, 1400 and 1500 meters is associated with Intermediate, 1600 to 1800 meters is associated with Classic, 1900 to 2200 meters is associated with Solid and 2300 meters or more is associated with Professional. These assignments do not imply a rigorous correlation; however, they are convenient for our purpose. The "average" South African sire had 38% winners in the 1000 to 1300 meter range, 15% in the 1400 to 1500 meter range, 29% in the 1600-1800 meter range and 5% in the 2300 meters or more range. If we arrange these percentages as 38-15-29-13-5, they take on the general appearance of a DP analogous to 38 points in B, 15 points in I, 29 points in C, 13 points in S and 5 points in P. This DP format then allows us to calculate the equivalent of a CD using the standard formula. In the example, 38-15-29-13-5 equals a "CD" of 0.68. We can then do the same for each of the South African sires. The two examples shown below are for Harry Hotspur (SAF), 1971 (Mexico (GB)-Saturna (SAF), by Silver Tor (IRE)) and Rakeen, 1987 (Northern Dancer (CAN)-Glorious Song (CAN), by Halo (USA)).

	Wins	1000 - 1300m	1400 - 1500m	1600 - 1800m	1900 - 2200m	2300m+
Distance Range		38%	15%	29%	13%	5%
Harry Hotspur	724	80%	10%	8%	2%	1%
Rakeen	253	8%	10%	40%	28%	14%

Average"CD"	((2 x 38) + 15 -13 - (2 x 5))/100 =	68/100 =	0.68
Harry Hotspur "CD"	((2 x 80) + 10 - 2 - (2 x 1))/101 =	166/101 =	1.64
Rakeen "CD"	((2 x 8) + 10 -28 - (2 x 14))/100 =	-30/100 =	-0.30

We calculated a "CD" for all of the sires on the list, after which we sorted the sires by decreasing "CD" to generate another list with the most speed oriented at the top and the most stamina oriented at the bottom. Limiting the number of sires to those with at least 200 progeny wins, we assigned notional *chef-de-race* categories to each sire depending on his position on the list. Table 28 shows the sires in descending order of "CD" along with the notional *chef-de-race* assignment.

Table 28. Provisional South African *chefs-de-race*

SIRE	"B"	"I"	"C"	"S"	"P"	"CD"	CDR ASSIGNMENT
Song of Songs	81	10	8	2	0	1.68	B
Harry Hotspur	80	10	8	2	1	1.64	B
Golden Thatch	76	12	10	2	0	1.62	B
Mexico II	73	15	10	1	0	1.62	B
Argosy	65	18	14	3	0	1.45	B
Caerdeon	68	13	15	3	1	1.44	B
Rocky Marriage	68	15	12	3	2	1.44	B
Waterville Lake	64	16	17	4	0	1.39	B
National Assembly	61	16	17	5	0	1.34	B
Sunny North	52	19	21	4	3	1.14	B/I
Divine King	57	11	21	11	0	1.14	B/I
Hard Up	53	15	23	7	1	1.13	B/I
Comic Blush	51	19	23	6	1	1.13	B/I
Mistral Dancer	53	13	23	9	1	1.09	B/I
Peaceable Kingdom	49	17	26	8	0	1.07	B/I
Phantom Earl	45	23	23	7	1	1.05	B/I
Qui Danzig	50	17	24	6	3	1.05	B/I
Proclaim	48	22	20	6	4	1.04	B/I
Jallad	46	17	29	6	1	1.02	B/I
Folmar	46	21	23	8	2	1.01	B/I
Fine Edge	47	17	27	7	2	1.00	B/I
All Fired Up	48	18	24	8	3	0.99	I
Best By Test	50	16	23	8	4	0.99	I
Freedom Land	45	19	28	6	2	0.99	I
Really and Truly	45	17	25	8	4	0.92	B/C
On Stage	48	12	26	11	3	0.91	B/C
Centenary	38	23	27	11	0	0.89	B/C
Complete Warrior	40	19	31	9	1	0.88	B/C
Piaffer	39	26	24	6	5	0.88	B/C
Shoe Danzig	42	17	30	9	2	0.88	B/C
Damascus Gate	44	19	24	9	5	0.87	B/C
Lords	44	17	23	10	5	0.86	B/C
Lost Chord	42	14	28	12	3	0.81	I/C
Russian Fox	39	21	23	15	2	0.8	I/C
Rainbow Dream	42	15	26	11	5	0.79	I/C
Northern Guest	37	19	32	9	4	0.75	I/C
Tilden	45	7	32	10	6	0.75	I/C
Averof	37	19	28	12	4	0.73	I/C
ALL	38	15	29	13	5	0.68	I/C
Al Mufti	32	18	38	9	3	0.67	I/C
Volcanic	31	18	37	12	1	0.67	I/C
Only a Pound	32	18	38	11	2	0.66	I/C
Jungle Cove	35	15	34	15	2	0.65	I/C
Elliodor	32	18	33	14	4	0.59	C
The Eliminator	33	15	32	18	2	0.59	C

Table 28. Provisional South African *chefs-de-race*, cont.

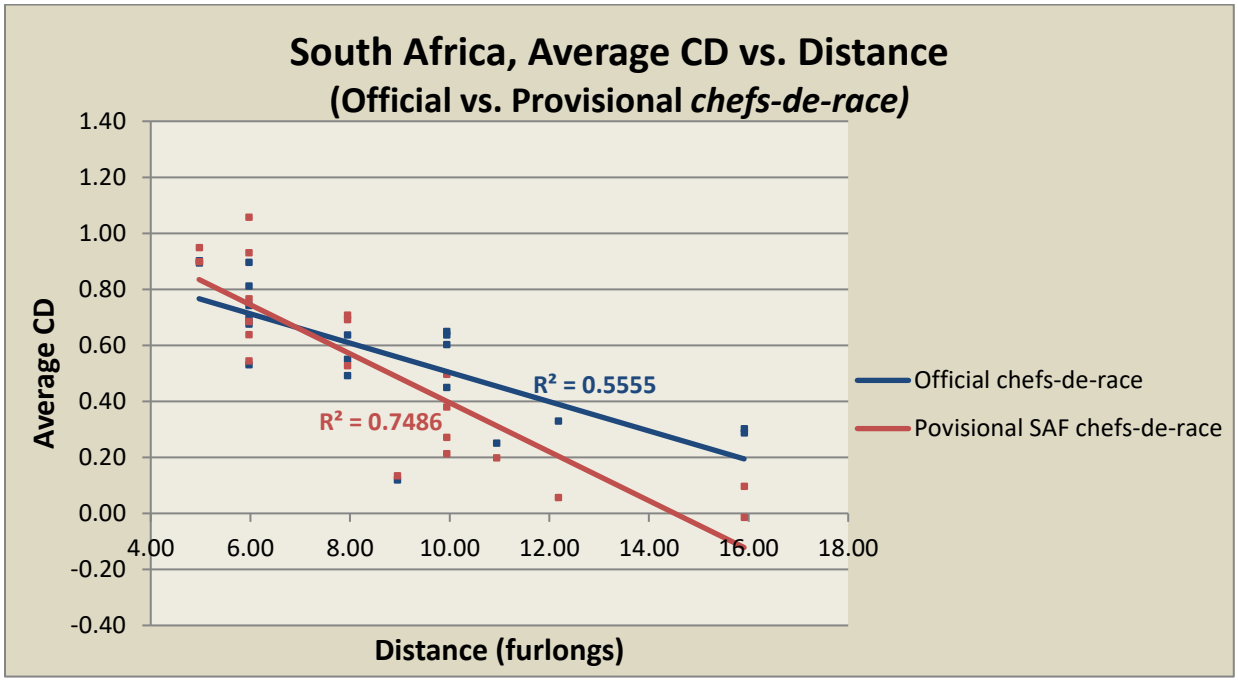
SIRE	"B"	"I"	"C"	"S"	"P"	"CD"	CDR ASSIGNMENT
Esplendor	32	21	26	17	5	0.57	C
Home Guard	36	13	33	11	8	0.57	C
Steady Beat	28	18	39	13	2	0.57	C
Secret Prospector	27	19	38	13	3	0.54	C
Fair Season	30	18	31	16	5	0.52	C
Dancing Champ	29	18	34	16	4	0.51	C
Model Man	26	20	35	16	3	0.50	C
Over the Air	34	12	28	19	7	0.47	C/S
Our Casey's Boy	30	15	33	18	5	0.47	C/S
Royal Chalice	24	17	40	12	6	0.41	C/S
Royal Prerogative	24	17	35	20	4	0.37	C/S
Northfields	26	13	37	19	6	0.34	C/S
Foveros	28	13	32	18	9	0.33	C/S
Truly Nureyev	28	12	30	25	5	0.33	C/S
Badger Land	20	16	40	18	5	0.28	C/S
Roland Gardens	22	15	35	21	6	0.26	C/S
Peacetime	25	13	31	20	9	0.26	C/S
Lucy's Axe	18	15	41	17	10	0.14	S
Elevation	19	13	35	25	7	0.12	S
Condorcet	15	15	37	26	7	0.05	C/P
Politician	22	11	28	26	13	0.03	C/P
Coastal	18	12	33	24	13	-0.02	C/P
Dolpour	9	8	51	25	7	-0.13	S/P
Concertino	16	9	34	25	17	-0.18	S/P
Rakeen	8	10	40	28	14	-0.30	P
Del Sarto	9	10	37	28	16	-0.32	P
Hobnob	9	8	34	31	18	-0.41	P

Finally, we used the new South African modified *chef-de-race* list to recalculate the Dosage figures for the South African Group 1 races examined in the initial evaluation. Chart 22 presents the results of the "CD" vs. distance study for both the original case and the "improved" case using notional South African *chefs-de-race*. Two things have occurred. First, the slope of the linear regression trend line has increased. The significance of an increased slope is greater separation of Dosage figures by distance. The original case indicates a span of just under 0.6 CD units over a distance range of five to sixteen furlongs. The addition of South African *chefs-de-race* increases the CD span to over 0.9 CD units for the same distance range. Greater separation of populations by Dosage figures implies increased accuracy in aptitudinal pedigree classification. Second, the R^2-value has risen from 0.556 to 0.749. The higher the R^2-value, the better the correlation between Dosage figures and distance.

The increase in slope and the improved correlation both confirm that applying a sire's progeny distance profile is a useful and appropriate method of identifying aptitudinal prepotence. It further suggests that similar techniques can

be used internationally to enhance the utility of Dosage on a global scale. It also suggests that Varola was wrong when he insisted Dosage and distance potential were unrelated. Recall that the original contemporary Dosage studies utilized Varola's own *chefs-de-race* as complemented by Hewitt for application to American racing.

Chart 23. "Improved" Correlation When Applying Provisional South African *chefs-de-race*



It is immediately obvious that the Dosage model holds not only for North America but for Europe, Japan, Australia and South Africa as well. The inverse relationship between Dosage figures and distance transcends racing surfaces, nations, continents and hemispheres. Of particular interest is the closeness of the trend lines for European races and for North American races on the turf.

Chapter 19

Inbreeding in *Chefs-de-race*, Their Sires and Their Dams

As noted in Chapter 2 Jones and Bogart, in "Genetics of the Horse" (Edwards Brothers, Inc., Ann Arbor, Michigan, 1971), define inbreeding as the mating of two individuals more closely related than the average of the breed. They highly recommend that serious breeders know the amount of inbreeding in their stock in order to appreciate the rate at which homozygosity is developing, homozygosity being the condition where genes inherited from the sire and the dam are alike. The amount of inbreeding estimates the percentage of genes put in a homozygous condition. This estimate is always less than the actual because records will not allow for every relationship that exists. Horses that are highly homozygous tend to stamp their own characteristics on their offspring, a phenomenon often called "prepotency". Prepotency also may be considered a regular or predictable transmission of particular traits.

The amount of inbreeding can be calculated using a formula proposed by Wright in 1923 (Mendelian Analysis of the Pure Breeds of Livestock, J. Hered. 14:339-348). Wright's formula generates a fraction (the coefficient of inbreeding) which, when multiplied by 100, affords the amount of inbreeding as a percentage. Wright's equation is:

$$F_X = \sum\left[(1/2)^{n_1+n_2+1}(1 + F_A)\right]$$

where F_X is the inbreeding coefficient of the horse in question, F_A is the inbreeding coefficient of the common ancestor, n_1 is the number of generations from the sire to the common ancestor, and n_2 is the number of generations from the dam to the common ancestor.

The information below includes Wright's Six-Generation Inbreeding Coefficient (6-Gen IC) expressed as a percentage for 217 *chefs-de-race* as well as for their sires and their dams. The raw data are preceded by some general statistics.

Observations

The general trend of inbreeding percentage among *chefs-de-race* declined steadily from the late 19th century until it began to level off among *chefs-de-race* born after the mid-20th century. This trend is displayed in Chart 24. The approximate overall rate at which inbreeding among *chefs-de-race* has declined since the late 19th century until the present time is 0.019% per year, although as noted, the decline is non-linear. Whether the pattern found among *chefs-de-race* represents the pattern found among all Thoroughbreds is not known. Chart 25 shows the decrease in inbreeding among *chefs-de-race* born within discreet time frames (before 1920; 1920 to 1929; 1930 to

1939; 1940 to 1949; 1950 to 1959; 1960 to 1969 and since 1969) using the median 6-Gen IC within each time segment. Here we use the median figure because the sample sets are small and the median deemphasizes data points very far from the average. This avoids a situation in which one outlying data point can significantly skew the average. The chart shows a similar pattern for annual leading earners since 1902, although the slope is flatter and corresponds to an annual decrease in inbreeding among these runners of 0.007 percent per year. Also, within every time frame, inbreeding among *chefs-de-race* is greater than inbreeding among the runners.

Chart 24. Inbreeding in *Chefs-de-Race*, Part 1

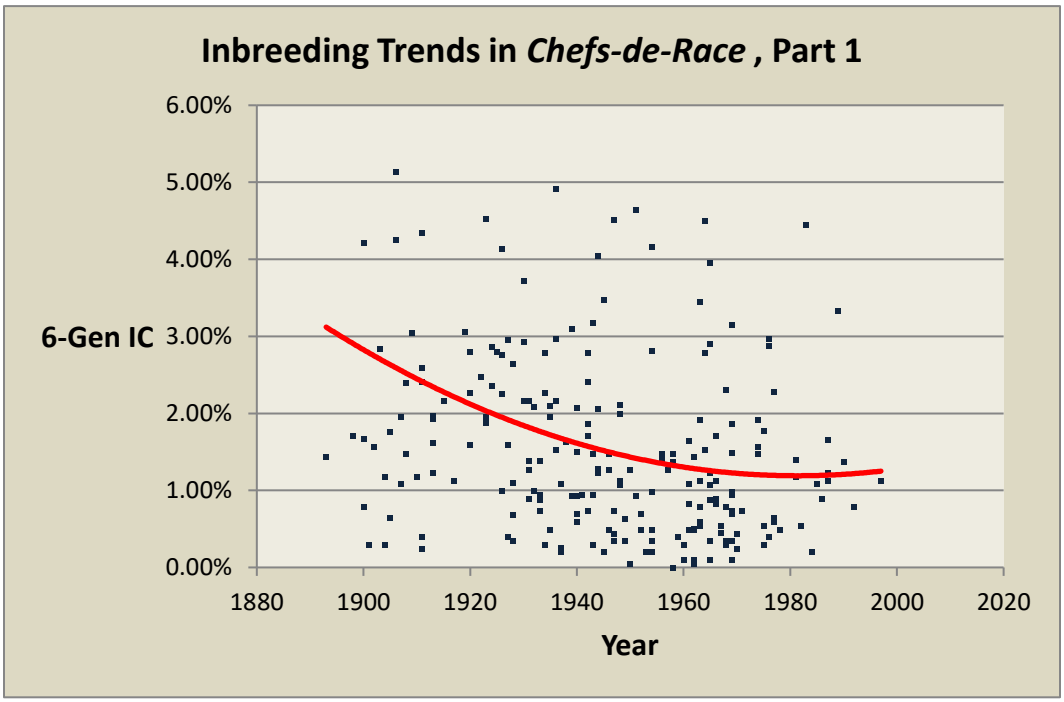
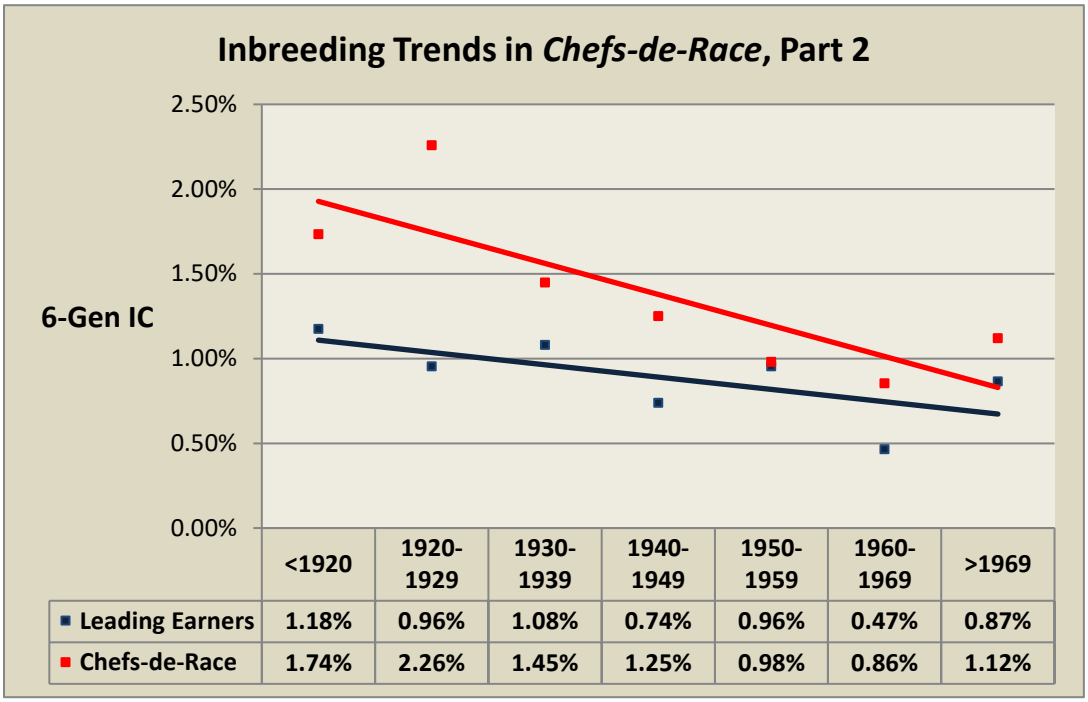


Chart 25. Inbreeding in Chefs-de-Race, Part 2



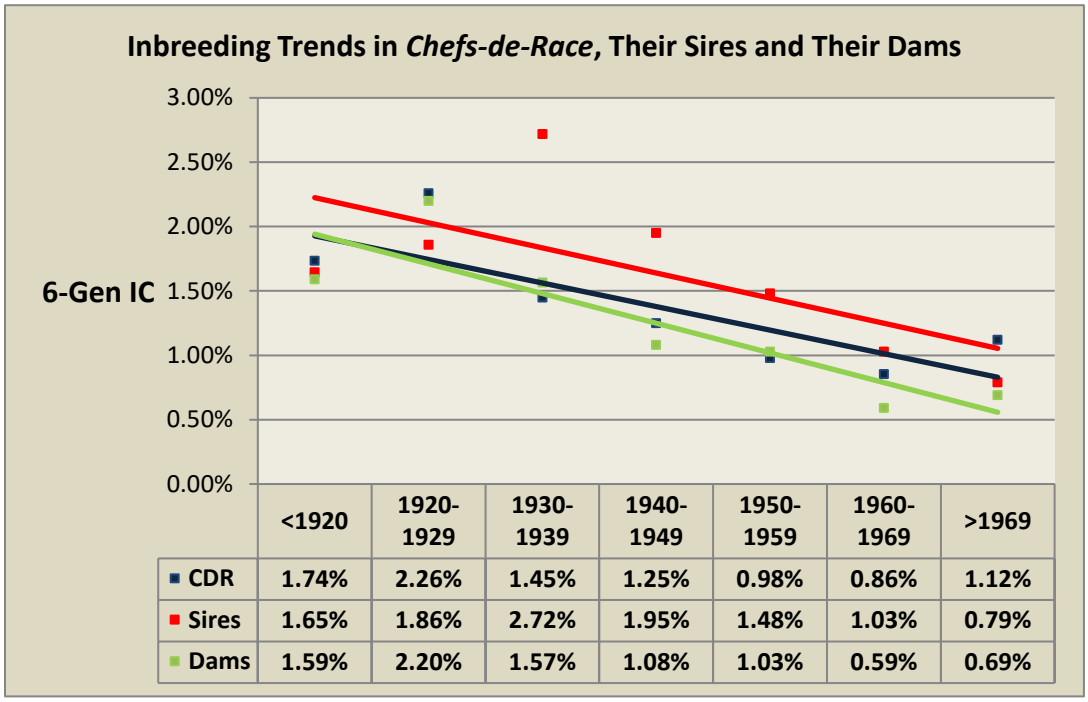
	<1920	1920-1929	1930-1939	1940-1949	1950-1959	1960-1969	>1969
Leading Earners	1.18%	0.96%	1.08%	0.74%	0.96%	0.47%	0.87%
Chefs-de-Race	1.74%	2.26%	1.45%	1.25%	0.98%	0.86%	1.12%

The amount of inbreeding found among *chefs-de-race* covers the range from over 14% for Ultimus down to 0% for Speak John, with some of the most influential stallions being found at both ends of the spectrum. For example, Havresac II (a key link to Ribot) and Bayardo (a key link to Hyperion) are among the most highly inbred, while Native Dancer (a close up ancestor of Raise a Native, Mr. Prospector and Northern Dancer) is among the least inbred.

Arguably, the best runners among the *chefs-de-race* are Secretariat (0.24%), Man o' War (1.13%), Ribot (0.69%), Nearco (1.95%) and Sea-Bird (0.49%). All except Nearco are inbred below the average or median percentage of inbreeding for the time frame in which they were foaled.

There is no significant pattern covering the relationship between inbreeding in the *chefs-de-race* and inbreeding in their parents. Most (82, 37.8%) are more inbred than one parent while 67 (30.9%) are less inbred than either parent and 64 (29.5%) are more inbred than either parent. The remaining 4 (1.8%) are inbred the same as one parent. Chart 26, again using median 6-Gen ICs for each time period, displays a similar decline in the percentage of inbreeding over time for the *chefs-de-race*, their sires and their dams, with the decline rates being 0.018% per year for *chefs-de-race*, 0.020% per year for their sires and 0.023% per year for their dams.

Chart 26. Inbreeding Trends in *Chefs-de-Race*, Their Sires and Their Dams



	<1920	1920-1929	1930-1939	1940-1949	1950-1959	1960-1969	>1969
CDR	1.74%	2.26%	1.45%	1.25%	0.98%	0.86%	1.12%
Sires	1.65%	1.86%	2.72%	1.95%	1.48%	1.03%	0.79%
Dams	1.59%	2.20%	1.57%	1.08%	1.03%	0.59%	0.69%

For 58.5% of the *chefs-de-race* (127), their sire is more highly inbred than their dam. For 40.6% of the *chefs-de-race* (88), the reverse is true. There are two examples (0.9%) where the sire and dam of the *chef-de-race* exhibit the same level of inbreeding.

There are observable differences in inbreeding among *chefs-de-race* sorted by aptitudinal contribution; however, these differences are not statistically significant.

The data clearly show that inbreeding among *chefs-de-race* and high end performers has decreased over the last century. What is not clear at this time is whether the greater inbreeding among *chefs-de-race* compared to the runners actually contributes to their ability to transmit consistent aptitudinal type to their descendants. It also is not clear whether the decrease in inbreeding among *chefs-de-race* has leveled off permanently in recent years or is a temporary situation. Note, however, that for both *chefs-de-race* and for the runners, the median 6-Gen IC has increased for those foaled between 1960 and 1969 and those foaled afterwards.

General Statistics

Average 6-Gen IC of all *chefs-de-race*: 1.64%
Average 6-Gen IC of the sires of all *chefs-de-race*: 1.76%
Average 6-Gen IC of the dams of all *chefs-de-race*: 1.65%

Photo Courtesy of Dell Hancock

Secretariat

DP 20-14-7-9-0, DI 3.00, CD 0.90

Secretariat, ch.c., 1970	**Bold Ruler (B/I)**	**Nasrullah (B)**	**Nearco (B/C)**	**Pharos (I)**
				Nogara
			Mumtaz Begum	**Blenheim II (C/S)**
				Mumtaz Mahal
		Miss Disco	**Discovery (S)**	Display
				Ariadne
			Outdone	**Pompey (B)**
				Sweep Out
	Somethingroyal	**Princequillo (I/S)**	**Prince Rose (C)**	Rose Prince
				Indolence
			Cosquilla	Papyrus
				Quick Thought
		Imperatrice	Caruso	Polymelian
				Sweet Music
			Cinquepace	Brown Bud
				Assignation

	DP Contribution	Equivalent to:	
Sire	20-10- 3- 5- 0	DI 4.85	CD 1.18
Dam	0- 4- 4- 4- 0	DI 1.00	CD 0.00

Intermediate/Classic *chef-de-race* Secretariat, ch.c., 1970 (Bold Ruler-Somethingroyal, by Princequillo) is considered by many to be the greatest Thoroughbred racehorse of all time. A Triple Crown winner and Horse-of-the-Year at two and three, his accomplishments are legendary and transcend the achievements of mere mortal horses. He is the product of breeding the brilliant speed of his sire, Brilliant/Intermediate *chef-de-race* Bold Ruler, to the classic stamina of his dam, resulting in DP 20-14-7-9-0, DI 3.00 and CD 0.90. Although it may seem that the figures are high by classic standards, the DI is well within classic guidelines and the CD captures his potential for speed. That speed is convincingly expressed in his fractions during the unforgettable 1973 Belmont Stakes which he won on the pace by an amazing 31 lengths: a half in :46.1; three-quarters in 1:09.4; a mile in 1:34.1; a mile and a quarter in 1:59 flat; and a mile and a half in 2:24 flat. These are previously unheard of fractions in a race of that distance. Later in the year, he clocked a mile in 1:33 flat *en route* to a world record 1:45.2 against older horses in

the nine-furlong Marlboro Cup Handicap. Secretariat won from six furlongs to a mile and five eighths, on dirt and on grass, from dead last and wire-to-wire. Although his style was versatile, he had awesome speed when called upon to use it.

% Inbreeding over Time

Average 6-Gen IC of *chefs-de-race* born 1893-1919: 2.62%
Average 6-Gen IC of *chefs-de-race* born 1920-1929: 2.16%
Average 6-Gen IC of *chefs-de-race* born 1930-1939: 1.70%
Average 6-Gen IC of *chefs-de-race* born 1940-1949: 1.50%
Average 6-Gen IC of *chefs-de-race* born 1950-1959: 1.24%
Average 6-Gen IC of *chefs-de-race* born 1960-1969: 1.18%
Average 6-Gen IC of *chefs-de-race* born 1970-1997: 1.30%

***Chefs-de-Race* with the Highest 6-Gen IC**

Ultimus: 14.32%
Havresac II: 12.71%
Bayardo: 5.13%
Heliopolis: 4.91%
Turn-to: 4.64%
Colorado: 4.52%
Mossborough: 4.51%
In Reality: 4.50%
Broad Brush: 4.45%
The Tetrarch: 4.35%

***Chefs-de-Race* with the Lowest 6-Gen IC**

Speak John: 0.00%
Native Dancer: 0.05%
Reliance II: 0.05%
Bold Bidder: 0.10%
King's Bishop: 0.10%
Relko: 0.10%
Stage Door Johnny:0.10%
Roman: 0.20%
My Babu: 0.20%
Lost Code: 0.20%
Prince John: 0.20%
Promised Land: 0.20%

Inbreeding in Chefs-de-Race Relative to Their Sire and Dam

Chefs-de-race with 6-Gen IC < 6-Gen IC of either sire or dam: 67 (30.9%)
Chefs-de-race with 6-Gen IC > 6-Gen IC of either sire or dam: 64 (29.5%)
Chefs-de-race with 6-Gen IC > 6-Gen IC in sire and < 6-Gen IC in dam: 34 (15.7%)
Chefs-de-race with 6-Gen IC < 6-Gen IC in sire and > 6-Gen IC in dam: 48 (22.1%)
Chefs-de-race with 6-Gen IC = 6-Gen IC in either sire or dam: 4 (1.8%)

% Inbreeding in Chefs-de-Race by Aptitudinal Group Representation

Average 6-Gen IC for *chefs-de-race* in Brilliant: 1.74%
Average 6-Gen IC for *chefs-de-race* in Intermediate: 1.64%
Average 6-Gen IC for *chefs-de-race* in Classic: 1.40%
Average 6-Gen IC for *chefs-de-race* in Solid: 1.41%
Average 6-Gen IC for *chefs-de-race* in Professional: 1.60%

Top runners among *chefs-de-race* that were inbred below the average percentage for the timeframe in which they were foaled.

Photo Courtesy of ?

Secretariat 0.24%

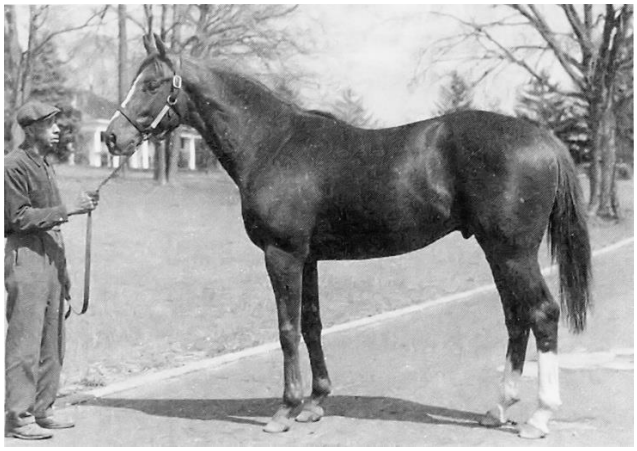


Photo Courtesy of the Keeneland Library

Sea-Bird II 0.49%

Photo Courtesy of the Keeneland Library

Ribot 0.69%

Photo Courtesy of the Keeneland Library

Man o' War 1.13%

CHEF-DE-RACE	YEAR	6-GEN IC	SIRE	6-GEN IC	DAM	6-GEN IC
A.P. Indy (I/C)	1989	3.33%	Seattle Slew	1.57%	Weekend Surprise	3.57%
Abernant (B)	1946	0.49%	Owen Tudor	3.72%	Rustom Mahal	0.15%
Ack Ack (I/C)	1966	0.89%	Battle Joined	1.76%	Fast Turn	1.71%
Admiral Drake (P)	1931	1.38%	Craig An Eran	1.22%	Plucky Liege	1.37%
Alcantara II (P)	1908	1.47%	Perth	2.99%	Toison d'Or	2.02%
Alibhai (C)	1938	1.63%	Hyperion	3.72%	Teresina	0.68%
Alizier (P)	1947	0.34%	Teleferique	1.18%	Alizarine	0.73%
Alycidon (P)	1945	3.47%	Donatello II	2.27%	Aurora	3.48%
Alydar (C)	1975	0.54%	Raise A Native	0.83%	Sweet Tooth	5.14%
Apalachee (B)	1971	0.74%	Round Table	0.98%	Moccasin	0.79%
Asterus (S)	1923	1.88%	Teddy	1.97%	Astrella	0.85%
Aureole (C)	1950	1.27%	Hyperion	3.72%	Angelola	1.62%
Bachelor's Double (S)	1906	4.25%	Tredennis	2.64%	Lady Bawn	2.20%
Bahram (C)	1932	2.08%	Blandford	3.06%	Friar's Daughter	3.74%
Baldski (B/I)	1974	1.92%	Nijinsky II	0.54%	Too Bald	7.18%
Ballymoss (S)	1954	2.81%	Mossborough	4.51%	Indian Call	1.87%
Bayardo (P)	1906	5.13%	Bay Ronald	1.62%	Galicia	0.98%
Ben Brush (I)	1893	1.43%	Bramble	0.79%	Roseville	0.88%
Best Turn (C)	1966	1.13%	Turn-to	4.64%	Sweet Clementine	0.73%
Big Game (I)	1939	3.09%	Bahram	2.08%	Myrobella	1.29%
Black Toney (B/I)	1911	0.39%	Peter Pan	0.29%	Belgravia	1.81%
Blandford (C)	1919	3.06%	Swynford	1.08%	Blanche	3.32%
Blenheim II (C/S)	1927	2.95%	Blandford	3.06%	Malva	1.75%
Blue Larkspur (C)	1926	2.25%	Black Servant	0.44%	Blossom Time	0.73%
Blushing Groom (B/C)	1974	1.48%	Red God	1.81%	Runaway Bride	2.40%
Bois Roussel (S)	1935	2.10%	Vatout	4.13%	Plucky Liege	1.37%
Bold Bidder (I/C)	1962	0.10%	Bold Ruler	0.49%	High Bid	1.37%
Bold Ruckus (I/C)	1976	2.87%	Boldnesian	0.93%	Raise A Ruckus	1.23%
Bold Ruler (B/I)	1954	0.49%	Nasrullah	0.69%	Miss Disco	0.30%
Brantome (C)	1931	0.89%	Blandford	3.06%	Vitamine	1.91%
British Empire (B)	1937	1.08%	Colombo	3.71%	Rose Of England	1.42%
Broad Brush (I/C)	1983	4.45%	Ack Ack	0.89%	Hay Patcher	0.69%
Broomstick (I)	1901	0.29%	Ben Brush	1.43%	Elf	1.13%
Bruleur (P)	1910	1.18%	Chouberski	0.39%	Basse Terre	3.03%
Buckaroo (B/I)	1975	1.77%	Buckpasser	1.13%	Stepping High	0.30%
Buckpasser (C)	1963	1.13%	Tom Fool	0.63%	Busanda	0.59%
Bull Dog (B)	1927	1.59%	Teddy	1.97%	Plucky Liege	1.37%
Bull Lea (C)	1935	0.49%	Bull Dog	1.59%	Rose Leaves	0.93%
Busted (S)	1963	0.54%	Crepello	0.34%	Sans Le Sou	0.05%
Caro (I/C)	1967	0.45%	Fortino II	0.78%	Chambord	1.80%
Carson City (B/I)	1987	1.66%	Mr. Prospector	0.44%	Blushing Promise	0.93%
Chateau Bouscaut (P)	1927	0.39%	Kircubbin	0.73%	Ramondie	2.20%
Chaucer (S)	1900	0.78%	St. Simon	0.75%	Canterbury Pilgrim	1.52%
Chief's Crown (I/S)	1982	0.54%	Danzig	0.59%	Six Crowns	0.98%
Cicero (B)	1902	1.56%	Cyllene	2.25%	Gas	1.91%
Clarissimus (C)	1913	1.93%	Radium	2.16%	Quintessence	1.18%
Codex (I/C)	1977	0.65%	Arts And Letters	0.25%	Roundup Rose	1.13%

CHEF-DE-RACE	YEAR	6-GEN IC	SIRE	6-GEN IC	DAM	6-GEN IC
Colorado (I)	1923	4.52%	Phalaris	1.22%	Canyon	2.93%
Congreve (I)	1924	2.86%	Copyright	4.42%	Per Noi	3.89%
Count Fleet (C)	1940	0.59%	Reigh Count	3.66%	Quickly	0.49%
Court Martial (B)	1942	2.41%	Fair Trial	0.99%	Instantaneous	0.15%
Creme Dela Creme (C/S)	1963	0.59%	Olympia	1.27%	Judy Rullah	1.03%
Crepello (P)	1954	0.34%	Donatello II	2.27%	Crepuscule	0.83%
Damascus (I/C)	1964	1.53%	Sword Dancer	0.93%	Kerala	1.17%
Danzig (I/C)	1977	0.59%	Northern Dancer	1.08%	Pas De Nom	0.30%
Dark Ronald (P)	1905	1.76%	Bay Ronald	1.62%	Darkie	2.21%
Discovery (S)	1931	1.27%	Display	1.33%	Ariadne	0.44%
Djebel (I)	1937	0.25%	Tourbillon	0.35%	Loika	4.09%
Donatello II (P)	1934	2.27%	Blenheim II	2.95%	Delleana	3.20%
Double Jay (B)	1944	1.28%	Balladier	0.60%	Broomshot	0.40%
Dr. Fager (I)	1964	2.78%	Rough'n Tumble	2.11%	Aspidistra	1.61%
Eight Thirty (I)	1936	2.16%	Pilate	2.64%	Dinner Time	0.44%
Ela-mana-mou (P)	1976	2.97%	Pitcairn	1.24%	Rose Bertin	2.57%
Equipoise (I/C)	1928	0.68%	Pennant	0.49%	Swinging	1.54%
Exclusive Native (C)	1965	1.07%	Raise A Native	0.83%	Exclusive	2.84%
Fair Play (S/P)	1905	0.64%	Hastings	1.32%	Fairy Gold	0.64%
Fair Trial (B)	1932	0.99%	Fairway	2.80%	Lady Juror	0.73%
Fairway (B)	1925	2.80%	Phalaris	1.22%	Scapa Flow	3.07%
Fappiano (I/C)	1977	0.64%	Mr. Prospector	0.44%	Killaloe	0.49%
Forli (C)	1963	1.91%	Aristophanes	1.61%	Trevisa	1.23%
Foxbridge (P)	1930	2.93%	Foxlaw	3.29%	Bridgemount	1.97%
Full Sail (I)	1934	2.79%	Fairway	2.80%	Fancy Free	3.08%
Gainsborough (C)	1915	2.16%	Bayardo	5.13%	Rosedrop	0.59%
Gallant Man (B/I)	1954	4.16%	Migoli	1.86%	Majideh	1.22%
Giant's Causeway (C)	1997	1.12%	Storm Cat	0.59%	Mariah's Storm	2.70%
Graustark (C/S)	1963	0.79%	Ribot	0.69%	Flower Bowl	1.53%
Grey Dawn II (B/I)	1962	0.50%	Herbager	1.47%	Polamia	0.10%
Grey Sovereign (B)	1948	1.99%	Nasrullah	0.69%	Kong	0.64%
Gundomar (C)	1942	1.71%	Alchimist	4.56%	Grossularia	5.00%
Habitat (B)	1966	0.83%	Sir Gaylord	0.39%	Little Hut	0.40%
Hail To Reason (C)	1958	1.47%	Turn-to	4.64%	Nothirdchance	1.76%
Halo (B/C)	1969	1.87%	Hail To Reason	1.47%	Cosmah	0.69%
Havresac II (I)	1915	12.71%	Rabelais	1.67%	Hors Concours	5.44%
Heliopolis (B)	1936	4.91%	Hyperion	3.72%	Drift	2.35%
Herbager (C/S)	1956	1.47%	Vandale	0.30%	Flagette	14.71%
High Top (C)	1969	0.35%	Derring-do	3.25%	Camenae	0.15%
His Majesty (C)	1968	0.79%	Ribot	0.69%	Flower Bowl	1.53%
Hoist The Flag (B/I)	1968	0.35%	Tom Rolfe	1.43%	Wavy Navy	0.05%
Hurry On (P)	1913	1.62%	Marcovil	5.67%	Tout Suite	2.85%
Hyperion (B/C)	1930	3.72%	Gainsborough	2.16%	Selene	3.89%
Icecapade (B/C)	1969	0.74%	Nearctic	2.85%	Shenanigans	0.34%
In Reality (B/C)	1964	4.50%	Intentionally	1.37%	My Dear Girl	0.34%
In The Wings (C/S)	1986	0.89%	Sadler's Wells	1.39%	High Hawk	0.39%
Indian Ridge (I)	1985	1.08%	Ahonoora	0.29%	Hillbrow	0.44%

CHEF-DE-RACE	YEAR	6-GEN IC	SIRE	6-GEN IC	DAM	6-GEN IC
Intentionally (B/I)	1956	1.37%	Intent	0.39%	My Recipe	0.05%
Key To The Mint (B/C)	1969	0.94%	Graustark	0.79%	Key Bridge	0.20%
Khaled (I)	1943	1.48%	Hyperion	3.72%	Eclair	1.08%
King Salmon (I)	1930	2.17%	Salmon Trout	0.69%	Malva	1.75%
Kingmambo (C/S)	1990	1.37%	Mr. Prospector	0.44%	Miesque	0.30%
King's Bishop (B/I)	1969	0.10%	Round Table	0.98%	Spearfish	2.21%
La Farina (P)	1911	2.59%	Sans Souci II	2.35%	Malatesta	1.23%
Le Fabuleux (P)	1961	0.49%	Wild Risk	2.07%	Anguar	0.49%
Lost Code (B/I)	1984	0.20%	Codex	0.65%	Loss Or Gain	1.18%
Luthier (C)	1965	0.88%	Klairon	0.78%	Flute Enchantee	3.89%
Lyphard (C)	1969	0.98%	Northern Dancer	1.08%	Goofed	0.15%
Mahmoud (I/C)	1933	1.38%	Blenheim II	2.95%	Mah Mahal	0.59%
Man O' War (S)	1917	1.13%	Fair Play	0.64%	Mahubah	1.71%
Massine (P)	1920	2.26%	Consols	0.35%	Mauri	2.94%
Midstream (C)	1933	0.94%	Blandford	3.06%	Midsummer	1.08%
Mieuxce (P)	1933	0.74%	Massine	2.26%	L'olivete	0.94%
Mill Reef (C/S)	1968	0.30%	Never Bend	0.29%	Milan Mill	0.50%
Mossborough (C)	1947	4.51%	Nearco	1.95%	All Moonshine	3.75%
Mr. Prospector (B/C)	1970	0.44%	Raise A Native	0.83%	Gold Digger	0.69%
My Babu (B)	1945	0.20%	Djebel	0.25%	Perfume II	5.09%
Nashua (I/C)	1952	0.49%	Nasrullah	0.69%	Segula	0.68%
Nasrullah (B)	1940	0.69%	Nearco	1.95%	Mumtaz Begum	0.54%
Native Dancer (I/C)	1950	0.05%	Polynesian	2.79%	Geisha	0.05%
Navarro (C)	1931	2.16%	Michelangelo	1.14%	Nuvolona	2.05%
Nearco (B/C)	1935	1.95%	Pharos	2.80%	Nogara	4.40%
Never Bend (B/I)	1960	0.29%	Nasrullah	0.69%	Lalun	1.32%
Never Say Die (C)	1951	0.93%	Nasrullah	0.69%	Singing Grass	0.73%
Nijinsky II (C/S)	1967	0.54%	Northern Dancer	1.08%	Flaming Page	0.44%
Niniski (C/P)	1976	0.39%	Nijinsky II	0.54%	Virginia Hills	0.30%
Nodouble (C/P)	1965	0.34%	Noholme II	1.42%	Abla-jay	0.54%
Noholme II (B/C)	1956	1.42%	Star Kingdom	1.47%	Oceana	1.63%
Northern Dancer (B/C)	1961	1.08%	Nearctic	2.85%	Natalma	0.60%
Nureyev (C)	1977	2.28%	Northern Dancer	1.08%	Special	0.34%
Oleander (S)	1924	2.35%	Prunus	3.38%	Orchidee II	6.11%
Olympia (B)	1946	1.27%	Heliopolis	4.91%	Miss Dolphin	2.40%
Orby (B)	1904	1.17%	Orme	0.98%	Rhoda B.	0.74%
Ortello (P)	1926	2.76%	Teddy	1.97%	Hollebeck	4.98%
Panorama (B)	1936	1.52%	Sir Cosmo	0.99%	Happy Climax	2.06%
Persian Gulf (C)	1940	0.93%	Bahram	2.08%	Double Life	1.66%
Peter Pan (B)	1904	0.29%	Commando	2.43%	Cinderella	1.43%
Petition (I)	1944	1.23%	Fair Trial	0.99%	Art Paper	2.08%
Phalaris (B)	1913	1.22%	Polymelus	1.42%	Bromus	8.16%
Pharis II (B)	1936	2.96%	Pharos	2.80%	Carissima	2.16%
Pharos (I)	1920	2.80%	Phalaris	1.22%	Scapa Flow	3.07%
Pia Star (S)	1961	1.65%	Olympia	1.27%	Inquisitive	0.20%
Pilate (C)	1928	2.64%	Friar Rock	3.64%	Herodias	1.22%
Pleasant Colony (I)	1978	0.49%	His Majesty	0.79%	Sun Colony	0.39%

CHEF-DE-RACE	YEAR	6-GEN IC	SIRE	6-GEN IC	DAM	6-GEN IC
Polynesian (I)	1942	2.79%	Unbreakable	3.40%	Black Polly	3.32%
Pompey (B)	1923	1.96%	Sun Briar	1.27%	Cleopatra	2.47%
Precipitation (P)	1933	0.88%	Hurry On	1.62%	Double Life	1.66%
Pretense (C)	1963	3.45%	Endeavour II	1.91%	Imitation	4.64%
Prince Bio (C)	1941	0.94%	Prince Rose	1.50%	Biologie	1.86%
Prince Chevalier (C)	1943	0.94%	Prince Rose	1.50%	Chevalerie	1.08%
Prince John (C)	1953	0.20%	Princequillo	1.10%	Not Afraid	1.03%
Prince Rose (C)	1940	1.50%	Rose Prince	1.14%	Indolence	0.77%
Princequillo (I/S)	1928	1.10%	Prince Rose	1.50%	Cosquilla	1.50%
Promised Land (C)	1954	0.20%	Palestinian	1.48%	Mahmoudess	1.14%
Rabelais (P)	1900	1.67%	St. Simon	0.75%	Satirical	3.23%
Rainbow Quest (C/S)	1981	1.18%	Blushing Groom	1.48%	I Will Follow	0.93%
Raise A Native (B)	1961	0.83%	Native Dancer	0.05%	Raise You	0.54%
Reliance II (S/P)	1962	0.05%	Tantieme	0.44%	Relance III	0.40%
Relko (S)	1960	0.10%	Tanerko	2.11%	Relance III	0.40%
Reviewer (B/C)	1966	1.71%	Bold Ruler	0.49%	Broadway	1.76%
Ribot (C/P)	1952	0.69%	Tenerani	1.87%	Romanella	2.46%
Right Royal (S)	1958	1.37%	Owen Tudor	3.72%	Bastia	3.28%
Riverman (I/C)	1969	0.69%	Never Bend	0.29%	River Lady	0.29%
Roberto (C)	1969	3.15%	Hail To Reason	1.47%	Bramalea	1.27%
Rock Sand (C/S)	1900	4.21%	Sainfoin	6.57%	Roquebrune	2.16%
Roman (B/I)	1937	0.20%	Sir Gallahad III	1.59%	Buckup	0.15%
Rough'n Tumble (B/C)	1948	2.11%	Free For All	0.89%	Roused	0.34%
Round Table (S)	1954	0.98%	Princequillo	1.10%	Knight's Daughter	0.94%
Royal Academy (B/I)	1987	1.12%	Nijinsky II	0.54%	Crimson Saint	0.44%
Royal Charger (B)	1942	0.74%	Nearco	1.95%	Sun Princess	2.00%
Run The Gantlet (P)	1968	2.31%	Tom Rolfe	1.43%	First Feather	0.10%
Sadler's Wells (C/S)	1981	1.39%	Northern Dancer	1.08%	Fairy Bridge	0.39%
Sardanapale (P)	1911	0.24%	Prestige	1.12%	Gemma	1.13%
Sea-bird (S)	1962	0.49%	Dan Cupid	4.45%	Sicalade	1.95%
Seattle Slew (B/C)	1974	1.57%	Bold Reasoning	1.53%	My Charmer	2.15%
Secretariat (I/C)	1970	0.24%	Bold Ruler	0.49%	Somethingroyal	0.34%
Sharpen Up (B/C)	1969	1.49%	Atan	0.88%	Rocchetta	0.40%
Shirley Heights (C/P)	1975	0.30%	Mill Reef	0.30%	Hardiemma	0.20%
Sicambre (C)	1948	1.07%	Prince Bio	0.94%	Sif	9.10%
Sideral (C)	1948	1.13%	Seductor	3.09%	Starling II	1.18%
Sir Cosmo (B)	1926	0.99%	The Boss	1.03%	Ayn Hali	0.54%
Sir Gallahad III (C)	1920	1.59%	Teddy	1.97%	Plucky Liege	1.37%
Sir Gaylord (I/C)	1959	0.39%	Turn-to	4.64%	Somethingroyal	0.34%
Sir Ivor (I/C)	1965	1.22%	Sir Gaylord	0.39%	Attica	0.59%
Smart Strike (I/C)	1992	0.79%	Mr. Prospector	0.44%	Classy 'n Smart	0.69%
Solario (P)	1922	2.47%	Gainsborough	2.16%	Sun Worship	2.94%
Son-in-law (P)	1911	2.41%	Dark Ronald	1.76%	Mother-in-law	1.66%
Speak John (B/I)	1958	0.00%	Prince John	0.20%	Nuit De Folies	0.29%
Spearmint (P)	1903	2.84%	Carbine	4.57%	Maid Of The Mint	6.02%
Spy Song (B)	1943	3.17%	Balladier	0.60%	Mata Hari	2.25%
Stage Door Johnny (S/P)	1965	0.10%	Prince John	0.20%	Peroxide Blonde	0.34%

CHEF-DE-RACE	YEAR	6-GEN IC	SIRE	6-GEN IC	DAM	6-GEN IC
Star Kingdom (I/C)	1946	1.47%	Stardust	2.36%	Impromptu	1.08%
Star Shoot (I)	1898	1.71%	Isinglass	2.95%	Astrology	1.14%
Sunny Boy (P)	1944	4.05%	Jock	2.26%	Fille De Soleil	1.03%
Sunstar (S)	1908	2.40%	Sundridge	3.33%	Doris	1.49%
Sweep (I)	1907	1.96%	Ben Brush	1.43%	Pink Domino	0.84%
Swynford (C)	1907	1.08%	John O'gaunt	1.23%	Canterbury Pilgrim	1.52%
T.v. Lark (I)	1957	1.27%	Indian Hemp	2.20%	Miss Larksfly	0.35%
Tantieme (S)	1947	0.44%	Deux Pour Cent	0.68%	Terka	0.94%
Teddy (S)	1913	1.97%	Ajax	1.38%	Rondeau	1.71%
The Tetrarch (I)	1911	4.35%	Roi Herode	2.61%	Vahren	4.60%
Ticino (C/S)	1939	0.93%	Athanasius	0.74%	Terra	1.82%
Tom Fool (I/C)	1949	0.63%	Menow	1.92%	Gaga	0.34%
Tom Rolfe (C/P)	1962	1.43%	Ribot	0.69%	Pocahontas	0.93%
Tourbillon (C/P)	1928	0.35%	Ksar	7.13%	Durban	2.58%
Tracery (C)	1909	3.05%	Rock Sand	4.21%	Topiary	1.51%
Traghetto (I)	1942	1.87%	Cavaliere D'arpino	2.75%	Talma	1.28%
Tudor Minstrel (B)	1944	2.06%	Owen Tudor	3.72%	Sansonnet	0.35%
Turn-to (B/I)	1951	4.64%	Royal Charger	0.74%	Source Sucree	1.67%
Ultimus (B)	1906	14.32%	Commando	2.43%	Running Stream	1.32%
Unbridled (B/I)	1987	1.23%	Fappiano	0.64%	Gana Facil	0.00%
Vaguely Noble (C/P)	1965	3.95%	Vienna	1.23%	Noble Lassie	1.27%
Vandale (P)	1943	0.30%	Plassy	2.41%	Vanille	1.97%
Vatellor (P)	1933	0.74%	Vatout	4.13%	Lady Elinor	1.47%
Vatout (S)	1926	4.13%	Prince Chimay	1.86%	Vashti	1.71%
Vieux Manoir (C)	1947	0.73%	Brantome	0.89%	Vieille Maison	0.29%
War Admiral (C)	1934	0.29%	Man O' War	1.13%	Brushup	0.10%
What A Pleasure (B)	1965	2.90%	Bold Ruler	0.49%	Grey Flight	0.44%
Wild Risk (P)	1940	2.07%	Rialto	1.19%	Wild Violet	1.37%
Worden (S)	1949	0.35%	Wild Risk	2.07%	Sans Tares	1.03%

Chapter 20

The Selection of *Chefs-de-Race*

No aspect of Dosage is more confusing to the general racing public than the selection of *chefs-de-race*. By contrast, the significance and meaning of the statistical indexes (i.e., DP, DI and CD) derived from Dosage methodology are reasonably well understood, although much of the subtlety associated with interpretation of the figures is often ignored. Also lost is the direct link between the figures and the assignment and placement of the *chefs-de-race*. In fact, it is critical that the selection of a *chef-de-race* reflects an undeniable aptitudinal contribution by the stallion proposed for inclusion. The type of contribution he makes not only must be readily identifiable, it must be consistent as well. That is to say, any candidate being considered as a *chef-de-race* must display prepotence, a condition in which an individual consistently transmits a similar quality to his offspring. Acknowledging a virtually infinite number of possible genetic combinations and permutations, it is truly unusual when a specific trait is passed along almost without exception. The broad scope of biological variation essentially precludes that every immediate descendant displays that trait, but in a statistical sense the trait appears with overwhelming regularity. The requirement that stallions exhibit prepotence is the very essence of Dosage methodology. Since Dosage is a technique for classifying pedigrees by type, its predictive capability depends on the aptitudinal qualities inherited from particular sires being largely the same from one foal to another. Imagine a situation in which the transmission of characteristics from generation to generation is a totally random affair. There would be no way to accurately predict what the product of a mating would be like. Breeding would be a game of pure chance and luck. Fortunately there is a degree of order and sense to genetics that allows for a reasonable amount of planning in the matching of stallions and mares. Although luck always plays a part, we have learned enough in more than 200 years of selective breeding at least to have an expectation that our choices will result in a foal reflecting the qualities of the sire and the dam. Most breeding animals, however, are not especially prepotent and we are limited in the accuracy of our predictions. On the other hand, those few breeding animals that are truly prepotent dramatically increase our ability to design a mating with a well-defined objective in mind. Since the goal of Dosage is to provide a method for classifying Thoroughbred pedigrees to better appreciate the relationship between pedigree and performance, it is essential to focus exclusively on those relatively few prepotent animals whose traits are passed on with consistency. The non-prepotent influences will introduce some uncertainty into the interpretation, but the prepotent influences do bring order to a complex process. Because few sires in any era actually are prepotent for type, once they are identified, the task of pedigree interpretation is facilitated when applying the Dosage techniques.

To elaborate, all versions of Dosage accept the principle that relatively few individuals account for most of the evolutionary forces within the breed. A consequence of this principle is the belief that a reasonable aptitudinal interpretation of a pedigree can be achieved by limiting the analysis to include only those select individuals. In

reality, every ancestor plays a role although not many will pass along definable traits in a regular manner. For our purposes we exclude the non-prepotent influences solely because of their unpredictability. Such exclusion can lead to errors if actual prepotence for type hasn't been confirmed. This is something to consider particularly when dealing with newer stallions that haven't yet proven their case for prepotency. For example, when they were young sires and before they were identified as *chefs-de-race*, A.P. Indy and Kingmambo showed convincing signs they might be consistent sources of classic stamina. Future developments confirmed those suspicions and they eventually emerged as *chef-de-race* candidates. In the meantime, it is a good idea to at least consider the possibility of unacknowledged aptitudinal prepotence in a pedigree and to make mental adjustments to the Dosage figures to account for them. This procedure may affect the analysis for an individual horse while having virtually no effect on the figures for the general Thoroughbred population.

There are other considerations when assessing unacknowledged sources of prepotent type. These are implicit in *chef-de-race* selection, a process that is not universally understood. For example, there is the exclusion of dams as *chefs-de-race*. The explanation for this relies on an appreciation of the fundamentals of Dosage methodology. The latest version of Dosage is based on statistics derived from large populations of Thoroughbreds. Pedigrees are grouped according to categories of performance type such as sprinters, routers, dirt horses, turf horses, juveniles, older runners, graded stakes performers and so on. By grouping the pedigrees, Dosage can identify common pedigree characteristics among the members of those categories. The Dosage figures are unique to the groups and the figures for one group may be readily differentiated from the figures for other groups. In any statistical study there is usually significant variation observed among the individuals, but the statistical results for the entire group are unique to that group. Any one horse in a large sample will have little effect on the overall statistics for the population under study. On the other hand, one horse in a small sample can have a profound effect. It is for this reason that mares have been excluded. A stallion may have hundreds of foals in a lifetime, but a mare will have only a few. Accordingly, mares have a minor impact on the broader statistical base. There is no suggestion here that mares don't influence their foals profoundly. Obviously they contribute 50% of the genetic material plus qualities perhaps less well defined. On the other hand, they contribute little to population-wide Dosage statistics. Furthermore, since most mares are represented by *chefs-de-race* in their own pedigree, their aptitudinal impact is generally accounted for. Furthermore, many mares appear in the pedigree of *chefs-de-race*. The aptitudinal prepotence of these *chefs-de*-race certainly reflects the influence of these mares. Including only stallions among the *chefs-de-race* simplifies the analysis while having a marginal effect on the accuracy of the population statistics. However, making mental adjustments to the figures to account for special mares is justified here as it is for the emerging young sires discussed earlier. A desirable objective of Dosage is the accuracy of individual pedigree interpretation even if the broad conclusions of Dosage apply to the entire population.

In the end, Dosage reserves the term *chef-de-race* for the aptitudinally prepotent and uniquely influential animal. We recall that at the beginning of the 20th century, Vuillier was content to name only fifteen *chefs-de-race* in three series covering the early, middle and late 1800's. Varola created an expanded *chef-de-race* list to include 120 stallions foaled mainly after 1900. The current number of *chefs-de-race* (as of July 2002) stands at 199 and includes Varola's 120, plus additions made by Hewitt in the 1970's. Since the introduction of the latest Dosage version in 1981 we have made further additions and refinements.

The method of identifying new *chefs-de-race* is inextricably linked to the philosophy that drives each variation of Dosage. Vuillier had it relatively easy. He observed that a select group of ancestors in the pedigrees of top class horses appeared with a frequency far greater than that of the other horses that were present. His task was to confirm this dominance by tallying those appearances. Among more recent sires, names such as Bold Ruler, Raise a Native, Northern Dancer, Ribot, and perhaps Turn-to come to mind as meeting the Vuillier requirement.

Varola focused on only "those sires who had transmitted such prepotent and unmistakable traits that any study of pedigrees would be meaningless without them". That in itself is a reasonable goal. However, Varola then compared the influence of sires to peaks in a mountain range and he excluded sires that failed to attain a particularly high altitude. As noble as his intentions may have been, his approach denies the existence of prepotence for type in any other than the most highly regarded stallions. Apart from there being no evidence for such a phenomenon, it weakens, through a largely arbitrary exclusion process, any attempt to accurately define a pedigree in terms of inherited aptitudes.

We apply one absolute criterion to *chef-de-race* selection. The *chef-de-race* candidate must be prepotent for aptitudinal type. Furthermore, we must be able to demonstrate his prepotence using statistical analysis. It would be helpful, although not necessary to the analysis if the *chef-de-race* candidate were a sire of sires or a sire of quality broodmares. In this way we would increase the sample size and show that prepotent influences carry through to successive generations. This obviously wouldn't be relevant to young sires that may have only a small number of sons and daughters at stud even though their aptitudinal prepotence is clearly visible in their racing progeny. Finally, a sire's reputation at stud is of minimal concern. The critical factor is enough racing data generated by his runners to allow for a meaningful statistical study. Keep in mind that we use the data from stakes races to develop our case. Stakes races are the most formful of all races and stakes horses are the most consistent of all runners. Horses entered in stakes generally belong in those races and the outcomes are likely to be the result of a suitable genetic expression of type. A decent stakes sire can often generate more than enough progeny data to make a case for his aptitudinal prepotence.

Nevertheless, there is often pressure to consider for selection as a *chef-de-race* any stallion that establishes a superior record as a sire of runners. Quite often there is a parallel between prepotence and exceptional stud performance, but not always. No one could deny, for example, that Brilliant *chef-de-race* Raise a Native, one of the purest sources of speed in the last sixty years, was also among the leading stallions of his era, getting runners and stallions such as Alydar, Majestic Prince and Mr. Prospector. Even more important in the context of Thoroughbred evolution is the definitive transmission of his speed through succeeding generations. That speed is so compelling that Raise a Native even has a significant impact on breeding in the American Quarter Horse. In contrast, many excellent stallions, despite outstanding progeny performance, have failed to display an overpowering aptitudinal influence from one generation to the next. Commonly, the types of foals they produce, regardless of talent, are more a reflection of the mares to which they have been bred. In effect, they are capable of getting world-class athletes but not necessarily of a pre-defined type. Sometimes this is hard to discern because the prepotent effects in the mare will obscure the absolute effect of the sire, but over time certain patterns will develop in a sire's offspring that give clues to his own prepotence. Occasionally it may take one or two generations to become clear. By contrast, some sires with less than world-class credentials have expressed extraordinary prepotence, easily overpowering the aptitudinal contributions of their mates. Their failure to reach the top of the sire lists may result from lack of opportunity more than any other factor. Often the mares to which they are bred are second or third rank as producers.

Such was the case of Apalachee, who was not among the leading sires when named a Brilliant *chef-de-race* in the late 1980s. However, between 1983 and 1991, Apalachee sired the winners of more major six-furlong stakes races than any North American sire other than Mr. Prospector and Fappiano. He also got a series of blazingly fast sprinting fillies such as Clocks Secret, Pine Tree Lane and Lazer Show, each capable of going a half-mile in under 44 seconds. He did this despite being a son of Solid *chef-de-race* Round Table. Undoubtedly the source of his speed is his female family descended from Rough Shod II through the brilliant Moccasin. Rough Shod II in turn is a direct male line descendant of Brilliant *chef-de-race* Orby. Nevertheless, excluding the consistently predictable speed influence associated with Apalachee's name in a four-generation pedigree because he wasn't a "good enough" sire misses the entire point of aptitudinal analysis, not to mention resulting in an incorrect interpretation of the pedigrees in which he appears. Regardless of the source, failure to acknowledge the speed influence of Apalachee in a pedigree will certainly result in a misinterpretation of the aptitudinal characteristics of his descendants. For the sake of accuracy, one must take into account his undeniable prepotence.

The most easily identifiable *chef-de-race* candidates are those like Apalachee whose exclusion in aptitudinal pedigree analysis leads to a grossly inaccurate picture of the pedigree type being evaluated. Using the data derived from thousands of pedigrees classified by performance type, we know where the figures lie for populations whose

abilities are expressed in particular racing categories. In evaluating a subpopulation of pedigrees that have in common the appearance of a particular sire, we can compare the Dosage figures derived from that subpopulation with the figures established for the breed at large. When there is a significant difference in the figures between the subpopulation and the general population of the same performance type, it is evidence that an aptitudinal influence in the subpopulation is being overlooked. That influence is could well be the sire that the subpopulation has in common. An example is a population of sprinters all with "Sire X" somewhere in their pedigree and with combined Dosage figures more typical of the general population of stayers. In this case it is likely that a prepotent influence from "Sire X" has been ignored. There is no reason to expect any group of sprinters not to conform to population standards established in thousands of races. When, through empirical calculations, a sire is placed in the appropriate aptitudinal group or groups and recalculation of the figures realigns the subpopulation with the general population, we can feel confident that we have identified and correctly assigned a new *chef-de-race*.

We can further illustrate the logic behind *chef-de-race* selection with specific examples, using the previously published assignments for Giant’s Causeway and Pulpit.

Photo Courtesy of the Thoroughbred Times

Apalachee

DP 9-4-7-20-0, DI 0.70, CD 0.05

Apalachee, b.c., 1971	**Round Table (S)**	**Princequillo (I/S)**	**Prince Rose (C)**	Rose Prince
				Indolence
			Cosquilla	Papyrus
				Quick Thought
		Knight's Daughter	**Sir Cosmo (B)**	The Boss
				Ayn Hali
			Feola	Friar Marcus
				Aloe
	Moccasin	**Nasrullah (B)**	**Nearco (B/C)**	Mumtaz Begum
				Flares
		Nantallah	Shimmer	Broad Ripple
				Golden Boss
			Gold Bridge	Flying Diadem
		Rough Shod II	**Blandford (C)**	Simon's Shoes
			Dalmary	

	DP Contribution	**Equivalent to:**
Sire	4- 4- 4-20- 0	DI 0.45 CD –0.25
Dam	5- 0- 3- 0- 0	DI 4.33 CD 1.25

The Dosage interpretation of Apalachee's pedigree is included here not because his figures match his performance, but precisely because they do not. The implications of this mismatch between pedigree and performance are fundamental to an understanding of the selection process for *chefs-de-race*.

Brilliant *chef-de-race* Apalachee, b.c., 1971 (Round Table-Moccasin, by Nantallah) is considered one of the great two-year-old runners of the 20th century in Great Britain. His Timeform rating of 137 pounds is surpassedby only twenty-five runners of any age. Undefeated as a juvenile, he won all three of his starts including a smashing win in the Group 1 Observor Gold Cup at a mile. As an early three-year-old he

defeated older horses in the Group 3 Gladness Stakes in Ireland, but failed to live up to his promise in the English Two Thousand Guineas by running third to Nonoalco and Giacometti. Nominally bred for tremendous endurance, he was instead a brilliant sprinter-miler. Apalachee is bred on a stamina over speed pattern, with his sire, Solid *chef-de-race* Round Table, contributing a full 20 Solid points to Apalachee's DP. His pedigree is virtually identical to that of Grade 1 winner King Pellinore whose dam, Thong, is a full sister to Apalachee's dam, Moccasin. In contrast to Apalachee, King Pellinore won the1976 Oak Tree Invitational Stakes (G1) at a mile and a half on the grass. Round Table sired many other stayers on dirt and grass, even when bred to speed mares. These include such Grade/Group 1 winners as Duel, He's a Smoothie, Dignitas, Drumtop, Tell, Royal Glint and Artaius. It appears as if the speed through Rough Shod II dominates Apalachee's pedigree in this instance and it carries over to Apalachee's descendants which include many spectacularly brilliant sprinters like Clocks Secret, Lazer Show, Pine Tree Lane, Artax and Texas Glitter. The disparity between Apalachee's influence on his descendants' pedigrees and the aptitudinal characteristics he passes along from his ancestors is the key factor in his selection as a *chef-de-race*. As a Brilliant *chef-de-rac*, Apalachee contributes 20-2-2-10-0 to the DP of his foals. The very large Brilliant contribution he makes readily accounts for their performance. Denying his speed influence would invariably lead to an aptitudinal misinterpretation.

El Prado showing prepotent shift to intermediate speed

by Steve Roman and Steve Miller, October 2013

Owned by Robert Sangster and trained by the immortal Vincent O'Brien, the Irish juvenile champion of 1991, deceased El Prado (IRE), gr.h., 1989 (Sadler's Wells-Lady Capulet, by Sir Ivor), was not among his sire's very best performers on the track, although rated at a very respectable 119 pounds by Timeform. He is, however, unquestionably his sire's best son ever to stand at stud in North America and his enduring influence is virtually assured by his success not only as a superior sire of runners but as an important sire of sires as well.

A winner of four of six starts with one second-place finish at two, El Prado that year captured Group 1, Group 2 and Group 3 events over sprint distances. He was unable to reproduce his form at three and was retired with a record of 9-4-1-0 and earnings of $237,394. After retirement he was sold privately as a four-year-old by Coolmore Stud to stand at Frank Stronach's Adena Springs in Midway, Kentucky, where he became one of North America's most prolific and prominent sires.

El Prado led the North American general sire list in 2002 and was second in both 2003 and 2004. Between the years 2002 and 2005 he was the only stallion to place among the top five sires every year. He also became the first sire to get Grade 1 winners on dirt, turf and an all-weather surface.

At the time of his death at age 20 in 2009 El Prado was standing for a stud fee of $75,000, ranked 14th among North American-based sires by lifetime AEI (Average-Earnings-Index) and had gotten over 70 stakes winners, a majority on turf. Nevertheless, some of his most accomplished performers were main track stars.

Among El Prado's best runners are (alphabetically) Artie Schiller, winner of the 2005 Breeders' Cup Mile (G1T) (over that year's turf male champion Leroidesanimaux) and six other graded stakes; Asi Siempre, winner of the 2006 Spinster Stakes (G1) and sold as a broodmare prospect for $3 million to Sheikh Mohammed; Borrego, a multiple Grade 1 winner at ten furlongs on dirt; Kitten's Joy, champion turf male of 2004 and a winner of seven graded stakes; Medaglia d'Oro, a winner of seven graded stakes on dirt including three Grade 1s; Paddy O'Prado, a winner of five graded stakes on turf including a Grade 1; and Winter Memories, a winner on turf of seven graded stakes including two Grade 1s.

El Prado's daughters have produced at least 31 lifetime stakes winners through early October 2013, at which time El Prado ranked 35th on the 2013 broodmare sire list. His daughter's best performers include Believe You Can, winner of the Kentucky Oaks (G1); Bit of Whimsy, winner of the Queen Elizabeth II Challenge Cup Stakes (G1T); Essence Hit Man, twice Canadian champion sprinter; Laragh, winner of the Hollywood Starlet Stakes (G1); and Summer Front, a multiple graded stakes winner and a leading contender for the 2013 Breeders' Cup Mile (G1T).

Of particular significance is the emergence of El Prado sons as major successful North American sires. These include Medaglia d'Oro, 10th among active North American sires by AEI (Average-Earnings-Index) and the sire of the brilliant three-year-old filly champion Rachel Alexandra; Kitten's Joy, 19th among active North American sires by AEI; and Artie Schiller, 11th among third-crop sires of 2012 and the sire of Grade/Group 1 winners in three countries.

Through early October 2013 Kitten's Joy led the North American general sire list, was 1st in number of stakes winners, 2nd in number of graded stakes winners and 1st in number of Grade 1 stakes winners. Medaglia d'Oro ranked 12th on the general sire list, co-4th in number of stakes winners and co-8th in number of graded stakes winners. Artie Schiller ranked 60th on the general sire list with progeny earnings over $3.5 million, 2nd on the juvenile sire list, was tied for 1st in number of two-year-old stakes winners and was the only North American stallion to have sired two Grade 1-winning juveniles in 2013. In 2012, the first two finished among the top 20 on the general sire list. In 2011, Kitten's Joy led the third-crop sire list by a huge margin (he was 5th on the first-crop sire list of 2009). Without a doubt, sons of El Prado are making a significant impact at stud.

Generally, major winners by El Prado in North America favor turf and middle distances and tend to mature a bit later than average. The AWD (Average-Winning-Distance) of his descendants (as a combined sire and broodmare sire) is 8.13 furlongs compared to an AWD of 9.81 furlongs for his sire, Classic/Solid *chef-de-race* Sadler's Wells, also as a combined sire and broodmare sire, a difference approaching a quarter of a mile. This indicates a dramatic shift toward speed from father to son.

The following table displays the percentage of El Prado's major winners by distance in North America.

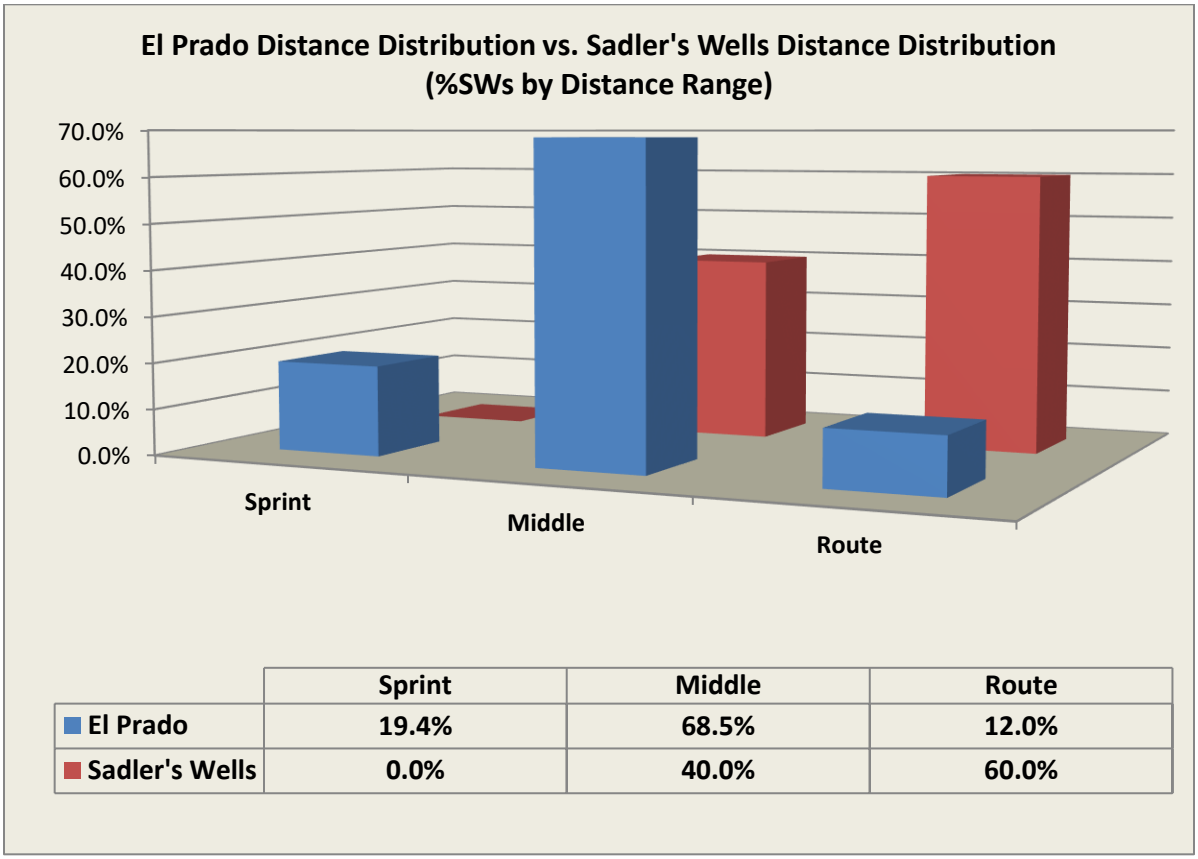
5.50f	6.00f	6.50f	7.00f	7.50f	8.00f	8.50f	9.00f	9.50f	10.00f	11.00f	12.00f
1.9%	7.4%	4.6%	4.6%	0.9%	18.5%	23.1%	26.9%	0.9%	8.3%	1.9%	0.9%

The percentage of winners between eight and nine furlongs is a very high 68.5%, well above the population average of 43%. Such a narrow distribution range is consistent with aptitudinal prepotence, a basic requirement for *chef-de-race* status.

We can then compare El Prado's North American distance distribution with that of his sire, Sadler's Wells.

5.50f	6.00f	6.50f	7.00f	7.50f	8.00f	8.50f	9.00f	9.50f	10.00f	11.00f	12.00f
0.0%	0.0%	0.0%	0.0%	0.0%	15.6%	13.3%	11.1%	2.2%	15.6%	13.3%	28.9%

This is a huge change in transmitted aptitudinal type within a single generation and suggests that El Prado is, indeed, passing along aptitudinal traits independently of his sire. We can observe the dramatic difference visually in the following graphic where the distance distributions of El Prado and Sadler's wells are compared more broadly in terms of sprints (less than eight furlongs), middle distances (eight to nine furlongs) and routes (greater than nine furlongs).



	Sprint	Middle	Route
El Prado	19.4%	68.5%	12.0%
Sadler's Wells	0.0%	40.0%	60.0%

The combined average Dosage figures for runners by El Prado and out of his daughters are DP 4.30-4.88-13.23-3.78-0.19, DI 1.60 and CD 0.36 based on 147 North American open stakes wins. The predicted values at an AWD of 8.13 furlongs derived from data for all sires since 1983 with at least 25 North American progeny stakes victories are DI 3.10 and CD 0.70. The obvious increase in transmitted speed between Sadler's Wells and El Prado clearly is not captured in the current Dosage figures of El Prado's descendants.

If we assign El Prado as a split Brilliant/Intermediate *chef-de-race*, his revised figures are DP 11.24-11.82-13.23-3.78-0.19, DI 2.97 and CD 0.76. These new figures are an almost ideal fit with the figures predicted from the general population and confirm El Prado's prepotent influence for speed.

We also observe siginificant improvement in the figures for second-generation descendants of El Prado though Artie Schiller, Kitten's Joy, Medaglia d'Oro and through El Prado's daughters as displayed in the followng table.

EL PRADO AS -->	NON-*CHEF-DE-RACE*			B/I *CHEF-DE-RACE*			PREDICTED	
	AWD (f)	DI	CD	AWD (f)	DI	CD	DI	CD
Artie Schiller	7.85	1.55	0.47	7.85	2.96	0.84	3.37	0.75
Kitten's Joy	8.48	1.35	0.32	8.48	2.44	0.69	2.77	0.63
Medaglia d'Oro	8.63	1.64	0.41	8.63	2.86	0.76	2.63	0.61
El Prado Daughters	7.53	1.93	0.54	7.53	2.97	0.79	3.67	0.81

The revised figures are much more realistic and confirm El Prado's prepotence for speed through at least his second-generation descendants.

Accordingly, we are confident is assigning El Prado as a split Brilliant/Intermediate *chef-de-race*, the 222nd in the series.

Prepotency passed down from Pulpit

by Steve Roman and Steve Miller, December 2014

A Claiborne Farm homebred by American Horse-of-the-Year and Intermediate/Classic *chef-de*-race A.P. Indy and out of the Grade 1-winning mare Preach by Brilliant/Classic *chef-de-race Mr*. Prospector, multiple Grade 2 winner Pulpit was unraced as a two-year-old. Winning his first three starts at three including the Fountain of Youth Stakes (G2), he followed with a second in the Florida Derby and an impressive victory in the Blue Grass Stakes (G2). He ran fourth as the fourth choice in Silver Charm's Kentucky Derby while leading into the stretch before weakening and trailing the winner, Captain Bodgit and Free House under the wire. He came out of the race with an injury to his left hind leg and was shortly retired to stud at Claiborne Farm with a career record of 6-4-1-0 and earnings of $728,200.

Pulpit was an immediate success at stud getting almost 13% stakes winners from foals from his first three crops, including Grade 1 stakes winners Sky Mesa, Purge, Stroll and Tapit. Continually among the leading sires, he died prematurely at age 18 in his paddock in 2012 having displayed no prior signs of ill health. Through November of 2014 he is the sire of at least 77 stakes winners including additional Grade 1 winners Pyro, Rutherienne, Mr Speaker, Ice Box, Power Broker, Sermon of Love (over jumps) and Mi Sueno. Thus far, Pulpit's daughters have produced at least 32 stakes winners including Grade 1 winners Karlovy Vary and Real Solution.

Pulpit has sired five American runners with earnings in excess of $1 million: Essence of Dubai ($2.0 million, winner of four graded stakes in North America and Dubai and standing at stud in Venezuela), Pyro ($1.7 million, also a winner of four graded stakes including a Grade 1 and standing at stud in Japan), Rutherienne ($1.3 million, a winner of eight graded turf stakes including a Grade 1), Corinthian ($1.3 million, a Grade 1 stakes winner and winner of the first Breeders' Cup Dirt Mile) and Fiftyshadesofhay ($1.1 million, a winner of four graded stakes and recently sold for $1.3 million at the 2014 Keeneland November breeding stock sale). A sixth, Mr Speaker, is knocking at the door with earnings of $998 thousand.

Significantly, Pulpit has emerged as a prominent sire of sires. Five of his sons are currently among the top 150 on the 2014 North American general sire list. They include Tapit, the nation's leading sire through November with record progeny earnings, Sky Mesa (24th), Lucky Pulpit (sire of dual 2014 Classic winner California Chrome)

(35th), Corinthian (93rd) and Purge (139th). Pulpit, himself, ranks 35th on the 2014 general sire list and is 30th on the 2014 broodmare sire list. Only A.P. Indy, Storm Cat and Unbridled have more sons among the general sire list top 150 in 2014.

Major stakes winners by Pulpit express a relatively narrow winning distance range with over 75% of their victories coming between 8 and 9 furlongs compared to just 57% in the general sire population. A narrow winning distance range is representative of a sire with significant aptitudinal prepotence. The AWD (Average Winning Distance) of Pulpit's major winners is 8.31 furlongs. Their overall distribution by distance is:

5.00f	6.00f	6.50f	7.00f	7.50f	8.00f	8f70yds	8.50f	9.00f	9.50f	10.00f	12.00f
0.9%	6.4%	2.7%	7.3%	0.9%	14.5%	1.8%	38.2%	20.9%	0.9%	2.7%	2.7%

From the Dosage figures of the winners of 267 major stakes races in which Pulpit and his leading sons are either the sire or broodmare sire we observe that Pulpit's descendants have an AWD of 8.31 furlongs with average DP 6.75-6.06-10.93-0.80-0.14, average DI 2.97 and average CD 0.75. The predicted values at that AWD, based on the general population, are average DI 2.94 and average CD 0.67. The average DI of Pulpit's descendants is consistent with the AWD although the DP is skewed toward speed, resulting in an average CD that does not correlate with the AWD. In fact, an average CD of 0.75 correlates with an AWD of 7.86 furlongs, almost a full sixteenth of a mile shorter than Pulpit's AWD. It appears there is an influence for stamina in the pedigrees of Pulpit's descendants not presently captured in their Dosage figures.

If we assign Pulpit as an Intermediate/Classic *chef-de-race*, the revised figures become average DP 6.75-11.70-16.58-0.80-0.14, average DI 2.95 and average CD 0.67. There is no virtually change in the average DI but there is a meaningful shift toward stamina in the CD resulting in a essentially a perfect fit with the general population at the same AWD (i.e., DI 2.95, CD 0.67 for Pulpit's descendants vs. DI 2.94, CD 0.67 for AWD 8.31 furlongs). Clearly there was an element of stamina previously missing from the figures for Pulpit's descendants that is now captured in the revised numbers.

The following tables display the Dosage figures for Pulpit's and Tapit's Grade 1 winners without and with Pulpit's assignment as a *chef-de-race*. They are listed in order of decreasing maximum winning distance (MWD) in major stakes races.

Grade 1 Winners by Pulpit (as a non-*chef-de-race*)

GRADE 1 WINNER	DAM SIRE	MWD	DP	DI	CD	PTS
Mr Speaker	Unbridled	10.00	12 - 13 - 13 - 0 - 2	3.71	0.83	40
Corinthian	Easy Goer	9.50	8 - 6 - 17 - 1 - 0	2.37	0.66	32
Ice Box	Tabasco Cat	9.00	7 - 6 - 11 - 0 - 0	3.36	0.83	24
Purge	Copelan	9.00	7 - 8 - 11 - 0 - 0	3.73	0.85	26
Rutherienne	Rahy	9.00	10 - 6 - 18 - 0 - 0	2.78	0.76	34
Stroll	Prince Sabo	9.00	8 - 5 - 11 - 0 - 0	3.36	0.88	24
Tapit	Unbridled	9.00	13 - 11 - 16 - 2 - 2	2.67	0.70	44
Power Broker	Wild Again	8.50	8 - 8 - 12 - 0 - 0	3.67	0.86	28
Pyro	Wild Again	8.50	8 - 7 - 11 - 0 - 0	3.73	0.88	26
Sky Mesa	Storm Cat	8.50	7 - 6 - 13 - 2 - 0	2.29	0.64	28
Mi Sueno	Hennessy	7.00	6 - 5 - 11 - 0 - 0	3.00	0.77	22

Grade 1 Winners by Pulpit (as an Intermediate/Classic *chef-de-race*

GRADE 1 WINNER	DAM SIRE	MWD	DP	DI	CD	PTS
Mr Speaker	Unbridled	10.00	12 - 21 - 21 - 0 - 2	3.48	0.73	56
Corinthian	Easy Goer	9.50	8 - 14 - 25 - 1 - 0	2.56	0.60	48
Ice Box	Tabasco Cat	9.00	7 - 14 - 19 - 0 - 0	3.21	0.70	40
Purge	Copelan	9.00	7 - 16 - 19 - 0 - 0	3.42	0.71	42
Rutherienne	Rahy	9.00	10 - 14 - 26 - 0 - 0	2.85	0.68	50
Stroll	Prince Sabo	9.00	8 - 13 - 19 - 0 - 0	3.21	0.73	40
Tapit	Unbridled	9.00	13 - 19 - 24 - 2 - 2	2.75	0.65	60
Power Broker	Wild Again	8.50	8 - 16 - 20 - 0 - 0	3.40	0.73	44
Pyro	Wild Again	8.50	8 - 15 - 29 - 0 - 0	3.42	0.74	42
Sky Mesa	Storm Cat	8.50	7 - 14 - 21 - 2 - 0	2.52	0.59	44
Mi Sueno	Hennessy	7.00	6 - 13 - 19 - 0 - 0	3.00	0.66	38

Grade 1 Winners by Tapit (Pulpit as a non-*chef-de-race*)

GRADE 1 WINNER	DAM SIRE	MWD	DP	DI	CD	PTS
Tonalist	Pleasant Colony	12.00	5 - 13 - 14 - 1 - 1	2.78	0.59	34
Careless Jewel	Hennessy	10.00	4 - 6 - 7 - 1 - 0	3.00	0.72	18
Constitution	Distorted Humor	9.00	5 - 6 - 8 - 1 - 0	3.00	0.75	20
Dance Card	Editor's Note	9.00	6 - 5 - 8 - 1 - 0	3.00	0.80	20
Joyful Victory	Wild Again	9.00	8 - 7 - 12 - 1 - 0	3.00	0.79	28
Untapable	Prized	9.00	4 - 5 - 8 - 1 - 0	2.60	0.67	18
Hansen	Sir Cat	8.50	6 - 5 - 6 - 1 - 0	3.50	0.89	18
Laragh	El Prado	8.50	9 - 12 - 10 - 3 - 0	3.25	0.79	34
Stardom Bound	Tarr Road	8.50	8 - 7 - 7 - 2 - 0	3.36	0.88	24
Zazu	Mr. Greeley	8.50	6 - 11 - 13 - 2 - 0	2.76	0.66	32
Tapitsfly	Marlin	8.00	4 - 6 - 8 - 2 - 0	2.33	0.60	20
Tapizar	Deputy Minister	8.00	6 - 5 - 8 - 1 - 0	3.00	0.80	20
Tell A Kelly	Tabasco Cat	7.00	6 - 5 - 10 - 1 - 0	2.67	0.73	22

Grade 1 Winners by Tapit (Pulpit as an Intermediate/Classic *chef-de-race*)

GRADE 1 WINNER	DAM SIRE	MWD	DP	DI	CD	PTS
Tonalist	Pleasant Colony	12.00	5 - 17 - 18 - 1 - 1	2.82	0.57	42
Careless Jewel	Hennessy	10.00	4 - 10 - 11 - 1 - 0	3.00	0.65	26
Constitution	Distorted Humor	9.00	5 - 10 - 12 - 1 - 0	3.00	0.68	28
Dance Card	Editor's Note	9.00	6 - 9 - 12 - 1 - 0	3.00	0.71	28
Joyful Victory	Wild Again	9.00	8 - 11 - 16 - 1 - 0	3.00	0.72	36
Untapable	Prized	9.00	4 - 9 - 12 - 1 - 0	2.71	0.62	26
Hansen	Sir Cat	8.50	6 - 9 - 10 - 1 - 0	3.33	0.77	26
Laragh	El Prado	8.50	9 - 16 - 14 - 3 - 0	3.20	0.74	42
Stardom Bound	Tarr Road	8.50	8 - 11 - 11 - 2 - 0	3.27	0.78	32
Zazu	Mr. Greeley	8.50	6 - 15 - 17 - 2 - 0	2.81	0.63	40
Tapitsfly	Marlin	8.00	4 - 10 - 12 - 2 - 0	2.50	0.57	28
Tapizar	Deputy Minister	8.00	6 - 9 - 12 - 1 - 0	3.00	0.71	28
Tell A Kelly	Tabasco Cat	7.00	6 - 9 - 14 - 1 - 0	2.75	0.67	30

As we have noted previously, the CD, along a linear scale, is the more accurate statistical tool. Using that as the measure, the revised figures for Classic distance winners Mr Speaker, Corinthian and Careless Jewel are improved, as are those for middle distance types including Ice Box, Purge, Rutherienne, Stroll, Power Broker, Pyro, Dance Card, Joyful Victory and Hansen whose figures previously were more typical of long sprinter/miler types.

The assignment of Pulpit as an Intermediate/Classic *chef-de-race* is justified on the basis of both the performance characteristics of his descendants on the track and the success of his sons and daughters at stud which ensure an enduring influence through successive generations. Accordingly, Pulpit is assigned as the 223rd *chef-de-race*.

Photo Courtesy of the Thoroughbred Times

Dr. Fager

DP 15-1-10-2-0, DI 3.00, CD 1.04

Dr. Fager, b.c., 1964	**Rough'n Tumble (B/C)**	Free For All	Questionnaire
			Sting
			Miss Puzzle
		Panay	Chicle
			Panasette
	Aspidistra	***Bull Dog (B)***	**Teddy (S)**
			Plucky Liege
		Roused	Upset
			Cushion
		Bimelech	**Black Toney (B/I)**
			La Troienne
		Better Self	**War Admiral (C)**
			Baba Kenny
		Bull Brier	***Bull Dog (B)***
			Rose Eternal
		Tilly Rose	Draymont
			Teak
		Tilly Kate	

	DP Contribution					Equivalent to:	
Sire	12-	0-	8-	2-	0	DI 2.67	CD 1.00
Dam	3-	1-	2-	0-	0	DI 5.00	CD 1.17

The extraordinary Intermediate *chef-de-race* Dr. Fager, b.c., 1964 (Rough'n Tumble-Aspidistra, by Better Self), certainly one of the fastest Thoroughbreds in history, displays a pedigree with elements of both brilliance and classicity. His sire, Brilliant/Classic *chef-de-race* Rough'n Tumble, contributes both stamina and speed while his dam contributes a more modest component of sprinting speed. The result is DP 15-1-10-2-0, DI 3.00 and CD 1.04. These figures represent a middle distance-type DI derived from dominant double-digit brilliance, double-digit classicity and a touch of stamina, affording a CD consistent with sprinting speed. During a three-year racing career, Dr. Fager went undefeated in sprints, winning by an average margin of just under six lengths. These included a record-breaking time of 1:20.1 for seven furlongs (with internal fractions of :43.4 and 1:07.4) while toting 139 pounds in the 1968 Vosburgh

Handicap. Dr. Fager also won twice at a mile and a quarter in under 2:00 minutes (although the only times he failed to finish first past the age of two were at that distance). He still holds the record for a mile on dirt (1:32.1) after thirty-four years, and won his only start on grass in the United Nations Handicap while giving sixteen pounds to the previous year's turf champion, Fort Marcy. He is inbred 3x4 to Brilliant *chef-de-race* Bull Dog. In terms of style, Dr. Fager invariably raced on the pace or closely pressing it.

Chapter 21
Dosage and the Classics: Dual Qualifiers

One of the more provocative applications of Dosage combines it with an assessment of juvenile form. Together, these factors function as a guide to classic potential and have helped to define the unique qualities of the American classic horse.

Each spring, many horsemen and handicappers turn their attention to the so-called Dual Qualifiers (DQs), a select group of three-year-old Thoroughbreds sharing similar characteristics. These are characteristics typically found among American classic horses but not among the general Thoroughbred population. For this reason, Dual Qualifiers stand apart from the rest of their generation. In the early 1980's we introduced (in Leon Rasmussen's *Bloodlines* column in Daily Racing Form) the idea that American classic performers generally have distinguishing traits in common. Since then, the concept's ability to isolate legitimate classic contenders has increased its visibility greatly, although as we'll see later, subtle variations in breeding patterns over time suggest that the long-standing characteristics of American classic horses may be changing. The ability of Dosage to rapidly identify and highlight these subtle shifts in pedigree and performance relationships is one of its greatest strengths.

The standard definition of a Dual Qualifier is a three-year-old with a Dosage Index (DI) of 4.00 or less and ranked as a two-year-old within ten pounds of the high-weight on the Experimental Free Handicap (EFH), or designated a champion in another country. The DI is a mathematical expression of the balance between speed and stamina inherited from selected aptitudinally prepotent ancestors. The higher the DI, the greater is the influence of speed in a pedigree. Historically, five winners of the Kentucky Derby since 1940 had a DI over 4.00. Table 29 contains a list of the Derby winners where the cited Dosage figures are those on the day the Derby was won and do not reflect changes to the *chef-de*-race list since that time. Two others, Tables 30 and 31, displaying similar lists for the Preakness Stakes and the Belmont Stakes, follow table 27. There have been nine Preakness winners and five Belmont winners with pedigrees exceeding the DI guideline figure of 4.00 since 1940. Among contemporary stakes winners on dirt, between 23% have a DI over 4.00. The percentage rises to 30% for stakes winners under a mile, but drops to less than 13% for stakes winners at a mile and a quarter. In general, the percentage of stakes winners with a DI over 4.00 on dirt or grass decreases steadily with increasing distance:

DISTANCE	DIRT *(% with DI>4)*	TURF (% with DI>4)
6f	32.9%	21.8%
7f	26.0%	22.8%
8f	20.9%	10.4%
8½f	18.6%	11.2%
9f	17.5%	9.4%
10f	13.4%	4.8%
12f	3.7%	4.7%

Table 29. Dosage History of the Kentucky Derby Since 1940

YEAR	WINNER	DP	DI	CD	PTS
2015	American Pharoah	2 - 3 - 3 - 0 - 0	4.33	0.88	8
2014	California Chrome	7 - 5 - 10 - 0 - 0	3.40	0.86	22
2013	Orb	11 - 12 - 15 - 0 - 2	3.21	0.75	40
2012	I'll Have Another	2 - 4 - 7 - 1 - 0	2.11	0.50	14
2011	Animal Kingdom	2 - 0 - 6 - 0 - 0	1.67	0.50	8
2010	Super Saver	7 - 7 - 14 - 0 - 0	3.00	0.75	28
2009	Mine That Bird	8 - 3 - 5 - 0 - 0	5.40	1.19	16
2008	Big Brown	4 - 7 - 23 - 2 - 0	1.67	0.36	36
2007	Street Sense	8 - 1 - 12 - 0 - 1	2.14	0.68	22
2006	Barbaro	10 - 4 - 21 - 2 - 1	1.81	0.53	38
2005	Giacomo	5 - 5 - 6 - 0 - 0	4.33	0.94	16
2004	Smarty Jones	10 - 3 - 8 - 1 - 0	3.40	1.00	22
2003	Funny Cide	7 - 2 - 11 - 3 - 1	1.53	0.46	24
2002	War Emblem	9 - 4 - 8 - 1 - 0	3.40	0.95	22
2001	Monarchos	2 - 2 - 13 - 1 - 0	1.40	0.28	18
2000	Fusaichi Pegasus	22 - 10 - 24 - 0 - 0	3.67	0.96	28
1999	Charismatic	9 - 10 - 9 - 0 - 0	5.22	1.00	28
1998	Real Quiet	13 - 2 - 7 - 0 - 0	5.29	1.27	38
1997	Silver Charm	3 - 5 - 17 - 5 - 0	1.22	0.20	30
1996	Grindstone	6 - 4 - 6 - 0 - 6	1.44	0.18	22
1995	Thunder Gulch	10 - 2 - 8 - 0 - 0	4.00	1.10	20
1994	Go For Gin	8 - 5 - 16 - 7 - 6	1.00	0.05	42
1993	Sea Hero	3 - 5 - 22 - 4 - 2	1.12	0.08	36
1992	Lil E. Tee	6 - 2 - 8 - 0 - 0	3.00	0.88	16
1991	Strike The Gold	10 - 6 - 4 - 0 - 0	9.00	1.30	20
1990	Unbridled	11 - 3 - 10 - 0 - 12	1.12	0.03	36
1989	Sunday Silence	4 - 3 - 9 - 0 - 0	2.56	0.69	16
1988	Winning Colors	10 - 14 - 8 - 0 - 4	3.50	0.72	36
1987	Alysheba	12 - 4 - 6 - 2 - 0	3.80	1.08	24
1986	Ferdinand	14 - 2 - 16 - 8 - 0	1.50	0.55	40
1985	Spend A Buck	2 - 3 - 18 - 1 - 0	1.40	0.25	24
1984	Swale	8 - 1 - 11 - 2 - 0	1.93	0.68	22
1983	Sunny's Halo	4 - 5 - 13 - 2 - 0	1.82	0.46	24
1982	Gato Del Sol	6 - 3 - 5 - 2 - 2	1.77	0.50	18
1981	Pleasant Colony	7 - 1 - 9 - 1 - 4	1.32	0.27	22
1980	Genuine Risk	14 - 10 - 24 - 2 - 0	2.57	0.72	50

Table 29. Dosage History of the Kentucky Derby Since 1940, cont.

YEAR	WINNER	DP					DI	CD	PTS
1979	Spectacular Bid	9 -	6 -	2 -	3 -	0	4.00	1.05	20
1978	Affirmed	8 -	6 -	26 -	0 -	0	2.08	0.55	40
1977	Seattle Slew	7 -	6 -	4 -	5 -	0	2.14	0.68	22
1976	Bold Forbes	11 -	4 -	9 -	4 -	0	2.29	0.79	28
1975	Foolish Pleasure	27 -	10 -	11 -	4 -	2	3.70	1.04	54
1974	Cannonade	9 -	14 -	14 -	3 -	4	2.14	0.48	44
1973	Secretariat	20 -	14 -	7 -	9 -	0	3.00	0.90	50
1972	Riva Ridge	19 -	4 -	7 -	2 -	2	3.53	1.06	34
1971	Canonero Ii	5 -	0 -	7 -	2 -	2	1.13	0.25	16
1970	Dust Commander	9 -	4 -	3 -	3 -	1	2.64	0.85	20
1969	Majestic Prince	27 -	11 -	12 -	4 -	2	3.67	1.02	56
1968	Forward Pass	22 -	2 -	17 -	1 -	0	3.42	1.07	42
1967	Proud Clarion	11 -	8 -	26 -	4 -	3	1.60	0.38	52
1966	Kauai King	0 -	22 -	18 -	8 -	0	1.82	0.29	48
1965	Lucky Debonair	2 -	0 -	15 -	3 -	0	0.90	0.05	20
1964	Northern Dancer	8 -	16 -	15 -	3 -	0	3.00	0.69	42
1963	Chateaugay	4 -	16 -	6 -	0 -	4	3.29	0.53	30
1962	Decidedly	2 -	2 -	17 -	6 -	3	0.71	-0.20	30
1961	Carry Back	4 -	2 -	12 -	6 -	0	1.00	0.17	24
1960	Venetian Way	5 -	9 -	4 -	2 -	0	4.00	0.85	20
1959	Tomy Lee	20 -	2 -	26 -	0 -	4	2.06	0.65	52
1958	Tim Tam	10 -	11 -	17 -	4 -	0	2.36	0.64	42
1957	Iron Liege	8 -	2 -	28 -	11 -	3	0.86	0.02	52
1956	Needles	4 -	2 -	10 -	2 -	2	1.22	0.20	20
1955	Swaps	4 -	18 -	14 -	4 -	8	1.53	0.13	48
1954	Determine	4 -	4 -	41 -	3 -	2	1.12	0.09	54
1953	Dark Star	8 -	2 -	0 -	4 -	8	0.83	-0.09	22
1952	Hill Gail	8 -	0 -	26 -	9 -	3	0.84	0.02	46
1951	Count Turf	8 -	0 -	16 -	0 -	2	1.60	0.46	26
1950	Middleground	6 -	0 -	4 -	0 -	2	2.00	0.67	12
1949	Ponder	4 -	0 -	22 -	10 -	4	0.60	-0.25	40
1948	Citation	12 -	0 -	24 -	6 -	8	0.92	0.04	50
1947	Jet Pilot	0 -	0 -	29 -	13 -	2	0.49	-0.39	44
1946	Assault	6 -	6 -	8 -	1 -	3	2.00	0.46	24
1945	Hoop, Jr.	0 -	4 -	16 -	8 -	4	0.60	-0.38	32
1944	Pensive	8 -	0 -	16 -	8 -	8	0.67	-0.20	40
1943	Count Fleet	0 -	2 -	1 -	1 -	0	1.67	0.25	4
1942	Shut Out	4 -	14 -	9 -	3 -	6	1.67	0.19	36
1941	Whirlaway	0 -	12 -	20 -	8 -	0	1.22	0.10	40
1940	Gallahadion	0 -	0 -	16 -	8 -	8	0.33	-0.75	32
	AVERAGE =	**7.88 -**	**5.22 -**	**12.99 -**	**2.92 -**	**1.86**	**2.31**	**0.50**	**30.87**

Table 30. Dosage History of the Preakness Stakes Since 1940

YEAR	WINNER	DP	DI	CD	PTS
2015	American Pharoah	2 - 3 - 3 - 0 - 0	4.33	0.88	8
2014	California Chrome	7 - 5 - 10 - 0 - 0	3.40	0.86	22
2013	Oxbow	6 - 0 - 8 - 0 - 0	2.50	0.86	14
2012	I'll Have Another	2 - 4 - 7 - 1 - 0	2.11	0.50	14
2011	Shackleford	6 - 13 - 9 - 0 - 2	3.62	0.70	30
2010	Lookin At Lucky	10 - 4 - 12 - 0 - 0	3.33	0.92	26
2009	Rachel Alexandra	3 - 2 - 7 - 2 - 0	1.55	0.43	14
2008	Big Brown	4 - 7 - 23 - 2 - 0	1.67	0.36	36
2007	Curlin	9 - 3 - 8 - 0 - 0	4.00	1.05	20
2006	Bernardini	7 - 8 - 13 - 0 - 0	3.31	0.79	28
2005	Afleet Alex	5 - 0 - 9 - 0 - 0	2.11	0.71	14
2004	Smarty Jones	10 - 3 - 8 - 1 - 0	3.40	1.00	22
2003	Funny Cide	7 - 2 - 11 - 3 - 1	1.53	0.46	24
2002	War Emblem	9 - 4 - 8 - 1 - 0	3.40	0.95	22
2001	Point Given	8 - 0 - 8 - 0 - 0	3.00	1.00	16
2000	Red Bullet	7 - 10 - 11 - 0 - 6	1.96	0.35	34
1999	Charismatic	9 - 10 - 9 - 0 - 0	5.22	1.00	28
1998	Real Quiet	13 - 2 - 7 - 0 - 0	5.29	1.27	22
1997	Silver Charm	3 - 5 - 17 - 5 - 0	1.22	0.20	30
1996	Louis Quatorze	11 - 7 - 8 - 0 - 0	5.50	1.12	26
1995	Timber Country	11 - 5 - 22 - 0 - 0	2.45	0.71	38
1994	Tabasco Cat	7 - 3 - 5 - 1 - 0	3.57	1.00	16
1993	Prairie Bayou	6 - 4 - 6 - 0 - 0	4.33	1.00	16
1992	Pine Bluff	10 - 12 - 22 - 0 - 0	3.00	0.73	44
1991	Hansel	10 - 3 - 13 - 2 - 0	2.29	0.75	28
1990	Summer Squall	9 - 10 - 16 - 1 - 0	3.00	0.75	36
1989	Sunday Silence	4 - 3 - 9 - 0 - 0	2.56	0.69	16
1988	Risen Star	12 - 7 - 19 - 4 - 2	1.84	0.52	44
1987	Alysheba	12 - 4 - 6 - 2 - 0	3.80	1.08	24
1986	Snow Chief	0 - 4 - 2 - 0 - 0	5.00	0.67	6
1985	Tank's Prospect	14 - 6 - 8 - 0 - 0	6.00	1.21	28
1984	Gate Dancer	13 - 4 - 17 - 2 - 0	2.43	0.78	36
1983	Deputed Testamony	6 - 3 - 9 - 2 - 0	2.08	0.65	20
1982	Aloma's Ruler	13 - 10 - 6 - 1 - 0	6.50	1.17	30
1981	Pleasant Colony	7 - 1 - 9 - 1 - 4	1.32	0.27	22
1980	Codex	5 - 1 - 6 - 0 - 4	1.29	0.19	16
1979	Spectacular Bid	9 - 6 - 2 - 3 - 0	4.00	1.05	20
1978	Affirmed	8 - 6 - 26 - 0 - 0	2.08	0.55	40
1977	Seattle Slew	7 - 6 - 4 - 5 - 0	2.14	0.68	22
1976	Elocutionist	10 - 5 - 13 - 2 - 0	2.53	0.77	30
1975	Master Derby	8 - 6 - 2 - 0 - 0	15.00	1.38	16
1974	Little Current	8 - 12 - 9 - 16 - 1	1.14	0.22	46
1973	Secretariat	20 - 14 - 7 - 9 - 0	3.00	0.90	50
1972	Bee Bee Bee	2 - 2 - 3 - 2 - 1	1.22	0.20	10
1971	Canonero II	5 - 0 - 7 - 2 - 2	1.13	0.25	16

Table 30. Dosage History of the Preakness Stakes Since 1940, cont.

YEAR	WINNER	DP	DI	CD	PTS
1970	Personality	11 - 9 - 26 - 2 - 2	1.94	0.50	50
1969	Majestic Prince	27 - 11 - 12 - 4 - 2	3.67	1.02	56
1968	Forward Pass	22 - 2 - 17 - 1 - 0	3.42	1.07	42
1967	Damascus	10 - 4 - 3 - 1 - 0	6.20	1.28	18
1966	Kauai King	0 - 22 - 18 - 8 - 0	1.82	0.29	48
1965	Tom Rolfe	4 - 8 - 14 - 4 - 8	1.00	-0.11	38
1964	Northern Dancer	8 - 16 - 15 - 3 - 0	3.00	0.69	42
1963	Candy Spots	2 - 12 - 4 - 0 - 2	4.00	0.60	20
1962	Greek Money	12 - 4 - 10 - 0 - 0	4.20	1.08	26
1961	Carry Back	4 - 2 - 12 - 6 - 0	1.00	0.17	24
1960	Bally Ache	16 - 0 - 4 - 2 - 2	3.00	1.08	24
1959	Royal Orbit	22 - 8 - 15 - 6 - 7	1.83	0.55	58
1958	Tim Tam	10 - 11 - 17 - 4 - 0	2.36	0.64	42
1957	Bold Ruler	26 - 8 - 8 - 11 - 1	2.38	0.87	54
1956	Fabius	6 - 4 - 12 - 2 - 2	1.60	0.38	26
1955	Nashua	22 - 8 - 10 - 2 - 4	3.18	0.91	46
1954	Hasty Road	10 - 14 - 10 - 15 - 3	1.26	0.25	52
1953	Native Dancer	4 - 18 - 0 - 9 - 1	2.20	0.47	32
1952	Blue Man	1 - 3 - 8 - 10 - 2	0.50	-0.38	24
1951	Bold	7 - 3 - 4 - 7 - 1	1.20	0.36	22
1950	Hill Prince	2 - 10 - 10 - 10 - 0	1.13	0.13	32
1949	Capot	10 - 0 - 4 - 3 - 1	2.00	0.83	18
1948	Citation	12 - 0 - 24 - 6 - 8	0.92	0.04	50
1947	Faultless	8 - 0 - 21 - 9 - 2	0.86	0.08	40
1946	Assault	6 - 6 - 8 - 1 - 3	2.00	0.46	24
1945	Polynesian	9 - 1 - 1 - 3 - 0	3.00	1.14	14
1944	Pensive	8 - 0 - 16 - 8 - 8	0.67	-0.20	40
1943	Count Fleet	0 - 2 - 1 - 1 - 0	1.67	0.25	4
1942	Alsab	2 - 6 - 0 - 2 - 2	2.00	0.33	12
1941	Whirlaway	0 - 12 - 20 - 8 - 0	1.22	0.10	40
1940	Bimelech	16 - 12 - 0 - 8 - 0	3.50	1.00	36
	AVERAGE =	**8.57 - 5.86 - 10.11 - 2.97 - 1.11**	**2.83**	**0.65**	**28.61**

Table 31. Dosage History of the Belmont Stakes Since 1940

YEAR	WINNER	DP					DI	CD	PTS
2014	Tonalist	5 -	13 -	14 -	1 -	1	2.78	0.59	34
2013	Palace Malice	4 -	5 -	11 -	0 -	0	2.64	0.65	20
2012	Union Rags	9 -	1 -	10 -	2 -	0	2.14	0.77	22
2011	Ruler On Ice	6 -	1 -	9 -	0 -	0	2.56	0.81	16
2010	Drosselmeyer	7 -	2 -	10 -	2 -	1	1.75	0.55	22
2009	Summer Bird	4 -	4 -	7 -	1 -	0	2.56	0.69	16
2008	Da' Tara	4 -	2 -	5 -	0 -	1	2.43	0.67	12
2007	Rags To Riches	8 -	3 -	11 -	0 -	0	3.00	0.86	22
2006	Jazil	11 -	3 -	14 -	0 -	0	3.00	0.89	28
2005	Afleet Alex	5 -	0 -	9 -	0 -	0	2.11	0.71	14
2004	Birdstone	3 -	4 -	9 -	0 -	2	1.77	0.33	18
2003	Empire Maker	10 -	7 -	13 -	0 -	6	1.88	0.42	36
2002	Sarava	8 -	6 -	8 -	0 -	0	4.50	1.00	22
2001	Point Given	8 -	0 -	8 -	0 -	0	3.00	1.00	16
2000	Commendable	17 -	11 -	14 -	0 -	0	5.00	1.07	42
1999	Lemon Drop Kid	13 -	4 -	21 -	0 -	0	2.62	0.79	38
1998	Victory Gallop	10 -	2 -	9 -	0 -	1	3.00	0.91	22
1997	Touch Gold	4 -	3 -	17 -	0 -	0	1.82	0.46	24
1996	Editor's Note	10 -	4 -	11 -	0 -	3	2.29	0.64	28
1995	Thunder Gulch	10 -	2 -	8 -	0 -	0	4.00	1.10	20
1994	Tabasco Cat	7 -	3 -	5 -	1 -	0	3.57	1.00	16
1993	Colonial Affair	8 -	1 -	19 -	4 -	2	1.19	0.26	34
1992	A. P. Indy	13 -	6 -	16 -	3 -	0	2.45	0.76	38
1991	Hansel	10 -	3 -	13 -	2 -	0	2.29	0.75	28
1990	Go And Go	11 -	3 -	10 -	1 -	1	2.71	0.85	26
1989	Easy Goer	10 -	6 -	14 -	0 -	0	3.29	0.87	30
1988	Risen Star	12 -	7 -	19 -	4 -	2	1.84	0.52	44
1987	Bet Twice	10 -	3 -	6 -	9 -	0	1.33	0.50	28
1986	Danzig Connection	6 -	12 -	14 -	2 -	0	2.78	0.65	34
1985	Creme Fraiche	15 -	4 -	1 -	0 -	0	39.00	1.70	20
1984	Swale	8 -	1 -	11 -	2 -	0	1.93	0.68	22
1983	Caveat	8 -	6 -	5 -	1 -	2	3.00	0.77	22
1982	Conquistador Cielo	18 -	10 -	6 -	0 -	0	10.33	1.35	34
1981	Summing	8 -	7 -	10 -	1 -	0	3.33	0.85	26
1980	Temperence Hill	7 -	4 -	13 -	0 -	0	2.69	0.75	24
1979	Coastal	13 -	7 -	17 -	1 -	0	3.00	0.84	38
1978	Affirmed	8 -	6 -	26 -	0 -	0	2.08	0.55	40
1977	Seattle Slew	7 -	6 -	4 -	5 -	0	2.14	0.68	22
1976	Bold Forbes	11 -	4 -	9 -	4 -	0	2.29	0.79	28
1975	Avatar	1 -	2 -	22 -	9 -	4	0.58	-0.34	38
1974	Little Current	8 -	12 -	9 -	16 -	1	1.14	0.22	46
1973	Secretariat	20 -	14 -	7 -	9 -	0	3.00	0.90	50
1972	Riva Ridge	19 -	4 -	7 -	2 -	2	3.53	1.06	34
1971	Pass Catcher	9 -	4 -	13 -	2 -	4	1.56	0.38	32
1970	High Echelon	11 -	12 -	9 -	6 -	0	2.62	0.74	38

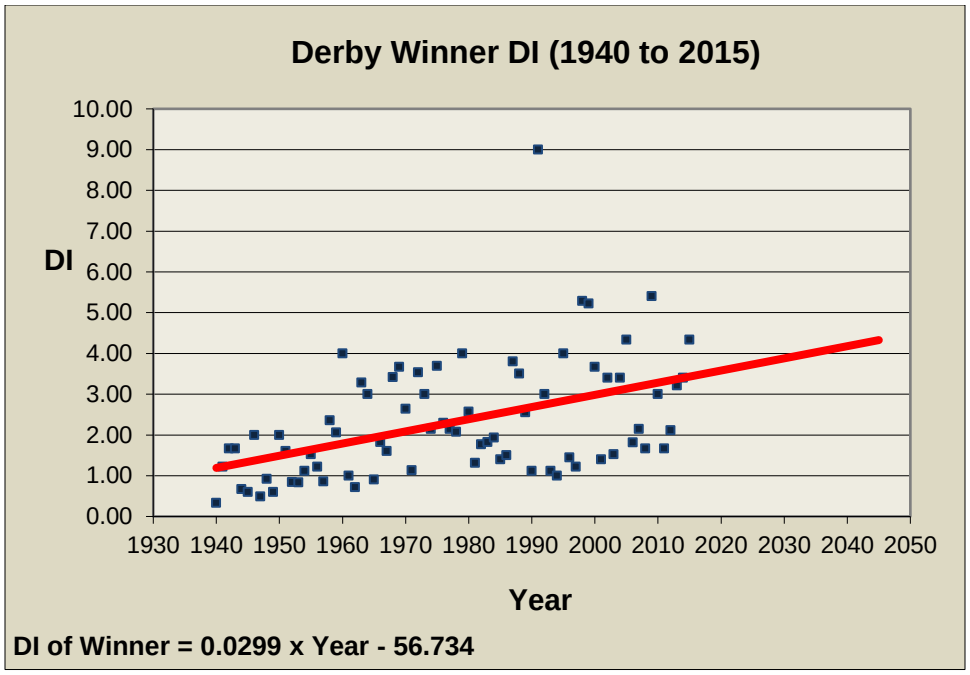
Table 31. Dosage History of the Belmont Stakes Since 1940, cont.

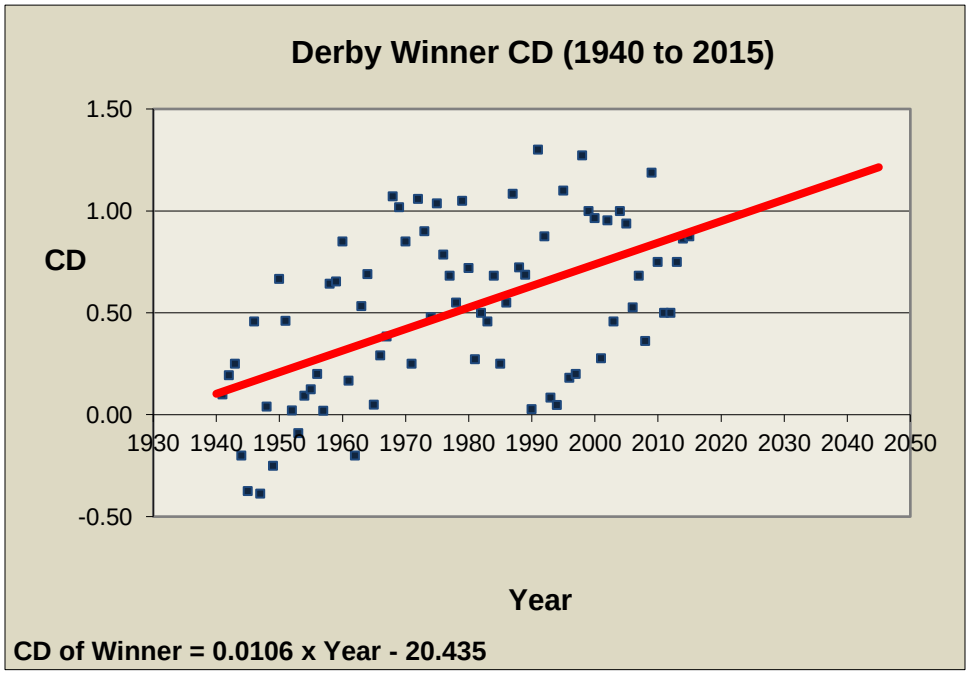
YEAR	WINNER	DP					DI	CD	PTS
1969	Arts And Letters	5 -	2 -	11 -	2 -	8	0.81	-0.21	28
1968	Stage Door Johnny	1 -	4 -	33 -	12 -	0	0.75	-0.12	50
1967	Damascus	10 -	4 -	3 -	1 -	0	6.20	1.28	18
1966	Amberoid	1 -	3 -	6 -	0 -	4	1.00	-0.21	14
1965	Hail To All	10 -	5 -	21 -	5 -	3	1.38	0.32	44
1964	Quadrangle	4 -	4 -	22 -	6 -	0	1.12	0.17	36
1963	Chateaugay	4 -	16 -	6 -	0 -	4	3.29	0.53	30
1962	Jaipur	22 -	16 -	16 -	4 -	0	3.83	0.97	58
1961	Sherluck	4 -	10 -	8 -	0 -	4	2.25	0.38	26
1960	Celtic Ash	1 -	0 -	29 -	6 -	4	0.63	-0.30	40
1959	Sword Dancer	2 -	0 -	2 -	5 -	1	0.43	-0.30	10
1958	Cavan	6 -	6 -	26 -	2 -	12	0.93	-0.15	52
1957	Gallant Man	0 -	4 -	18 -	16 -	2	0.48	-0.40	40
1956	Needles	4 -	2 -	10 -	2 -	2	1.22	0.20	20
1955	Nashua	22 -	8 -	10 -	2 -	4	3.18	0.91	46
1954	High Gun	20 -	2 -	12 -	7 -	3	1.75	0.66	44
1953	Native Dancer	4 -	18 -	0 -	9 -	1	2.20	0.47	32
1952	One Count	2 -	0 -	16 -	9 -	1	0.56	-0.25	28
1951	Counterpoint	4 -	2 -	16 -	7 -	1	0.88	0.03	30
1950	Middleground	6 -	0 -	4 -	0 -	2	2.00	0.67	12
1949	Capot	10 -	0 -	4 -	3 -	1	2.00	0.83	18
1948	Citation	12 -	0 -	24 -	6 -	8	0.92	0.04	50
1947	Phalanx	0 -	4 -	24 -	4 -	0	1.00	0.00	32
1946	Assault	6 -	6 -	8 -	1 -	3	2.00	0.46	24
1945	Pavot	6 -	2 -	1 -	19 -	2	0.40	-0.30	30
1944	Bounding Home	2 -	2 -	0 -	5 -	1	0.67	-0.10	10
1943	Count Fleet	0 -	2 -	1 -	1 -	0	1.67	0.25	4
1942	Shut Out	4 -	14 -	9 -	3 -	6	1.67	0.19	36
1941	Whirlaway	0 -	12 -	20 -	8 -	0	1.22	0.10	40
1940	Bimelech	16 -	12 -	0 -	8 -	0	3.50	1.00	36
	AVERAGE =	**8.35 -**	**5.38 -**	**11.76 -**	**3.76 -**	**1.57**	**2.85**	**0.51**	**30.73**

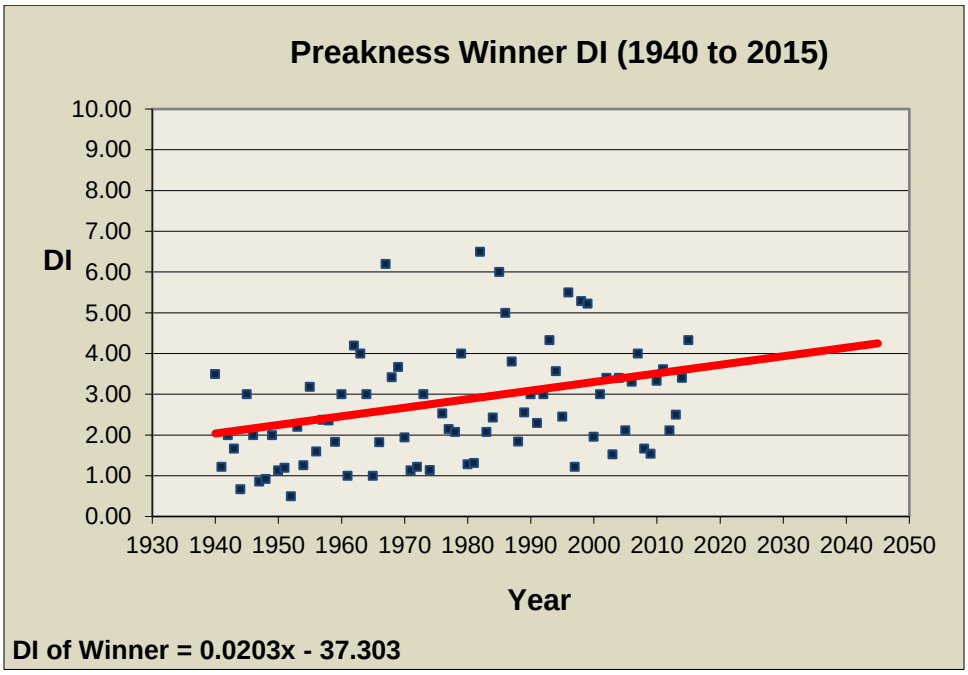
Chart 26 captures in dramatic detail the evolutionary changes that have occurred among North American classic winners over the last 75 to 80 years. The graphs plot the DI and CD of the classic winners by year and include a trend line derived by linear regression and extended thirty years ahead. The shift toward more speed in classic pedigrees is obvious. Should the trend remain the same, with even more speed being infused into pedigrees, there likely will be as many new classic winners within the next 25 years or so with a DI above 4.00 as there are below. At this stage one can only speculate as to the implications of increasing speed in pedigrees on the whole fabric of future racing. However, it may be relevant that the percentage of ten-furlong open stakes races contested on dirt

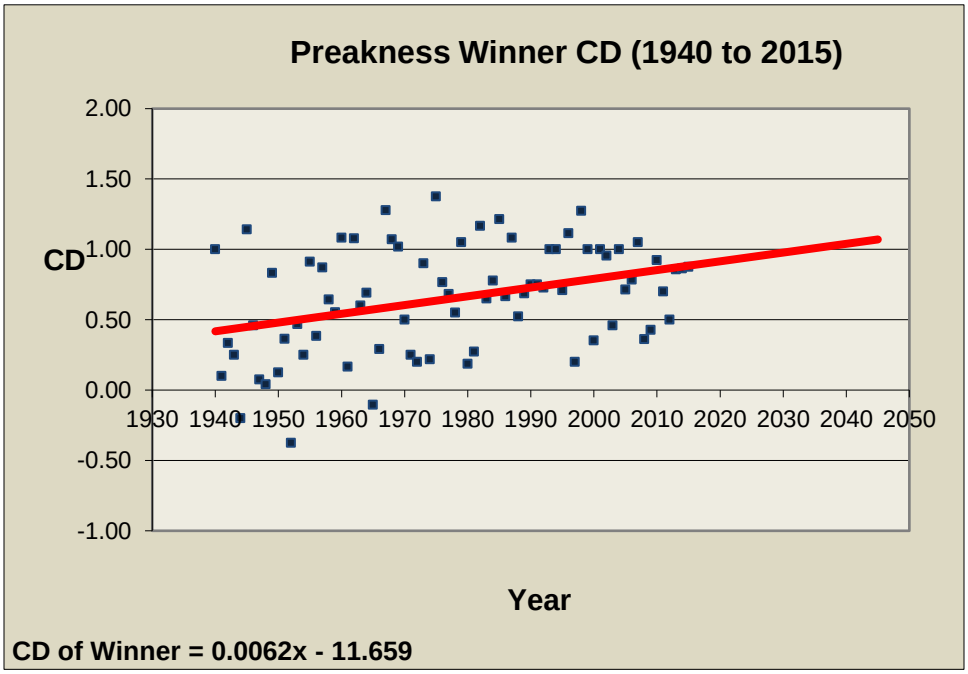
between the years 1983 and 2014 decreased by 38%. The similar trend observed for all three North American classic races since 1940 confirms an overall undeniable shift toward speed.

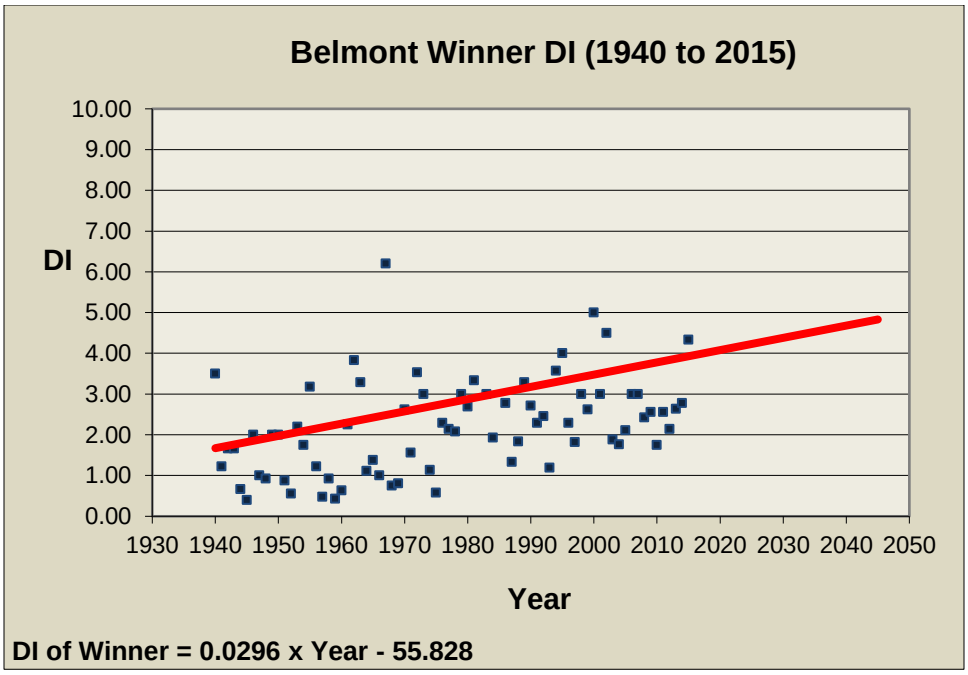
Chart 27. Dosage Trends for Kentucky Derby, Preakness and Belmont Winners (1940-2015)

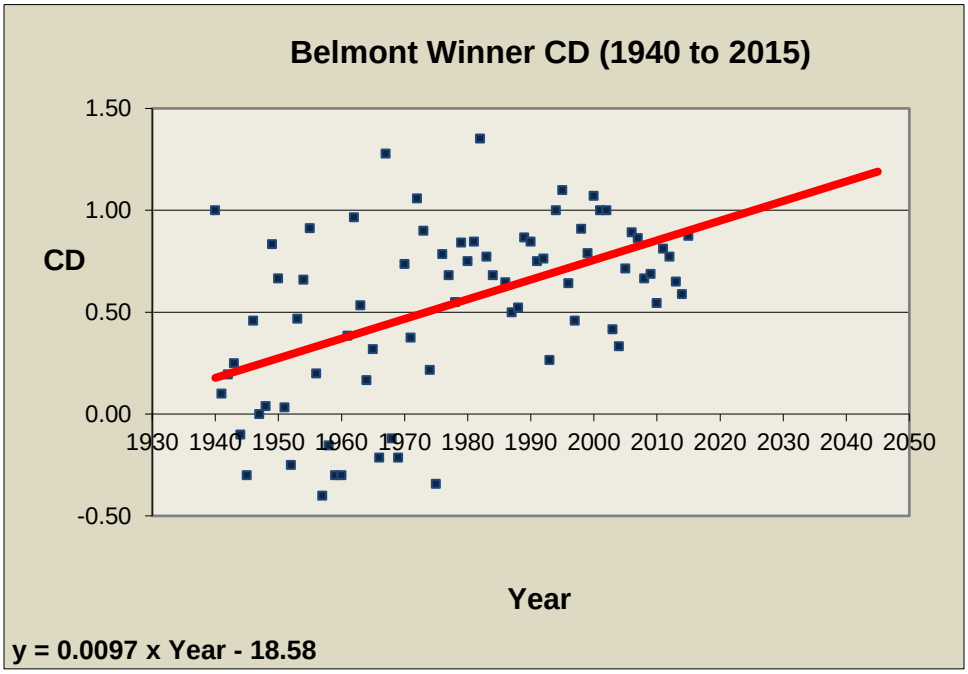





Preakness Winner DI (1940 to 2015)
DI
10.00
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
1930 1940 1950 1960 1970 1980 1990 2000 2010 2020 2030 2040 2050
Year
DI of Winner = 0.0203x - 37.303


Preakness Winner CD (1940 to 2015)
CD
2.00
1.50
1.00
0.50
0.00
-0.50
-1.00
1930 1940 1950 1960 1970 1980 1990 2000 2010 2020 2030 2040 2050
Year
CD of Winner = 0.0062x - 11.659





The EFH is a system of rating the performance of two-year-olds. A panel of experts evaluates the year's stakes quality juveniles and assigns them weights relative to one another. Normally, the highest weight for a colt is 126 pounds. Occasionally a truly exceptional colt will be weighted higher. These include Bimelech (130) in 1939; Alsab (130) in 1941; Count Fleet (132) in 1942; Native Dancer (130) in 1952; Summer Tan (128) in 1954; Bold Lad (130) in 1964; Silent Screen (128) in 1969; Secretariat (129) in 1972; Foolish Pleasure (127) in 1974; Devil's

Bag (128) in 1983; Arazi (130) in 1991; Favorite Trick (128) in 1997; Street Sense (127) in 2006; War Pass (127) in 2007 and Uncle Mo (128) in 2010. Although there is a degree of subjectivity involved in the EFH selection process, it still remains a reasonable guide to relative two-year-old ability. In the absence of a more objective assessment methodology, the EFH serves its purpose as fairly well.

Now the question is: why should a DI of 4.00 or less coupled with a prominent ranking on the EFH be important to classic potential? In the case of the Kentucky Derby (and perhaps to some degree the other classics as well) the reasons are intimately linked to the unique demands of the race, which is like no other run in North America. The answer to the question becomes clearer when we recall that the DI is a guide to distance ability while the EFH ranking is an approximation of early maturity and outstanding two-year-old form. A pedigree suited to the distance, along with demonstrated high class early in a racing career are the historical trademarks of the majority of classic winners over the last quarter century and beyond. First and foremost, the distance presents a formidable challenge. None of the contenders, at least none that raced exclusively in North America, have previously been asked to negotiate a mile and a quarter. The suitability of their breeding to the distance is paramount, and the DI is a clue to that suitability. A horse bred excessively for speed is unlikely to stay the course at this level of competition except when the pace is especially undemanding or the quality of the field is suspect. Those would be unusual circumstances for America's premier classic. Second, there are several attributes of the Derby that are constant from year to year. The overall quality and depth of the field are normally outstanding, with an abundance of regional superstars converging to meet for the first time. The pace is usually fast, pressure-packed, and stressful. The size of the field can often be very large, resulting in a race that is extremely physical as jockeys maneuver their horses for position. The horses are still young and immature; they are a long way from adulthood. The atmosphere is electric and filled with a spectacle that the horses have never experienced. It is reasonable that contenders with an edge in class as well as an edge in emotional and physical maturity should have an advantage. The Dual Qualifiers are blessed with staying pedigrees as expressed in their DI, and an advanced degree of class and maturity as reflected by their superior performance at two and acknowledged by their position on the EFH.

The correlation between Dual Qualifier status and success in the Derby is strong. Between 1946 and 2014 there were 1092 starters in the Derby, although in two years, 1998 and 2003, no Dual Qualifiers were entered. Of these 1092, 249 (22.8%) were Dual Qualifiers. That’s an average of just over three and one-half per race in an average size field of slightly under 16 starters. There was just one Dual Qualifier two times and both won, Cannonade in 1974 in a field of 23 starters, and Foolish Pleasure in 1975 in a field of 15. The largest number of Dual Qualifiers in a single Derby since 1946 is nine in 2010. A Dual Qualifier has captured 35 of the 67 Derbies (52.2%) in which a Dual Qualifier was entered and those 35 comprise 14.1% of all Dual Qualifiers entered. Twenty-nine other Dual Qualifiers (11.6%) finished second while another 24 (9.6%) ran third.

Eighty-eight of all starting Derby Dual Qualifiers (35.3%) finished in the money and 67 of of all starting Derby Dual Qualifiers (26.9%) won at least one American classic race. Dual Qualifiers captured nine exactas in the 64 Derbies in which at least two started. They also accounted for eight trifectas in the 51 Derbies in which at least three started.

It should be easy to see why the Dual Qualifier concept has aroused so much interest. These results are compelling evidence that a staying pedigree, early maturity, and an early expression of high class have been more critical to a Derby victory than some of the conventional criteria used to predict the winner. The Derby favorite is often the "form" horse, a colt or filly coming off a smashing win in his or her last Derby prep race. As we are all aware, these favorites had failed every year since 1978 and until Fusaichi Pegasus' Derby victory in 2000. One conclusion that may be drawn from the success of the Dual Qualifiers, often long odds winners, is that form at nine furlongs in the preps is not always a good predictor of form at ten furlongs in the Derby. The unique circumstances of the Derby provide the environment in which the Dual Qualifier factors, or rather what they represent, become dominant. Other factors are often less significant.

The historical significance of Dual Qualifiers extends even further back in time, although there is nothing comparable to the 16 straight Dual Qualifier wins in the Derby achieved between 1972 and 1987. Table 30 presents the complete history of Dual Qualifiers in the Derby since 1946 and includes the name of the Dual Qualifier and his finishing position. Winning Dual Qualifiers are highlighted in bold type.

Table 32. The History of DQs in the Kentucky Derby (1946-2015)
(including DQ winners of Other Classic Races)

YEAR	DUAL QUALIFIER	FINISH	STARTERS	WIN PAYOFF
2015	Firing Line	2	18	
	Dortmund	3		
	Carpe Diem	10		
	Mr. Z	13		
	Ocho Ocho Ocho	14		
	Upstart	18		
2014	Dance With Fate	6	19	
	We Miss Artie	10		
	Tapiture	15		
2013	Normandy Invasion	4	19	
	Overanalyze	11		
	Frac Daddy	16		
	Goldencents	17		
2012	Creative Cause	5	20	
	Liaison	6		
	UNION RAGS	7		
	Rousing Sermon	8		
	Hansen	9		
	Sabercat	15		
	Gemologist	16		
	Trinniberg	17		
2011	Soldat	11	19	
	Comma to the Top	19		
2010	**SUPER SAVER**	1	20	$18.00
	Make Music for Me	4		
	Noble's Promise	5		
	LOOKIN AT LUCKY	6		
	Dublin	7		
	Devil May Care	10		
	Discreetly Mine	13		
	Homeboykris	16		
	Awesome Act	19		
2009	Pioneerof the Nile	2	19	
	Chocolate Candy	5		
	West Side Bernie	9		
2008	Tale of Ekati	4	20	
	Pyro	8		
	Colonel John	6		
	Court Vision	13		
2007	**STREET SENSE**	1	20	$11.80
	Circular Quay	6		
	Any Given Saturday	8		
	Nobiz Like Shobiz	10		
	Great Hunter	13		
	Liquidity	14		
	Scat Daddy	18		
	Stormello	19		

DERBY WINNER
DERBY/PREAKNESS WINNER
DERBY/BELMONT WINNER
TRIPLE CROWN WINNER
PREAKNESS WINNER
PREAKNESS/BELMONT WINNER
BELMONT WINNER

Table 32. The History of DQs in the Kentucky Derby (1946-2015), cont.
(including DQ winners of Other Classic Races)

YEAR	DUAL QUALIFIER	FINISH	STARTERS	WIN PAYOFF
2006	Brother Derek	4	20	
	Private Vow	17		
2005	**AFLEET ALEX**	3	20	
	Sun King	15		
2004	Lion Heart	2	18	
	The Cliff's Edge	5		
	Action This Day	6		
	Read the Footnotes	7		
	BIRDSTONE	8		
2003	N/A	0	16	
2002	Came Home	6	18	
	Johannesburg	8		
	Saarland	10		
2001	**POINT GIVEN**	5	17	
	A P Valentine	7		
	Dollar Bill	15		
2000	More Than Ready	4	19	
	Captain Steve	8		
	Exchange Rate	12		
	Anees	13		
	High Yield	15		
1999	Cat Thief	3	19	
	Prime Timber	4		
	Excellent Meeting	5		
	LEMON DROP KID	9		
	Answer Lively	10		
	Three Ring	19		
1998	N/A	0	15	
1997	**SILVER CHARM**	1	13	$10.00
	Hello	8		
1996	Cavonnier	2	19	
	Unbridled's Song	5		
	EDITOR'S NOTE	6		
	Diligence	9		
	Matty G	18		
	Honour and Glory	19		
1995	**THUNDER GULCH**	1	19	$51.00
	Tejano Run	2		
	TIMBER COUNTRY	3		
	Eltish	6		
	Talkin Man	12		
	Serena's Song	16		
1994	**GO FOR GIN**	1	14	$20.20
	Blumin Affair	3		
	Brocco	4		
	TABASCO CAT	6		
	Valiant Nature	13		

DERBY WINNER
DERBY/PREAKNESS WINNER
DERBY/BELMONT WINNER
TRIPLE CROWN WINNER
PREAKNESS WINNER
PREAKNESS/BELMONT WINNER
BELMONT WINNER

Table 32. The History of DQs in the Kentucky Derby (1946-2014), cont.
(including DQ winners of Other Classic Races)

YEAR	DUAL QUALIFIER	FINISH	STARTERS	WIN PAYOFF
1993	SEA HERO	1	19	$27.80
	Silver of Silver	8		
	Truth of It All	10		
	Happy Jazz Band	11		
1992	PINE BLUFF	5	18	
	Arazi	8		
1991	Best Pal	2	16	
	Fly So Free	5		
	HANSEL	10		
	Happy Jazz Band	11		
1990	UNBRIDLED	1	15	$23.60
	SUMMER SQUALL	2		
	Pleasant Tap	3		
	Mister Frisky	8		
1989	EASY GOER	2	15	
	Hawkster	5		
	Irish Actor	7		
1988	Forty Niner	2	17	
	Regal Classic	5		
	Kingpost	15		
1987	ALYSHEBA	1	17	$18.80
	BET TWICE	2		
	Conquistarose	9		
	Capote	16		
	Demons Begone	17		
1986	FERDINAND	1	16	$37.40
	Groovy	16		
1985	SPEND A BUCK	1	13	$10.20
	Stephan's Odyssey	2		
1984	SWALE	1	20	$8.80
	Fali Time	4		
	Life's Magic	8		
1983	SUNNY'S HALO	1	20	$7.00
	CAVEAT	3		
	Pax In Bello	7		
1982	GATO DEL SOL	1	19	$44.40
	Laser Light	2		
	Casseleria	13		
1981	PLEASANT COLONY	1	21	$9.00
	Pass the Tab	6		
	Noble Nashua	9		
	Cure the Blues	15		

DERBY WINNER
DERBY/PREAKNESS WINNER
DERBY/BELMONT WINNER
TRIPLE CROWN WINNER
PREAKNESS WINNER
PREAKNESS/BELMONT WIN
BELMONT WINNER

Table 32. The History of DQs in the Kentucky Derby (1946-2015), cont.
(including DQ winners of Other Classic Races)

YEAR	DUAL QUALIFIER	FINISH	STARTERS	WIN PAYOFF
1980	**GENUINE RISK**	1	13	$28.60
	Rumbo	2		
	Rockhill Native	5		
	Plugged Nickle	7		
	Execution's Reason	11		
1979	**SPECTACULAR BID**	1	10	$3.20
	General Assembly	2		
	Golden Act	3		
1978	**AFFIRMED**	1	11	$5.60
	Alydar	2		
	Believe It	3		
1977	**SEATTLE SLEW**	1	15	$3.00
	Get the Axe	4		
	For the Moment	7		
	Nostalgia	13		
1976	**BOLD FORBES**	1	9	$8.00
	Honest Pleasure	2		
	ELOCUTIONIST	3		
	Cojak	6		
1975	**FOOLISH PLEASURE**	1	15	$5.80
1974	**CANNONADE**	1	23	$5.00
1973	**SECRETARIAT**	1	13	$5.00
	Angle Light	10		
1972	**RIVA RIDGE**	1	14	$5.00
	Hold Your Peace	3		
	Freetex	6		
1971	Jim French	2	20	
1970	My Dad George	2	17	
	HIGH ECHELON	3		
	Silent Screen	5		
	Terlago	11		
1969	Dike	3	8	
	Traffic Mark	4		
	Top Knight	5		
1968	T. V. Commercial	3	16	
	Don B.	7		
	Captain's Gig	11		
	Iron Ruler	12		
1967	Successor	6	14	
	Ruken	8		
	Diplomat Way	9		
	Lightning Orphan	14		
1966	Advocator	2	15	
	AMBEROID	7		

DERBY WINNER
DERBY/PREAKNESS WINNER
DERBY/BELMONT WINNER
TRIPLE CROWN WINNER
PREAKNESS WINNER
PREAKNESS/BELMONT WIN
BELMONT WINNER

Table 32. The History of DQs in the Kentucky Derby (1946-2014), cont.
(including DQ winners of Other Classic Races)

YEAR	DUAL QUALIFIER	FINISH	STARTERS	WIN PAYOFF
1965	TOM ROLFE	3	11	
	Native Charger	4		
	HAIL TO ALL	5		
	Swift Ruler	7		
	Bold Lad	10		
1964	NORTHERN DANCER	1	12	$8.80
	Roman Brother	4		
	QUADRANGLE	5		
	Mr. Brick	6		
	Ishkoodah	9		
	Wil Rad	10		
1963	Never Bend	2	9	
	CANDY SPOTS	3		
1962	Ridan	3	15	
	Crimson Satan	6		
1961	CARRY BACK	1	15	$7.00
	Globemaster	6		
	Ambiopoise	12		
1960	VENETIAN WAY	1	13	$14.60
	BALLY ACHE	2		
	Victoria Park	3		
	Tompion	4		
	Bourbon Prince	5		
1959	TOMY LEE	1	17	$9.40
	SWORD DANCER	2		
	First Landing	3		
	ROYAL ORBIT	4		
	Finnegan	6		
	Dunce	7		
	Atoll	9		
	Rico Tesio	10		
1958	Jewel's Reward	4	14	
1957	IRON LIEGE	1	9	$18.80
	Round Table	3		
	BOLD RULER	4		
	Federal Hill	5		
	Mister Jive	7		
1956	NEEDLES	1	17	$5.20
	Career Boy	6		
	Head Man	8		
	Ben A. Jones	16		
1955	NASHUA	2	10	
	Summer Tan	3		
1954	DETERMINE	1	17	$10.60
	HASTY ROAD	2		
	Goyamo	4		
	Correlation	6		
	Fisherman	7		

DERBY WINNER
DERBY/PREAKNESS WINNER
DERBY/BELMONT WINNER
TRIPLE CROWN WINNER
PREAKNESS WINNER
PREAKNESS/BELMONT WIN
BELMONT WINNER

Table 32. The History of DQs in the Kentucky Derby (1946-2015), cont.
(including DQ winners of Other Classic Races)

YEAR	DUAL QUALIFIER	FINISH	STARTERS	WIN PAYOFF
1953	NATIVE DANCER	2	11	
	Invigorator	3		
	Straight Face	6		
1952	HILL GAIL	1	16	$4.20
	Sub Fleet	2		
1951	Battle Morn	6	20	
	Big Stretch	18		
1950	MIDDLEGROUND	1	14	$17.80
	HILL PRINCE	2		
	Oil Capitol	5		
	Your Host	9		
1949	CAPOT	2	14	
	Palestinian	3		
	Olympia	6		
	Johns Joy	9		
	Wine List	13		
1948	CITATION	1	6	$2.80
	My Request	3		
	Grandpere	5		
	Escadru	6		
1947	JET PILOT	1	13	$12.80
	PHALANX	2		
	FAULTLESS	3		
	Cosmic Bomb	5		
1946	ASSAULT	1	17	$18.40
	Spy Song	2		
	Lord Boswell	4		
	Knockdown	5		
	Marine Victory	15		

DERBY WINNER
DERBY/PREAKNESS WINNER
DERBY/BELMONT WINNER
TRIPLE CROWN WINNER
PREAKNESS WINNER
PREAKNESS/BELMONT WIN
BELMONT WINNER

In Table 31 we provide a comparative summary for Dual Qualifiers and non-Dual Qualifiers in the Derby from 1946 through 2014.

Table 33. Dual Qualifiers vs. Non-Dual Qualifiers in the Kentucky Derby (1946-2014)

	DUAL QUALIFIERS	NON-DUAL QUALIFIERS
Starters	249	843
% Starters/Race	22.8%	77.2%
% Derbies Won	52.2%	47.8%
Avg. Finish Position	5.7	9.5
Impact Value*	2.3	0.6

* Impact Value (IV) is a ratio of success to opportunity. For example, Dual Qualifiers won 2.3 times the expected number of Derbies between 1946 and 2014 based on the percentage of Dual Qualifier winners vs. percentage of Dual Qualifier starters. Specifically, 22.8% of the starters were Dual Qualifiers and they won 52.2% of the Derbies. The ratio of 52.2 over 22.8 is 2.3.

Despite its predictive value, the Dual Qualifier concept never was initially intended as a handicapping tool. It was originally offered as a study of the defining qualities of American classic runners, the things that differentiate classic winners from their contemporaries. What may have been lost in its popularization is a full appreciation of the underlying principles. Sometimes a strict application of the "rules" can lead us astray. Part of the problem lies in the subjectivity that goes into EFH rankings and, for that matter, in the limitations of the DI. The EFH is a product of the collective judgment of experts. Sometimes their judgment can be imperfect. The DI is based on data derived from and applied to large populations. Occasionally there will be aptitudinally prepotent ancestors in an individual pedigree not accounted for by the current state of knowledge. It was in this framework that we developed the notion of a "conceptual Dual Qualifier"; i.e., a Derby contender that satisfies the criteria of a distance pedigree and superior juvenile form, yet may have been overlooked by the "rules". The idea first surfaced in the late 1980's with the Derby wins of two non-Dual Qualifiers, Winning Colors and Sunday Silence. Neither was even eligible for EFH ranking because they failed to compete in stakes races as two-year-olds. However, Winning Colors won at first asking while defeating eventual juvenile champion filly Epitome by 2 ½ lengths, ridden out, in a Saratoga Maiden Special Weight event. An injury kept her away until December when she returned to easily win an allowance race by 3½ lengths after a troubled start, leading at every call by daylight and finishing the six-furlong sprint in 1:09.4. One could argue based on her performance that she would have been near the top of her class had she raced through the fall. Similarly, Sunday Silence had broken his maiden at Hollywood Park by ten lengths in 1:09.2 in mid-November and returned three weeks later to lose an allowance race by a head to Houston at the same track. In both races he was on the lead in under 45 seconds through a half mile. Houston emerged as one of the winter-book Derby favorites after winning the Bay Shore Stakes (G2) as an early three-year-old. Arguments could be made that both Winning Colors and Sunday Silence were clearly among the best of their respective crops. Both conformed to the principles supporting the Dual Qualifier concept even though neither fit the "rules". It's reasonable to conclude that had they been given the opportunity to compete during the year in open stakes company they would have achieved prominent EFH rankings. Other Derby-winning conceptual Dual Qualifiers include Grindstone, Smarty Jones and Funny Cide.

Grindstone was assigned a low weight on the EFH on the basis of just two starts prior to suffering a season-ending injury in his stakes debut. How good was he? He broke his maiden by five lengths in early June at Belmont Park earning a speed figure on our system unsurpassed by any other North American two-year-old in 1995 in a maiden race until October of that year. He took up where he left off as a young three-year-old and moved forward, winning

the Louisiana Derby (G3) by 3½ lengths and falling short to finish second by a diminishing neck in the Arkansas Derby (G2). Based on his debut performance and sustained quality at three, we can be confident that had he not been injured he would have been among the elite of his juvenile season.

Funny Cide, was a New York-bred that never competed in open stakes company at two yet earned the 4th best two-year-old Beyer Speed Figure of 2003. His performances against open company as an early three-year-old easily confirmed his elite status as a juvenile, and with a DI well below 4.00, one could reasonably have argued for his Dual Qualifier status. The same is true in the case of 2004 Derby winner Smarty Jones, who also did not race in open stakes competition but earned the highest two-year-old Beyer Speed Figure of 2004 and had a DI well below 4.00.

Often the conceptual Dual Qualifier will not be apparent until stepping up as a classic contender at three. Horses that he (or she) defeated at two may emerge as major forces in the division. His juvenile form may have been obscured by a campaign-stopping injury, yet he may resurface in spectacular fashion the following spring. Again, one must use judgment. However, a conceptual Dual Qualifier is not a horse that simply faced the battles the previous year. There should be convincing evidence that he was among the best. Typically, several potential candidates will likely emerge during the course of a winter/spring pre-Derby campaign, although most will probably not make it to the Derby.

Legitimate Derby contenders will always be relatively few in number. The success of Dual Qualifiers over time is a testament to that fact. A horse with a pedigree ill-suited to the distance and/or an inexperienced, late-developing type, even though highly talented, will often falter when confronted by a true stayer that matured quickly, and who successfully competed at the highest levels in the early stages of his career. These Dual Qualifier traits contribute to the definition of American classic horses.

Even though Dosage has come under attack in recent years because its Kentucky Derby success in the 1990's did not match its success in the previous two decades, the actual accomplishments of Dual Qualifiers in Triple Crown races suggest that those who believe "Dosage is dead" are taking a rather narrow view. The following tables display the record of Dual Qualifiers (Table 34) and non-Dual Qualifiers (Table 35) since 1973 in all Triple Crown races in which both types competed. The races with no starting Dual Qualifiers were excluded for the obvious reason that they had no opportunity to win. The data are presented in terms of overall Impact Value (IV) by decade and by individual Triple Crown race. IV statistics for Dual Qualifiers are calculated by dividing the percentage of classic winners that were Dual Qualifiers by the percentage of Dual Qualifiers that started in the classic races. For example, if 20% of the races were won by Dual Qualifiers and 20% of the starters were Dual Qualifiers, then the IV

is 1.00. However, if 40% were won by Dual Qualifiers with the same 20% Dual Qualifier starters, then the IV is 2.00 or twice the expectation. The same calculations were made for non-Dual Qualifiers. In a random world where no traits offer an advantage, the IV would approach 1.00 for all contenders. As the reader will observe in Table 30, the IVs for Dual Qualifiers are 2.30 or higher for each of the Triple Crown races over the past 40-plus years. IV is, in effect, a ratio of success associated with a set of characteristics relative to the opportunity available. By contrast, the results for non-Dual Qualifiers as presented in Table 31 are generally quite poor. Critics may argue the point, but the success of Dual Qualifiers in defining North American classic type is apparent. It should be pointed out, however, that the IV for the Derby has been declining since the 1970s. This could mean that the characteristics of Derby winners are slowly evolving as more speed-bred or late developing types emerge as stronger Derby candidates. On the other hand, the Preakness and Belmont IV numbers have held up much better. It also may be noteworthy that it is only since 1998 that Triple Crown races have been run in the absence of any Dual Qualifiers. Between 1973 and 1997, every Triple Crown race had at least one Dual Qualifier among the starters. Between 1998 and 2014, fourteen of the fourty-eight Triple Crown races lacked a Dual Qualifier, two in the Derby, five in the Preakness and seven in the Belmont. The significance of this dramatic change in the makeup of American classic fields in recent years is unclear. It is possible that the prominent juveniles of today are no longer as well suited to distance racing as they once were and tend to be more precocious and speed oriented than in the past. Speed bred to speed may be adequate for success in juvenile races as presently configured, but it fails when challenged by classic distances. There certainly can be no argument that many prominent North American stallions are speed sires catering to an early sales market. High-class speed from a sire is still high class, but perhaps not over a classic distance, and especially when coupled with speed from the mare. It is also possible that increased fragility in the Thoroughbred diminishes the probability of early developing types surviving the rigors of a two-year-old campaign and a long three-year-old pre-classic campaign. This could account for their displacement by later-developing runners that have been subjected to less stress.

Table 34. Dual Qualifiers in Triple Crown Races Since 1973

YEARS		DERBY	%	PREAKNESS	%	BELMONT	%	ALL	%
2010-2014	**Races**	5		4		3		12	
	Winners	1	20.0%	1	25.0%	1	33.3%	3	25.0%
	DQs	22	28.2%	8	21.6%	5	14.3%	35	23.3%
	Starters	78		37		35		150	
	IV	0.71		1.16		2.33		1.07	
YEARS		**DERBY**	**%**	**PREAKNESS**	**%**	**BELMONT**	**%**	**ALL**	**%**
2000-2009	**Races**	9		7		5		21	
	Winners	1	11.1%	3	42.9%	3	60.0%	7	33.3%
	DQs	34	18.2%	17	23.0%	9	18.8%	60	19.4%
	Starters	187		74		48		309	
	IV	0.61		1.87		3.20		1.72	
YEARS		**DERBY**	**%**	**PREAKNESS**	**%**	**BELMONT**	**%**	**ALL**	**%**
1990-1999	**Races**	9		9		10		28	
	Winners	5	55.6%	6	66.7%	6	60.0%	17	60.7%
	DQs	38	25.0%	19	19.2%	21	20.0%	78	21.9%
	Starters	152		99		105		356	
	IV	2.22		3.47		3.00		2.77	
YEARS		**DERBY**	**%**	**PREAKNESS**	**%**	**BELMONT**	**%**	**ALL**	**%**
1980-1989	**Races**	10		10		10		30	
	Winners	8	80.0%	2	20.0%	5	50.0%	15	50.0%
	DQs	33	19.3%	13	13.8%	14	13.5%	60	16.3%
	Starters	171		94		104		369	
	IV	4.15		1.45		3.71		3.08	
YEARS		**DERBY**	**%**	**PREAKNESS**	**%**	**BELMONT**	**%**	**ALL**	**%**
1973-1979	**Races**	7		7		7		21	
	Winners	7	100.0%	5	71.4%	4	57.1%	16	76.2%
	DQs	21	21.9%	15	26.8%	11	20.4%	47	22.8%
	Starters	96		56		54		206	
	IV	4.57		2.67		2.81		3.34	
YEARS		**DERBY**	**%**	**PREAKNESS**	**%**	**BELMONT**	**%**	**ALL**	**%**
1973-2014	**Races**	**40**		**37**		**35**		**112**	
	Winners	**22**	**55.0%**	**17**	**45.9%**	**19**	**54.3%**	**58**	**51.8%**
	DQs	**148**	**21.6%**	**72**	**20.0%**	**60**	**17.3%**	**280**	**20.1%**
	Starters	**684**		**360**		**346**		**1390**	
	IV	**2.54**		**2.30**		**3.13**		**2.57**	

Table 35. Non-Dual Qualifiers in Triple Crown Races Since 1973

YEARS		DERBY	%	PREAKNESS	%	BELMONT	%	ALL	%
2010-2014	Races	5		4		3		12	
	Winners	4	80.0%	3	75.0%	2	66.7%	9	75.0%
	non-DQs	56	71.8%	29	78.4%	30	85.7%	115	76.7%
	Starters	78		37		35		150	
	IV	1.11		0.96		0.78		0.98	
YEARS		DERBY	%	PREAKNESS	%	BELMONT	%	ALL	%
2000-2009	Races	9		7		5		21	
	Winners	8	88.9%	4	57.1%	2	40.0%	14	66.7%
	non-DQs	153	81.8%	57	77.0%	39	81.3%	249	80.6%
	Starters	187		74		48		309	
	IV	1.09		0.74		0.49		0.83	
YEARS		DERBY	%	PREAKNESS	%	BELMONT	%	ALL	%
1990-1999	Races	9		9		10		28	
	Winners	4	44.4%	3	33.3%	4	40.0%	11	39.3%
	non-DQs	114	75.0%	80	80.8%	84	80.0%	278	78.1%
	Starters	152		99		105		356	
	IV	0.59		0.41		0.50		0.50	
YEARS		DERBY	%	PREAKNESS	%	BELMONT	%	ALL	%
1980-1989	Races	10		10		10		30	
	Winners	2	20.0%	8	80.0%	5	50.0%	15	50.0%
	non-DQs	138	80.7%	81	86.2%	90	86.5%	309	83.7%
	Starters	171		94		104		369	
	IV	0.25		0.93		0.58		0.60	
YEARS		DERBY	%	PREAKNESS	%	BELMONT	%	ALL	%
1973-1979	Races	7		7		7		21	
	Winners	0	0.0%	2	28.6%	3	42.9%	5	23.8%
	non-DQs	75	78.1%	41	73.2%	43	79.6%	159	77.2%
	Starters	96		56		54		206	
	IV	0.00		0.39		0.54		0.31	
YEARS		DERBY	%	PREAKNESS	%	BELMONT	%	ALL	%
1973-2014	**Races**	**40**		**37**		**35**		**112**	
	Winners	**18**	**45.0%**	**20**	**54.1%**	**16**	**45.7%**	**54**	**48.2%**
	non-DQs	**536**	**78.4%**	**288**	**80.0%**	**286**	**82.7%**	**1110**	**79.9%**
	Starters	**684**		**360**		**346**		**1390**	
	IV	**0.57**		**0.68**		**0.55**		**0.60**	

Chapter 22

Does Pedigree Matter Any Longer in the Kentucky Derby?

The startling upset wins by Giacomo in the 2005 Kentucky Derby and Mine That Bird in the 2009 Kentucky Derby, both at odds of greater than 50-1 and both with a DI over 4.00, have led to speculation that pedigree may no longer be as important as it once was in defining the classic American Thoroughbred. After all, Giacomo's sire, Holy Bull, had previously sired only one major stakes winner on the dirt at a distance beyond nine furlongs. That horse was Thunder Blitz, winner of Aqueduct's 2003 Grade 3 Queens County Handicap at 9½ furlongs and beaten in Monarchos' 2001 Kentucky Derby by almost nine lengths. Adding to concern about Holy Bull as a classic sire was the short 7.65 furlong average winning distance of his progeny in North American open stakes races. Mine That Bird's sire, Birdstone, although a classic winner, is a young sire with no established pattern regarding the distance capability of his get. One can speculate about the type he should transmit; however, there are numerous examples of sprinting sires consistently getting stayers and vice versa. You can't know how they will produce until they do.

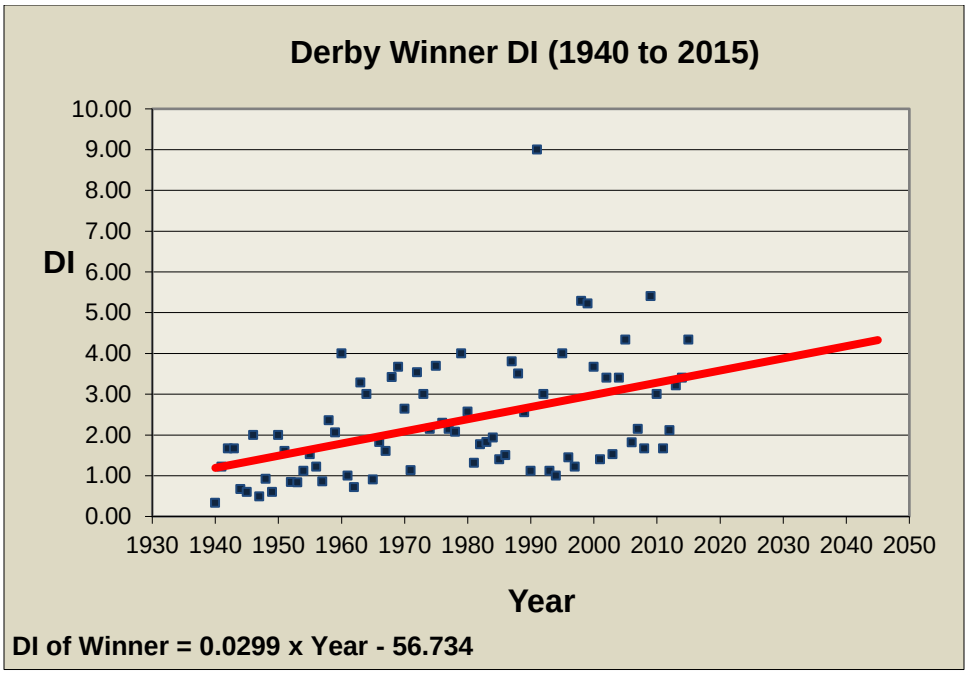
The situation is complicated by the recent Derby wins of Smarty Jones in 2004, Funny Cide in 2003 and War Emblem in 2002. They were all sired by young stallions, none of which had ever won a stakes race beyond a mile. Elusive Quality, sire of Smarty Jones, and Distorted Humor, sire of Funny Cide, were noted for their blazing speed, the former setting a world record for a mile on the turf and the latter setting the seven-furlong track record at Churchill Downs. War Emblem's sire, Our Emblem, could do no better than place in graded stakes races at seven and eight furlongs. There is little to indicate from their racing careers that they would become classic sires early in their stud career. Of course, the sire side of a pedigree is just one half of the equation. A speed sire alone doesn't preclude the possibility of a classically-bred, aptitudinally-balanced pedigree. Which brings us to Dosage.

Following a half century of Derby wins by horses with a Dosage Index (DI) of 4.00 or less, we have seen five winners exceeding that figure since 1991, including Giacomo and Mine That Bird. Now for many people these events are proof that Dosage has lost its usefulness or never was useful in the first place. That may be an obvious conclusion for those who considered Dosage to be only a mysterious magic formula for handicapping the Kentucky Derby. More than likely they are unaware that Dosage is, in fact, a pedigree classification system intended to monitor the dynamic changes in the relationship between pedigree type and track performance. If pedigree type is truly evolving, Dosage will capture the nature of that evolutionary process very well.

Dosage methodology has enabled us to observe an "inflation" factor in the DI of Derby winners for many years. Plotting the DI of Derby winners by year since 1940 and subjecting the data to linear regression yields a trend line indicating an

average increase of just under 0.03 DI units per year over the last 70 years. This trend is depicted graphically in Chart 28 which reproduces Chart 27 presented earlier.

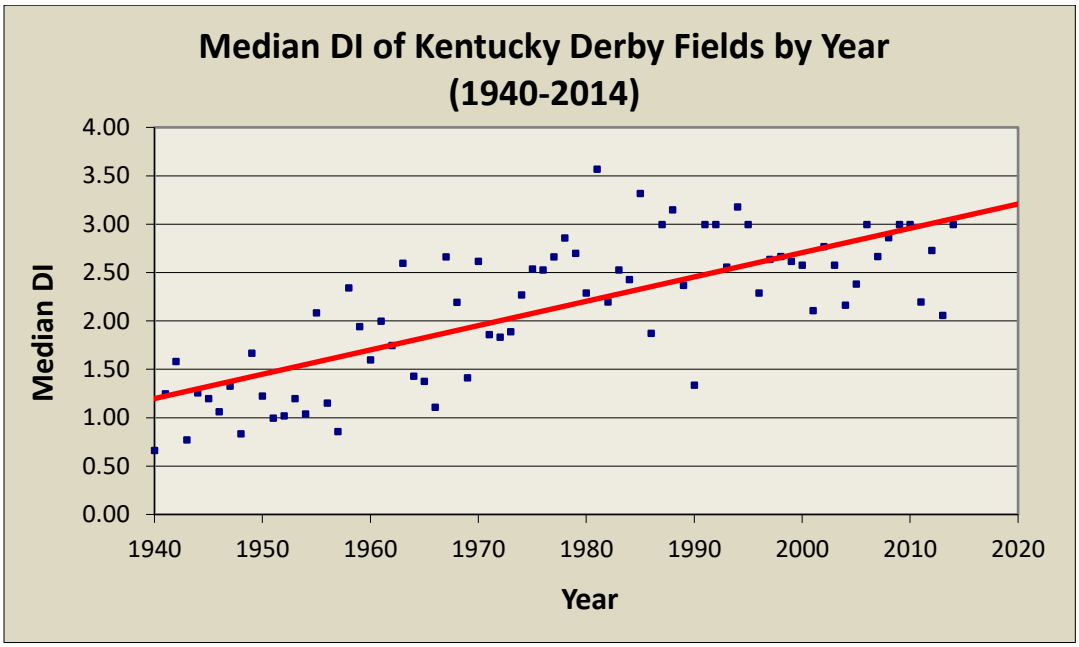
Chart 28. Derby Winner DIs



Extending the trend line 15 years into the future strongly suggests that in the absence of a dramatic shift in breeding patterns we can expect half of all Derby winners by 2025 to have a DI over the previous historical guideline figure of 4.00. This alone is compelling evidence that the pedigree type of Derby winners is constantly evolving toward greater speed, a development that is troubling to traditionalists who believe excessive speed in pedigrees is a detriment to the Thoroughbred and undermines the meaning of classicity. This chart also challenges the assertion by some that Dosage is no longer relevant to classic racing because several horses have now exceeded the DI 4.00 guideline figure initially observed in1981. At that time every Derby winner since 1940 had a pedigree with a DI below 4.00. Also at that time, in the original Daily Racing Form series introducing modern Dosage methodology, we had presented data clearly revealing an inflation in Dosage figures for various divisional champions between the 1940s and the 1970s. Thus, the notion of increasing speed in Thoroughbred pedigrees was well-established from the very beginning. That classic winners are following the same pattern should come as no surprise and, in reality, confirms the value of Dosage for monitoring the evolution of Thoroughbred speed.

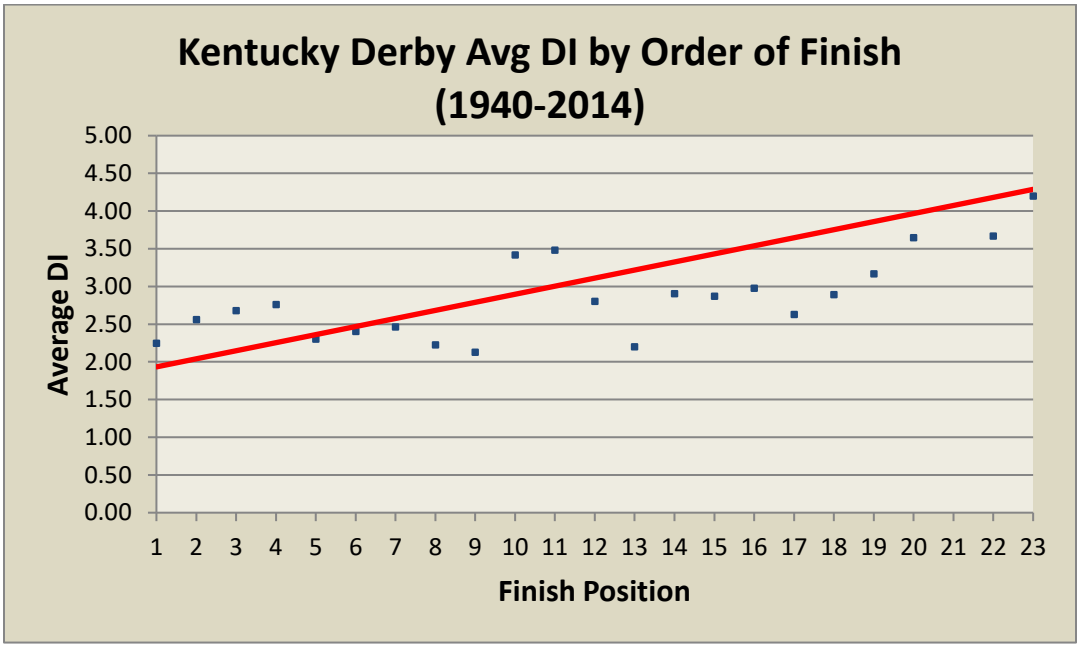
Similarly, we can observe a parallel rise in the overall speed of entire Kentucky Derby fields over the same timeframe as seen in Chart 29.

Chart 29. Median DI of Kentucky Derby Fields by Year



Separately, we can look at the DI of Kentucky Derby starters relative to their finishing position in the race. Chart 30 displays the trend line of the average DI by each finish position where we see a pattern in which lower DI starters have a history of finishing closer to the front than do higher DI starters. It's clear that more stoutly bred horses have a competitive advantage at the classic distance.

Chart 30. Average DI by Finish Position in the Kentucky Derby



But even if we accept that the pedigree type of Derby winners is changing, we are still confronted by the question of whether the changes we see have made pedigree less important to Derby performance. One way of addressing the question is to attempt a correlation of the quality of individual Kentucky Derbies with the pedigree type of the winners. How can we do this?

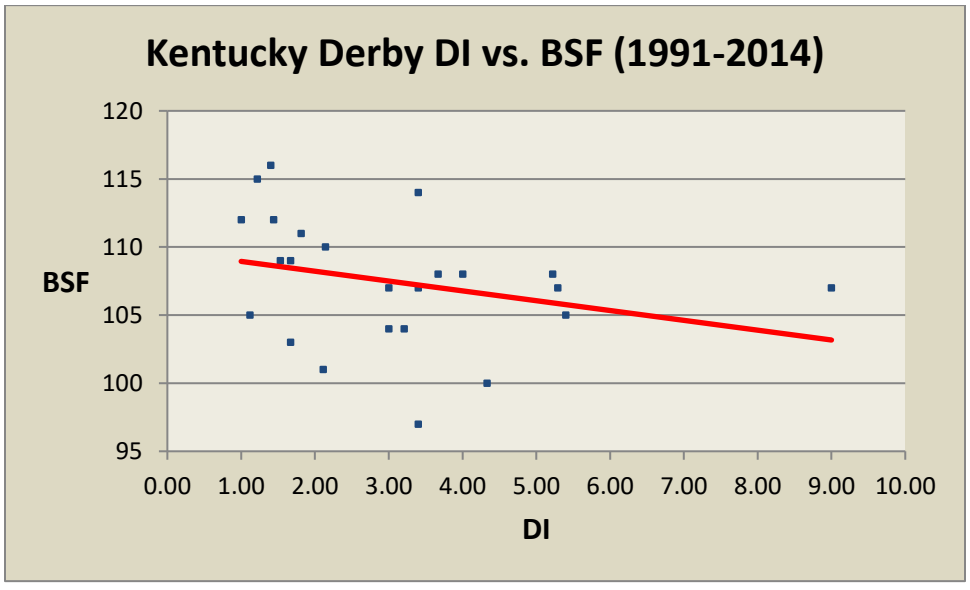
One measure of race quality is through the use of speed figures that tell us how fast a race was actually run. Speed figures are preferable to the raw final time of a race because time can be dramatically affected by track speed on a given day. Perhaps the longest established, widely known and most reliable speed figures available to the general public are those published by Andrew Beyer, long-time racing columnist for the Washington Post. Beyer, an internationally respected turf writer and handicapper, has been publishing his figures for quite some time, providing us with a good historical record. Meanwhile, the complementary historical pedigree type of Derby winners is available using Dosage figures.

The following table displays the DI of all Derby winners since 1991 along with the Beyer Speed Figure (BSF) for each year's Derby. We use 1991 as the starting point because that year was the first in which the historical DI 4.00 guideline was exceeded and it represents a dramatic shift in the pedigree type of Derby winners. The DI used in the table is the DI of the winner at the time of his Derby win and does not reflect any subsequent changes resulting from the addition of new *chefs-de-race*. The reader will notice that the five Derby winners with a DI above 4.00 were assigned BSFs by Beyer, an outspoken critic of Dosage, less than or equal to 108, his par figure for Derby winners. Only one of the five, Charismatic, actually matched the par figure. The nine highest BSFs belong to Derby winners with a DI of less than 4.00. Without him knowing it, Beyer's own data confirm a correlation between Dosage and Kentucky Derby performance. Chart 31 plots the DI against the BSF. The red line is the trend line derived by linear regression.

Table 36. Derby Winner DI vs. Derby Winner BSF

YEAR	DERBY WINNER	DI	BSF
1991	Strike The Gold	9.00	107
1992	Lil E. Tee	3.00	107
1993	Sea Hero	1.12	105
1994	Go For Gin	1.00	112
1995	Thunder Gulch	4.00	108
1996	Grindstone	1.44	112
1997	Silver Charm	1.22	115
1998	Real Quiet	5.29	107
1999	Charismatic	5.22	108
2000	Fusaichi Pegasus	3.67	108
2001	Monarchos	1.40	116
2002	War Emblem	3.40	114
2003	Funny Cide	1.53	109
2004	Smarty Jones	3.40	107
2005	Giacomo	4.33	100
2006	Barbaro	1.81	111
2007	Street Sense	2.14	110
2008	Big Brown	1.67	109
2009	Mine That Bird	5.40	105
2010	Super Saver	3.00	104
2011	Animal Kingdom	1.67	103
2012	I'll Have Another	2.11	101
2013	Orb	3.21	104
2014	California Chrome	3.40	97

Chart 31. The Relationship Between Derby Winner DIs and Their BSFs



Although we see the expected typical scatter in the data, the trend line is quite revealing. The slant of the line from upper left to lower right indicates that the higher BSFs are associated with lower DIs. Said another way, Derby winners with more stamina-oriented pedigrees tend to run faster and earn better speed figures. Of course there are exceptions, such as War Emblem with DI 3.40, BSF 114 and Sea Hero with DI 1.12, BSF 105. However, the purpose of a statistical analysis is not to show that every member of a population with a common characteristic fits the population profile, Rather, the purpose is to demonstrate whether separate populations, each sharing unique characteristics, are the same or different. In this case we are trying to determine if Derby winners with higher DIs (i.e., relatively more inherited speed in their pedigree) have exhibited a different level of performance in the Derby than winners with lower DIs (i.e., relatively more inherited stamina). Note in this study that there are two clusters in the data, one group (or population) with DI 2.00 and above and another group (or population) with DI below 2.00. A statistical t-test showing whether the two populations are different from one another by more than mere chance yields the following result when we compare the BSFs of the two groups.

	DI<2 (Avg = 1.43)	DI>=2 (Avg = 4.04)
BSF Average	110.2	105.8
P-Value	0.02	

Perhaps most important to this analysis is the P-value of 0.02, suggesting that even though the sample sizes are relatively small, the difference observed between the two groups is statistically significant (requiring a value of 0.05 or less). It tells us that there is only about a 2% likelihood that the difference we see in the average BSFs for the two groups is the result of chance.

From this analysis we may interpret the result to mean that pedigree actually does still make a difference in the Kentucky Derby, not necessarily in terms of which horse will win, but rather in terms of the quality of the classic performance. We have seen several classic winners with DIs over 4.00 in the last few years, but they belong to a group of speedier-bred horses that have not performed as well as their stouter-bred counterparts. Apparently not all classic races are created equal, and at least in recent years that inequality correlates especially well with the pedigree type of the winners. Stamina, required to stay a classic distance in classic horse time, is still a great asset. When a horse not traditionally bred to stay a classic distance wins a classic race, there is a reasonable probability that the race will fall short of historical classic standards.

Chapter 23

The Controversy Surrounding Dosage

Anyone even remotely familiar with modern day Dosage is aware of the controversy it has spawned. The source of the controversy is problematic at best and often results from a gross misinterpretation of Dosage's purpose and intent. As stated at the outset, contemporary Dosage is simply a pedigree classification technique. It is not, as some have claimed, a breeding theory. It is not, as still others maintain, a handicapping system. However, the information Dosage provides may be used in both breeding and handicapping. The way people use it depends on how it addresses their particular need. Those who apply it to the breeding of racehorses and who feel comfortable with the result are perfectly free to do so. If Dosage affords a better idea of the type of foal a mating might produce, then it has served its purpose. Those who believe it can help identify the potential winners of races are equally free to use it in that manner. If Dosage can increase the horseplayer's chances of cashing a ticket, who is in a position to deny him the opportunity? The only measure of Dosage's validity is if its application enhances one's understanding and whether it provides insights one wouldn't have without it.

The most obvious source of negative reaction to Dosage may be that it challenges conventional thinking. In that regard it represents a threat to those heavily invested in traditional ways of interpreting Thoroughbred pedigrees. A defensive posture in such circumstances is typical of human behavior. The perception of a threat from Dosage may be enhanced by the fact that it is constructed within the context of rigorous statistical analysis. Few if any other approaches to pedigree interpretation are as well supported by such a statistical framework. For the most part, traditional pedigree interpretation is anecdotal in character. There are many misconceptions and false principles espoused as truth that are based on subjectivity and intuition rather than real data or solid facts. One such misconception is the notion of a direct correlation between a horse's characteristics as a runner and its ability to transmit those same characteristics to its descendants. Such a correlation can obviously exist in individual cases, but it is not predictable with any degree of certainty. We have alluded to this in our earlier discussions. If it were, then Kingmambo, a miler by a sprinter and sire of sprinter-milers and out of a champion miler, would hardly be a candidate to consistently sire classic distance types. Yet he does. Similarly, we would not expect Slewpy, a Grade 1 winner at a classic distance by a classic sire and out of a producer of middle distance horses, to have been predominantly a sire of sprinters. Yet he was. In fact, Dosage avoids the trap created when the emphasis is on an ancestor's racing performance rather than its actual performance at stud. That doesn't make Dosage a superior method, just an alternative one. The problem is that some people have a difficult time dealing with things that are different from what they know and what they understand. Nevertheless, there are legitimate questions raised about Dosage methodology that should be answered.

Perhaps the most sensitive issue is that of *chef-de-race* selection. Many critics insist that the list of *chefs-de-race* should comprise only those sires "worthy" of inclusion based on their overall excellence at stud or that have achieved a level of recognition within the breed that elevates them far beyond the ordinary. That would be fine if the *chef-de-race* list were a roster of great sires – a Stallion Hall of Fame, so to speak. But it isn't. A requirement for stallion greatness in a *chef-de*-race candidate parallels Varola's selection philosophy discussed earlier. However, contemporary Dosage methodology seeks the most accurate possible aptitudinal interpretation of a pedigree. If a strong case can be made for a less than stellar sire, yet one that is successful enough to generate sufficient data from his descendants to confirm aptitudinal prepotence, he becomes more important to an interpretation than the leading sire with no evidence of such prepotence. Those who are most concerned with honoring stallions will be served best by other systems of pedigree analysis. Dosage must rely on demonstrated prepotence for type as the driver behind the *chef-de-race* selection process.

One consequence of a *chef-de*-race selection process requiring convincing statistical evidence can be a time lag in updating the aptitudinal interpretation of some pedigrees. This is a legitimate concern and is most apparent with younger, unproven sires that have not had enough time to establish their aptitudinal credentials. It may also be the case with more established sires that haven't met the statistical criteria for *chef-de-race* assignment. The result can be a shortage of first- and second-generation *chefs-de-race* in many pedigrees. Although the impact on population-wide Dosage trends is likely to be minimal, this situation can and does influence the aptitudinal interpretation of individual pedigrees. To deal with this situation we can catalog recent non-*chef-de-race* sires according to the general performance characteristics of their better runners, using the average winning distance of their progeny in open stakes races as a convenient guide.

Appendix II classifies many current and recent prominent sires and broodmare sires according to the apparent qualities of speed or stamina they transmit to their progeny. An assignment to a category does not imply aptitudinal prepotence. That is reserved for *chefs-de-race*. Rather, the classification reflects the general character of their runners. In many cases, the speed or stamina seen may derive from prepotent ancestors in their own pedigree. Nevertheless, the classifications are a guide to the typical performance traits of the sire's runners, where speed is associated with shorter races, and stamina with longer races and, quite often, turf. The Table is a useful guide in cases where *chefs-de-race* are not present close up in a pedigree. In those situations, making a mental adjustment to the Dosage Profile can be helpful in better understanding the aptitudinal makeup of the horse in question.

Still another area of controversy focuses on the influence of mares. Many critics allege that mares are ignored in the Dosage calculations. The role of mares in contemporary Dosage methodology is adequately explained by the European Dosage expert Steve Miller in a recently published response to critics:

"*…it is a common misconception that the system does not take account of the dam's side – it does through qualifying chef-de-race sires that are present in that half of the pedigree. The reasons females are excluded as individuals are: 1) characteristics transmitted by a given individual are not necessarily those they possessed as a racehorse and 2) there is not enough data to make any assumption based of the performance of a mare's progeny – even the most successful mare may have only a small handful of offspring that make it to the racecourse in their lifetime, whereas a stallion may have more than 1,000 individuals racing over less than a decade. It is clearly unsafe to base any claim of aptitudinal prepotence on such a relatively tiny progeny sample as a mare can offer and unwise to base it on an individual's racecourse performances."*

Even for individual mares, however, the argument used for non-*chef-de-race* sires and broodmare sires would apply. If one is convinced of a reliable aptitudinal influence from a mare, then the same process for making a mental adjustment to the Dosage Profile is justified.

The critics of Dosage most often come out in force when an individual horse's performance contradicts its Dosage figures, particularly in high profile races. Rarely do those same critics acknowledge the validity of Dosage when conventional analysis falters and Dosage prevails. Of course, these isolated examples have no bearing on the issue anyway. As the reader has no doubt noticed, Dosage is presented as a tool for developing statistical studies on large populations of Thoroughbreds in order to facilitate the observation of aptitudinal trends within the breed. Insistence that every individual conform to an arbitrary standard is a pointless exercise. Within large populations, especially those involving biological systems, we will always find a broad distribution range of characteristics. If, however, Dosage can statistically differentiate one subgroup from another even in the face of broad distributions within each group, then it has achieved its purpose. For example, as noted earlier, Dosage can confirm that the pedigrees of seven-furlong stakes winners are configured differently from those of eight-furlong stakes winners. Nevertheless, within each group there will be individuals with Dosage figures more suited to five furlongs or to twelve furlongs. Their presence in the subgroups has already been accounted for in the statistical analysis that showed the seven- and eight-furlong winners were indeed dissimilar in terms of pedigree construction. Whenever one deals with distributions within large populations, one must always consider the probability that an individual's traits will conform to those of the general population. A reasonable analogy may be the five pack-a-day smoker who lives to be one hundred years old. Most people who smoke five packs a day will expire long before their one-hundredth birthday. But such hardy individuals certainly do exist. Their survival against the odds does not in any way bring into question the validity of the demographic studies done on smoking and life expectancy. The same is true of individual horses with Dosage figures that fail to conform to those of the majority of the group they populate.

In this context, it is noteworthy that the critics of Dosage have never been able to challenge the accuracy of the data. For the most part they ignore it and don't try. They probably don't try because, as the reader has seen, the correlations are so strong and so compelling that it would be fruitless to do so. If one finds Dosage a waste of time, that determination will result not from the data that support it, but from a philosophical barrier that exists between conventional and progressive thought.

In retrospect, much of the controversy could have been avoided had the subject matter been presented not as a continuation of Dosage theory but as a separate study of the effects of inherited speed on performance. The terms Speed Profile and Speed Index seem far less intimidating than Dosage Profile and Dosage Index. In truth, the current studies have only a marginal association with the historical aspects of Dosage theory. They do borrow the concepts of ancestral prepotence and aptitudinal type, but in a context very different from that proposed by either Vuillier or Varola. Latter day *chefs-de-race* are less icons of racing greatness than they are centers of inherited speed within a pedigree. Vuillier emphasized the class of the pedigrees that were populated with his *chefs-de-race*. Varola also emphasized class, but within a "sociological" framework of aptitudinal type and by taking great pains to dissociate type from specific performance traits. The latest iteration of Dosage concerns itself only with the relationship between aptitudinal type and racing performance. Sires are considered not for their place in Thoroughbred history but for the characteristics of speed and stamina they may consistently pass along to their descendants. Those who think about modern day Dosage in this way and who appreciate the value of a pedigree classification system as a research tool should find the material not the least bit controversial.

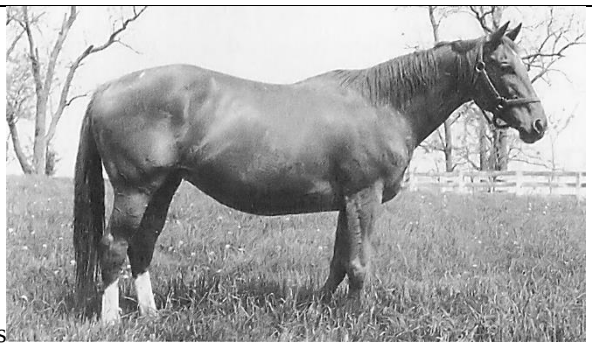


Photo Courtesy of the Thoroughbred Times

Gay Hostess

DP 24-8-26-2-4, DI 2.37, CD 0.72

			Pharos (I)	**Phalaris (B)**
		Nearco (B/C)		Scapa Flow
			Nogara	**Havresac II (I)**
	Royal Charger (B)			Catnip
			Solario (P)	***Gainsborough (C)***
		Sun Princess		Sun Worship
			Mumtaz Begum	***Blenheim II (C/S)***
Gay Hostess, ch.f., 1957				Mumtaz Mahal
			Hyperion (B/C)	***Gainsborough (C)***
		Alibhai (C)		Selene
			Teresina	**Tracery (C)**
	Your Hostess			Blue Tit
			Mahmoud (I/C)	***Blenheim II (C/S)***
		Boudoir II		Mah Mahal
			Kampala	**Clarissimus (C)**
				La Soupe II

	DP Contribution	**Equivalent to:**	
Sire	22- 6- 7- 1- 4	DI 3.71	CD 1.03
Dam	2- 2-19- 1- 0	DI 1.29	CD 0.21

Gay Hostess is the dam of Kentucky Derby winner and leading sire Majestic Prince. She was unraced. Therefore, her Dosage figures would seem to be irrelevant. Obviously, from a performance perspective, they are. However, Gay Hostess is presented here as an example of the rare Thoroughbred with a full complement of 64 Dosage points, 40 from her sire and 24 from her dam.

Chapter 24

The Future of Dosage

Dosage will survive as it has for over a century; perhaps not in its current form, but in a form that integrates current knowledge with what we learn in the future. This is the same process that brought us from the original Dosage concept of Vuillier through Varola to today. It is the process by which science builds on the foundation of what came before. Dosage will continue to evolve as long as there is the desire by pedigree aficionados, owners, breeders and handicappers for a better, more accurate model of the Thoroughbred world of breeding and racing.

We will undoubtedly continue to see a growing international interest in the subject. Significant efforts already are underway in Europe and Australia designed to complement and reinforce the work done in the United States. New *chefs-de-race* will emerge to replace those lost from four-generation pedigrees. Fresh ideas will be introduced that refine the Dosage model and narrow the distributions within populations. This will increase the statistical separation of populations based on performance characteristics and increase the accuracy of the pedigree interpretation. We will probably see advances in *chef-de-race* selection as well, using techniques as yet undefined.

In the background, however, is a fundamental philosophical issue that may ultimately affect the direction of Dosage research. That issue relates to the definition and continuity of classicity through time. It is best captured in the question: is the classic horse of today the same type as the classic horse of the past? Current methodology makes no assumption that classicity is a constant. It merely observes the evolutionary development of aptitudinal traits within the Thoroughbred breed. In so doing, it has identified a progression toward ever-increasing speed and there is practical evidence of this shift in aptitudinal character. Between 1983 and 2014, the percentage of open stakes races in the United States at ten furlongs or longer on the main track decreased by one-third. The reason for this change is not entirely obvious. On the one hand, there may be fewer horses now that are competitive at classic distances. On the other, the change may be cultural, with races having been shortened in response to fan interest. If the latter is true, then Dosage will have a difficult time identifying traditional stamina influences because sires will have less opportunity to express those attributes. The dilemma, then, is deciding which route to follow over the long term. The present scheme apparently is accurate in highlighting the transition to shorter races and the increased need for speed over shorter distances. The alternative, proposed by some, is to redefine classicity continually, using as the standard how contemporary classic horses are bred. In that way, classic winners of today are assumed to possess the same aptitudinal qualities as classic winners of long ago. By this approach we assume that the historical standards of stamina continue to exist as they always have, but that their full expression is obscured by the loss of opportunity resulting from fewer distance events. Which direction is the correct one is a matter of judgment. We can define aptitudinal type in two ways. The first is in response to the evolving culture and the changing

configuration of racing over time. The second is by continuously re-evaluating classicity in contemporary terms. Either way, the research opportunities are virtually unlimited.

Dosage is an intellectually stimulating area of research with infinite possibilities and a broad range of applications. As long as it remains focused on aptitudinal prepotence and rejects a politically correct but scientifically questionable "honor roll of sires" approach, Dosage will enhance our appreciation of the aptitudinal evolution of the Thoroughbred. At the same time, Dosage requires more than a superficial understanding of its principles and how they are applied. As a result, many within the Thoroughbred industry will continue to consider it an esoteric system of pedigree analysis.

Chapter 25

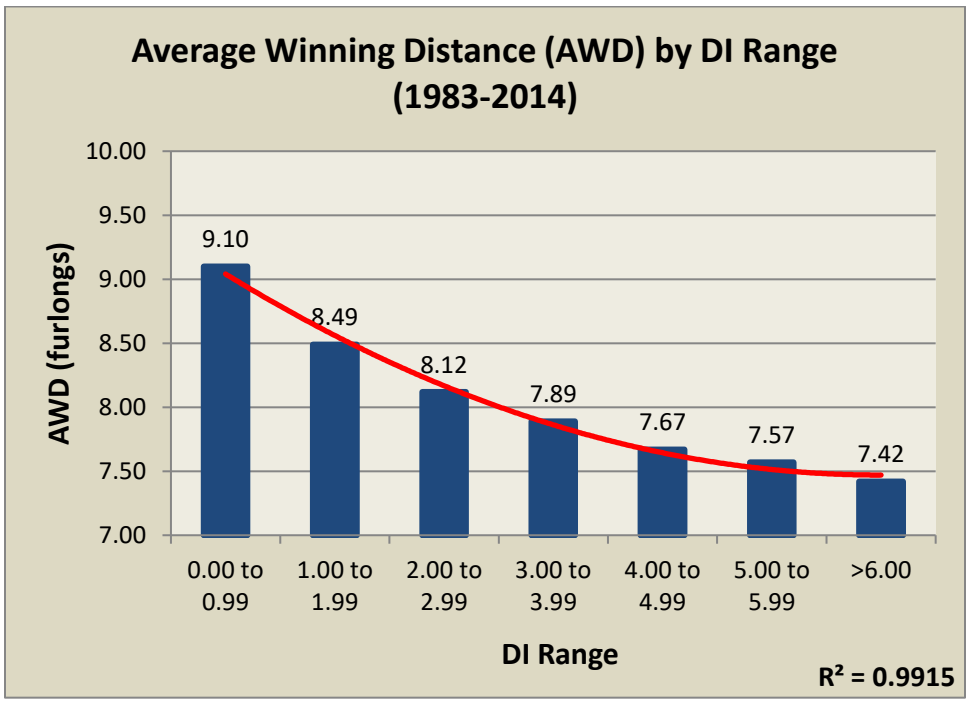
A Few Dosage Guidelines for Breeders and Handicappers

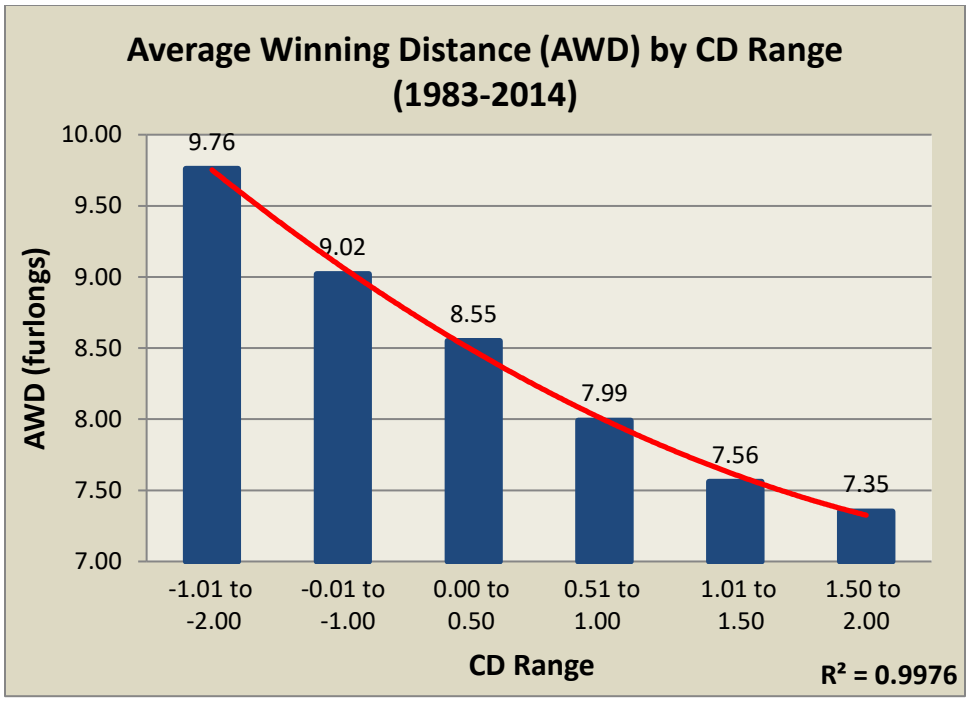
For Breeders:

- If you are breeding to race, have clear, well-defined objectives concerning the sptitudinal type desired from a mating. For example, are you looking for a classic prospect, a futurity winner or a marathoner on the turf? Breeding extreme speed to extreme speed will probably not produce a Derby winner. Breeding extreme stamina to extreme stamina will probably not produce a two-year-old champion.
- High Dosage numbers imply speed, shorter distance racing, early maturity and suitability for dirt. Low Dosage numbers imply stamina, longer distance racing and suitability for turf.
- There are no good or bad Dosage figures. Dosage figures only describe a pedigree in terms of aptitudinal type. The figures themselves are like classification codes that allow us to compare the performance characteristics of other horses with similar figures.
- Understand the aptitudinal contribution of your mare in terms of both type and magnitude. She can contribute a maximum of 24 points to the Dosage Profile (DP) of her foals.
- Look for potential "hidden" sources of aptitudinal prepotence in your mare, although do so in a conservative manner. If warranted, make provisional adjustments to her DP contribution.
- Especially consider compatible emerging young sires that appear to be passing along consistent type but have not yet generated enough statistical information to absolutely confirm aptitudinal prepotence. Make provisional adjustments to the DP here as well.
- Emphasize stallion selection from among the best, established sires in your stud fee range. Unproven sires are high-risk propositions when breeing to race because very few stallions ever become succesful. When favoring stallions, recall that the most successful sires usually have high DP point totals and/or generated superior speed figures on the track.
- If possible, determine the aptitudinal type of those mares most successful with a sire of choice to see if a clear pattern emerges.
- The total number of points in the DP of your proposed foal's pedigree may correlate marginally with potential class. However, higher point totals are desirable mainly because the aptitudinal interpretation of the pedigree is likely to be more accurate. Don't arbitrarily assume superior class because of high DP point totals.
- Use common sense and appreciate that the breeding quality of the stallion and the mare, as well as their conformational compatibility, are more important than any statistial formula. Dosage can be supportive of your breeding decisions, but it should not be the primary driver.

For Handicappers:

- Develop an appreciation for the Dosage model correlating Dosage figures with average winning distance (AWD) and where sprinters tend to have higher Dosage numbers while stayers tend to have lower Dosage numbers.
- Understand that the interplay of the DP (Dosage Profile), DI (Dosage Index) and CD (Center of Distribution) is more meaningful than any individual Dosage figure alone. The DI by itself is not sufficient for evaluating aptitudinal type. Know when the CD is unusually high or low for a particular DI.
- The following charts show the AWD in major North American open stakes races of horses with Dosage figures (DI and CD) falling within defind ranges. They may be used as a general guide to the typical Dosage figure/distance profile.





- Runners with double-digit representation in the Brilliant aptitudinal group will often express front-running speed as well as early maturity.
- Do not arbitrarily dismiss low Dosage figure runners in sprints if they also have significant representation in the Brilliant aptitudinal group, particularly double digits.
- Among juveniles, a first-time starter with a speed-oriented DP is often a good play against maidens that have started but have fared poorly in their initial efforts. Since most juvenile maiden wins are accomplished in wire-to-wire fashion, speed types, even though inexperienced, often can get to the front and stay out of trouble.
- Do not ignore first-time steeplechasers coming from the ranks of sprinters on the flat. In races where the pace is likely to be moderate, their quickness and agility can be a benefit in getting cleanly over the hurdles.
- Consider first-time starters on the turf with strong representation in the Solid and/or Professional aptitudinal groups.
- Classic races are won by a disproportionately high percentage of horses with a DI of 4.00 or less.
- Don't necessarily eliminate two-year-old speedsters going a route of ground. Two-year-olds with sprint type Dosage figures can win around two turns on the basis of class. However, these same horses, when mature, often revert back to type and will no longer be competitive in routes.
- It is important to consider the racing surface in the context of aptitudinal type. Does the track favor speed or stamina? Which horses seem best suited by Dosage to track and race conditions?

- Starters with DI<1.00 or CD<0.00 virtually can be eliminated from contention in sprints unless they hold a significant class edge. Only 12% of stakes winners with DI<1.00 and 14% of stakes winners with CD<0.00 win their races at less than a mile.
- Almost 87% of the stakes races won by horses with more than 20 Classic points in their DP are at a mile or longer. By contrast, just below 50% of the stakes races won by horses with less than 10 Classic points in their DP are at a mile or longer.
- Only 22% of stakes winners at the classic distance of a mile and a quarter or longer have no DP points in either the Solid or Professional group while only 10% of stakes-winning sprinters have points in both.
- Always consider Dosage (or pedigree) in the context of class. Higher class runners will often defeat lower class runners even when pedigree suggests an unsuitable distance.
- Most important, as noted by the great breeding authority, Abram S. Hewitt, Dosage is as much art as it is science. There are no shortcuts. Applying Dosage to handicapping requires an understanding of its fundamental principles as well as its myriad subtleties. Usefulness comes with experience.

Appendix I

Three-Generation Pedigrees of *Chefs-de-Race*

			GAINSBOROUGH 15 C
		HYPERION 30 BC	¦
	Owen Tudor 38	¦	Selene 19
	¦	¦	PHAROS 20 I
	¦	Mary Tudor II 31	¦
ABERNANT 46 B	¦		Anna Bolena 20
	¦		SON-IN-LAW 11 P
	¦	Rustom Pasha 27	¦
	Rustom Mahal 34	¦	Cos 20
		¦	THE TETRARCH 11 I
		Mumtaz Mahal 21	¦
			Lady Josephine 12

			Alsab 39
		Armageddon 49	¦
	Battle Joined 59	¦	Fighting Lady 43
	¦	¦	Revoked 43
	¦	Ethel Walker 53	¦
ACK ACK 66 IC	¦		Ethel Terry 47
	¦		ROYAL CHARGER 42 B
	¦	TURN-TO 51 BI	¦
	Fast Turn 59	¦	Source Sucree 40
		¦	PRINCEQUILLO 40 IS
		Cherokee Rose 51	¦
			The Squaw II 39

			Sundridge 1898
		SUNSTAR 08 S	¦
	Craig An Eran 18	¦	Doris 1898
	¦	¦	Cyllene 1895
	¦	Maid Of The Mist 06	¦
ADMIRAL DRAKE 31 P			Sceptre 1899
	¦		Carbine 1885
	¦	SPEARMINT 03 P	¦
	Plucky Liege 12	¦	Maid Of The Mint 1897
		¦	St Simon 1881
		Concertina 1896	¦
			Comic Song 1884

			Galliard 1880
		War Dance 1887	¦
	Perth 1896	¦	War Paint 1876
	¦	¦	Barcaldine 1878
	¦	Primrose Dame 1885	¦
ALCANTARA II 08 P			Lady Rosebery 1872
	¦		Atlantic 1871
	¦	Le Sancy 1884	¦
	Toison D'or 01	¦	Gem Of Gems 1873
		¦	Archiduc 1881
		Harfleur II 1890	¦
			Hauteur 1880

			BAYARDO 06 P

```
                                GAINSBOROUGH 15 C   ¦
                 HYPERION 30 BC ¦                   Rosedrop 07
                 ¦              ¦                   CHAUCER 00 S
                 ¦              Selene 19           ¦
ALIBHAI 38 C     ¦                                  Serenissima 13
                 ¦                                  ROCK SAND 00 CS
                 ¦              TRACERY 09 C        ¦
                 Teresina 20    ¦                   Topiary 01
                                ¦                   Wildfowler 1895
                                Blue Tit 08         ¦
                                                    Petit Bleu 02

                                                    Tetratema 17
                                Bacteriophage 29    ¦
                 Teleferique 34 ¦                   Pharmacie 18
                 ¦              ¦                   Saint Just 07
                 ¦              Beaute De Neige 12  ¦
ALIZIER 47 P     ¦                                  Bellezza 07
                 ¦                                  HURRY ON 13 P
                 ¦              Coronach 23         ¦
                 Alizarine 39   ¦                   Wet Kiss 13
                                ¦                   BLANDFORD 19 C
                                Armoise 30          ¦
                                                    Coriandre 25

                                                    BLANDFORD 19 C
                                BLENHEIM II 27 CS   ¦
                 DONATELLO II 34 P                  Malva 19
                 ¦              ¦                   CLARISSIMUS 13 C
                 ¦              Delleana 25         ¦
ALYCIDON 45 P    ¦                                  Duccia Di Buoninse 20
                 ¦                                  GAINSBOROUGH 15 C
                 ¦              HYPERION 30 BC      ¦
                 Aurora 36      ¦                   Selene 19
                                ¦                   SWYNFORD 07 C
                                Rose Red 24         ¦
                                                    Marchetta 07

                                                    POLYNESIAN 42 I
                                NATIVE DANCER 50 IC ¦
                 RAISE A NATIVE 61 B                Geisha 43
                 ¦              ¦                   Case Ace 34
                 ¦              Raise You 46        ¦
ALYDAR 75 C      ¦                                  Lady Glory 34
                 ¦                                  NASRULLAH 40 B
                 ¦              On-And-On 56        ¦
                 Sweet Tooth 65 ¦                   Two Lea 46
                                ¦                   Ponder 46
                                Plum Cake 58        ¦
                                                    Real Delight 49

                                                    Boldnesian 63
                                Bold Reasoning 68   ¦
```

```
                SEATTLE SLEW 74 BC                  Reason to Earn 63
                ¦               ¦                   Poker 63
                ¦               My Charmer 69       ¦
A.P. INDY 89 IC                                     Fair Charmer 59
                ¦                                   BOLD RULER 54 BI
                ¦               SECRETARIAT 70 IC   ¦
                Weekend Surprise 80                 Somethingroyal 52
                                ¦                   BUCKPASSER 63 C
                                Lassie Dear 74      ¦
                                                    Gay Missile 67

                                                    PRINCE ROSE 28 C
                                PRINCEQUILLO 40 IS  ¦
                ROUND TABLE 54 S¦                   Cosquilla 33
                ¦               ¦                   SIR COSMO 26 B
                ¦               Knight's Daughter 41¦
APALACHEE 71 B¦                                     Feola 33
                ¦                                   NASRULLAH 40 B
                ¦               Nantallah 53        ¦
                Moccasin 63     ¦                   Shimmer 45
                                ¦                   Gold Bridge 29
                                Rough Shod II 44    ¦
                                                    Dalmary 31

                                                    Flying Fox 1896
                                Ajax 01             ¦
                TEDDY 13 S      ¦                   Amie 1893
                ¦               ¦                   Bay Ronald 1893
                ¦               Rondeau 00          ¦
ASTERUS 23 S    ¦                                   Doremi 1894
                ¦                                   RABELAIS 00 P
                ¦               Verdun 06           ¦
                Astrella 12     ¦                   Vellena 1894
                                ¦                   Ladas 1891
                                Saint Astra 04      ¦
                                                    Saint Celestra 1897

                                                    BAYARDO 06 P
                              GAINSBOROUGH 15 C     ¦
                HYPERION 30 BC  ¦                   Rosedrop 07
                ¦               ¦                   CHAUCER 00 S
                ¦               Selene 19           ¦
AUREOLE 50 C    ¦                                   Serenissima 13
                ¦                                   BLENHEIM II 27 CS
                ¦               DONATELLO II 34 P   ¦
                Angelola 45     ¦                   Delleana 25
                                ¦                   Friar Marcus 12
                                Feola 33            ¦
                                                    Aloe 26

                                                    Bend Or 1877
                                Kendal 1883         ¦
                Tredennis 1898  ¦                   Windermere 1870
```

```
             ¦               ¦                   Hermit 1864
             ¦               St Marguerite 1879  ¦
BACHELOR'S DOUBLE 06 S                           Devotion 1869
             ¦                                   Isonomy 1875
             ¦               Le Noir 1889        ¦
             Lady Bawn 02    ¦                   Knavery 1870
                             ¦                   Kisber 1873
                             Milady 1886         ¦
                                                 Alone 1878
```

```
                                                 John O' Gaunt 01
                             SWYNFORD 07 C       ¦
             BLANDFORD 19 C  ¦                   Canterbury Pilgrim 1893
             ¦               ¦                   White Eagle 05
             ¦               Blanche 12          ¦
BAHRAM 32 C  ¦                                   Black Cherry 1892
             ¦                                   CICERO 02 B
             ¦               Friar Marcus 12     ¦
             Friar's Daughter¦21                 Prim Nun 06
                             ¦                   Roseland 12
                             Garron Lass 17      ¦
                                                 Concertina 1896
```

```
                                                 Nearctic 54
                             NORTHERN DANCER 61 BC
             NIJINSKY II 67 CS                   Natalma 57
             ¦               ¦                   Bull Page 47
             ¦               Flaming Page 59     ¦
BALDSKI 74 BI ¦                                  Flaring Top 47
             ¦                                   NASRULLAH 40 B
             ¦               Bald Eagle 55       ¦
             Too Bald 64     ¦                   Siama 47
                             ¦                   Dark Star 50
                             Hidden Talent 56    ¦
                                                 Dangerous Dame 51
```

```
                                                 PHAROS 20 I
                             NEARCO 35 BC        ¦
             MOSSBOROUGH 47 C¦                   Nogara 28
             ¦               ¦                   Bobsleigh 32
             ¦               All Moonshine 41    ¦
BALLYMOSS 54 S¦                                  Selene 19
             ¦                                   GAINSBOROUGH 15 C
             ¦               Singapore 27        ¦
             Indian Call 36  ¦                   Tetrabbazia 18
                             ¦                   Buchan 16
                             Flittemere 26       ¦
                                                 Keysoe 16
```

```
                                                 Lord Clifden 1860
                             Hampton 1872        ¦
             Bay Ronald 1893 ¦                   Lady Langden 1868
             ¦               ¦                   Galliard 1880
```

```
                 ¦                Black Duchess 1886  ¦
BAYARDO 06 P     ¦                                    Black Corrie 1879
                 ¦                                    Vedette 1854
                 ¦                Galopin 1872        ¦
                 Galicia 1898     ¦                   Flying Duchess 1853
                 ¦                ¦                   Isonomy 1875
                 ¦                Isoletta 1891       ¦
                 ¦                                    Lady Muncaster 1884
```

```
                                                      Iago 1843
                 ¦                Bonnie Scotland 1853¦
                 Bramble 1875     ¦                   Queen Mary 1843
                 ¦                ¦                   Australian 1858
                 ¦                Ivy Leaf 1867       ¦
BEN BRUSH 1893¦I                                      Bay Flower 1859
                 ¦                                    Leamington 1853
                 ¦                Reform 1871         ¦
                 Roseville 1888   ¦                   Stolen Kisses 1864
                 ¦                ¦                   Alarm 1869
                 ¦                Albia 1881          ¦
                 ¦                                    Elastic 1871
```

```
                                                      NEARCO 35 BC
                 ¦                ROYAL CHARGER 42 B  ¦
                 TURN-TO 51 BI    ¦                   Sun Princess 37
                 ¦                ¦                   ADMIRAL DRAKE 31 P
                 ¦                Source Sucree 40    ¦
BEST TURN 66 C¦                                       Lavendula 30
                 ¦                                    KHALED 43 I
                 ¦                Swaps 52            ¦
                 Sweet Clementine¦60                  Iron Reward 46
                 ¦                ¦                   BULL LEA 35 C
                 ¦                Miz Clementine 51   ¦
                 ¦                                    Two Bob 33
```

```
                                                      SWYNFORD 07 C
                 ¦                BLANDFORD 19 C      ¦
                 BAHRAM 32 C      ¦                   Blanche 12
                 ¦                ¦                   Friar Marcus 12
                 ¦                Friar's Daughter 21 ¦
BIG GAME 39 I ¦                                       Garron Lass 17
                 ¦                                    THE TETRARCH 11 I
                 ¦                Tetratema 17        ¦
                 Myrobella 30     ¦                   Scotch Gift 07
                 ¦                ¦                   White Eagle 05
                 ¦                Dolabella 11        ¦
                 ¦                                    Gondolette 02
```

```
                                                      Domino 1891
                 ¦                Commando 1898       ¦
                 PETER PAN 04 B   ¦                   Emma C 1892
                 ¦                ¦                   Hermit 1864
                 ¦                Cinderella 1888     ¦
```

```
  BLACK TONEY 11¦BI                                    Mazurka 1878
                ¦                                      Bramble 1875
                ¦               BEN BRUSH 1893 I       ¦
                Belgravia 03    ¦                      Roseville 1888
                                ¦                      Galopin 1872
                                Bonnie Gal 1889        ¦
                                                       Bonnie Doon 1870
```

```
                                                       Isinglass 1890
                                John O' Gaunt 01       ¦
                SWYNFORD 07 C   ¦                      La Fleche 1889
                ¦               ¦                      Tristan 1878
                ¦               Canterbury Pilgrim 1893
  BLANDFORD 19 C¦                                      Pilgrimage 1875
                ¦                                      Gallinule 1884
                ¦               White Eagle 05         ¦
                Blanche 12      ¦                      Merry Gal 1897
                                ¦                      Bendigo 1880
                                Black Cherry 1892      ¦
                                                       Black Duchess 1886
```

```
                                                       John O' Gaunt 01
                                SWYNFORD 07 C          ¦
                BLANDFORD 19 C  ¦                      Canterbury Pilgrim 1893
                ¦               ¦                      White Eagle 05
                ¦               Blanche 12             ¦
  BLENHEIM II 27¦CS                                    Black Cherry 1892
                ¦                                      Desmond 1896
                ¦               Charles O'Malley 07    ¦
                Malva 19        ¦                      Goody-Two-Shoes 1899
                                ¦                      Robert Le Diable 1899
                                Wild Arum 11           ¦
                                                       Marliacea 02
```

```
                                                       PETER PAN 04 B
                                BLACK TONEY 11 BI      ¦
                Black Servant 18¦                      Belgravia 03
                ¦               ¦                      Laveno 1892
                ¦               Padula 06              ¦
  BLUE LARKSPUR 26 C                                   Padua 1886
                ¦                                      SUNSTAR 08 S
                ¦               North Star III 14      ¦
                Blossom Time 20 ¦                      Angelic 01
                                ¦                      Fariman 00
                                Vaila 11               ¦
                                                       Padilla 00
```

```
                                                      NEARCO 35 BC
                                NASRULLAH 40 B         ¦
                Red God 54      ¦                      Mumtaz Begum 32
                ¦               ¦                      Menow 35
                ¦               Spring Run 48          ¦
  BLUSHING GROOM¦74 BC                                 Boola Brook 37
```

```
                ¦                                 Rialto 23
                ¦               WILD RISK 40 P    ¦
                Runaway Bride 62¦                 Wild Violet 35
                ¦               ¦                 TUDOR MINSTREL 44 B
                                Aimee 57          ¦
                                                  Emali 45

                                                  CHAUCER 00 S
                                Prince Chimay 15  ¦
                VATOUT 26 S     ¦                 Gallorette 07
                ¦               ¦                 Sans Souci II 04
                ¦               Vasthi 21         ¦
BOIS ROUSSEL 35 S                                 Vaya 09
                ¦                                 Carbine 1885
                ¦               SPEARMINT 03 P    ¦
                Plucky Liege 12 ¦                 Maid Of The Mint 1897
                ¦               ¦                 St Simon 1881
                                Concertina 1896   ¦
                                                  Comic Song 1884

                                                  NEARCO 35 BC
                                NASRULLAH 40 B    ¦
                BOLD RULER 54 BI¦                 Mumtaz Begum 32
                ¦               ¦                 DISCOVERY 31 S
                ¦               Miss Disco 44     ¦
BOLD BIDDER 62  ¦IC                               Outdone 36
                ¦                                 Market Wise 38
                ¦               To Market 48      ¦
                High Bid 56     ¦                 Pretty Does 44
                                ¦                 PRINCEQUILLO 40 IS
                                Stepping Stone 50 ¦
                                                  Step Across 41

                                                  NASRULLAH 40 B
                                BOLD RULER 54 BI  ¦
                Boldnesian 54   ¦                 Miss Disco 44
                ¦               ¦                 POLYNESIAN 42 I
                ¦               Alanesian 54      ¦
BOLD RUCKUS 76 IC                                 Alablue 45
                ¦                                 NATIVE DANCER 50 IC
                ¦               RAISE A NATIVE 61 B ¦
                Raise a Ruckus 65                 Raise You 46
                                ¦                 Double Jay 44 B
                                Fine Feathers 52  ¦
                                                  Rare Susan 41

                                                  PHAROS 20 I
                                NEARCO 35 BC      ¦
                NASRULLAH 40 B  ¦                 Nogara 28
                ¦               ¦                 BLENHEIM II 27 CS
                ¦               Mumtaz Begum 32   ¦
BOLD RULER 54 BI                                  Mumtaz Mahal 21
                ¦                                 Display 23
```

```
                 ¦                 DISCOVERY 31 S      ¦
                 Miss Disco 44     ¦                   Ariadne 26
                                   ¦                   POMPEY 23 B
                                   Outdone 36          ¦
                                                       Sweep Out 26

                                                       John O' Gaunt 01
                                   SWYNFORD 07 C       ¦
                 BLANDFORD 19 C    ¦                   Canterbury Pilgrim 1893
                 ¦                 ¦                   White Eagle 05
                 ¦                 Blanche 12          ¦
BRANTOME 31 C    ¦                                     Black Cherry 1892
                 ¦                                     Radium 03
                 ¦                 CLARISSIMUS 13 C    ¦
                 Vitamine 24       ¦                   Quintessence 00
                                   ¦                   Sans Souci II 04
                                   Viridiflora 12      ¦
                                                       Rose Nini 01

                                                       PHALARIS 13 B
                                   Manna 22            ¦
                 Colombo 31        ¦                   Waffles 17
                 ¦                 ¦                   CHAUCER 00 S
                 ¦                 Lady Nairne 19      ¦
BRITISH EMPIRE   ¦37 B                                 Lammermuir 14
                 ¦                                     Ajax 01
                 ¦                 TEDDY 13 S          ¦
                 Rose Of England   27                  Rondeau 00
                                   ¦                   Neil Gow 07
                                   Perce-Neige 16      ¦
                                                       Gallenza 05

                                                       Armageddon 49
                                   Battle Joined 59    ¦
                 ACK ACK 66 IC     ¦                   Ethel Walker 53
                 ¦                 ¦                  #TURN-TO 51 BI
                 ¦                 Fast Turn 59        ¦
BROAD BRUSH 83   ¦IC                                   Cherokee Rose 51
                 ¦                                     TOM ROLFE 62 CP
                 ¦                 HOIST THE FLAG 68 BI¦
                 Hay Patcher 73    ¦                   Wavy Navy 54
                                   ¦                  #TURN-TO 51 BI
                                   Turn To Talent 63   ¦
                                                       Hidden Talent 56

                                                       Bonnie Scotland 1853
                                   Bramble 1875        ¦
                 BEN BRUSH 1893 I  ¦                   Ivy Leaf 1867
                 ¦                 ¦                   Reform 1871
                 ¦                 Roseville 1888      ¦
BROOMSTICK 01    I                                     Albia 1881
                 ¦                                     Galopin 1872
                 ¦                 Galliard 1880       ¦
```

```
                 Elf 1893          ¦                    Mavis 1874
                                   ¦                    Bend Or 1877
                                   Sylvabelle 1887      ¦
                                                        St Editha 1873

                                                        Cambyse 1884
                                   Gardefeu 1895        ¦
                 Chouberski 02     ¦                    Bougie 1887
                 ¦                 ¦                    The Bard 1883
                 ¦                 Campanule 1891       ¦
BRULEUR 10 P     ¦                                      Saint Lucia 1880
                 ¦                                      Upas 1883
                 ¦                 Omnium II 1892       ¦
                 Basse Terre 1899  ¦                    Bluette 1886
                                   ¦                    St Gatien 1881
                                   Bijou 1890           ¦
                                                        Thora 1878

                                                        Menow 35
                                   TOM FOOL 49 IC       ¦
                 BUCKPASSER 63 C   ¦                    Gaga 42
                 ¦                 ¦                    WAR ADMIRAL 34 C
                 ¦                 Busanda 47           ¦
BUCKAROO 75 BI   ¦                                      Businesslike 39
                 ¦                                      Swaps 52
                 ¦                 No Robbery 60        ¦
                 Stepping High 69  ¦                    Bimlette 44
                                   ¦                    PRINCE BIO 41 C
                                   Bebop 57             ¦
                                                        Cappellina 40

                                                        Pharamond II 25
                                   Menow 35             ¦
                 TOM FOOL 49 IC    ¦                    Alcibiades 27
                 ¦                 ¦                    BULL DOG 27 B
                 ¦                 Gaga 42              ¦
BUCKPASSER 63    C                                      Alpoise 37
                 ¦                                      MAN O' WAR 17 S
                 ¦                 WAR ADMIRAL 34 C     ¦
                 Busanda 47        ¦                    Brushup 29
                                   ¦                    BLUE LARKSPUR 26 C
                                   Businesslike 39      ¦
                                                        La Troienne 26

                                                        Flying Fox 1896
                                   Ajax 01              ¦
                 TEDDY 13 S        ¦                    Amie 1893
                 ¦                 ¦                    Bay Ronald 1893
                 ¦                 Rondeau 00           ¦
BULL DOG 27 B    ¦                                      Doremi 1894
                 ¦                                      Carbine 1885
                 ¦                 SPEARMINT 03 P       ¦
                 Plucky Liege 12   ¦                    Maid Of The Mint 1897
```

```
                                ¦                   St Simon 1881
                                Concertina 1896     ¦
                                                    Comic Song 1884

                                                    Ajax 01
                                TEDDY 13 S          ¦
                    BULL DOG 27 B   ¦               Rondeau 00
                    ¦               ¦               SPEARMINT 03 P
                    ¦               Plucky Liege 12 ¦
BULL LEA 35 C       ¦                               Concertina 1896
                    ¦                               Voter 1894
                    ¦               Ballot 04       ¦
                    Rose Leaves 16  ¦               Cerito 1888
                                    ¦               Trenton 1881
                                    Colonial 1897   ¦
                                                    Thankful Blossom 1891

                                                    BLENHEIM II 27 CS
                                DONATELLO II 34 P   ¦
                    CREPELLO 54 P   ¦               Delleana 25
                    ¦               ¦               MIEUXCE 33 P
                    ¦               Crepuscule 48   ¦
BUSTED 63 S         ¦                               Red Sunset 41
                    ¦                               WILD RISK 40 P
                    ¦               Vimy 52         ¦
                    Sans Le Sou 57  ¦               Mimi 43
                                    ¦               COURT MARTIAL 42 B
                                    Martial Loan 50 ¦
                                                    Loan 40

                                                    NORTHERN DANCER 61 BC
                                DANZIG 77 IC        ¦
                    Green Desert 83 ¦               Pas de Nom 68
                    ¦               ¦               SIR IVOR 65 IC
                    ¦               Foreign Courier 79  ¦
CAPE CROSS 94 C                                     Courtly Dee 68
                    ¦                               Lorenzaccio 65
                    ¦               Ahonoora 75     ¦
                    Park Appeal 82  ¦               Helen Nichols 66
                                    ¦               Balidar 66
                                    Balidaress 73   ¦
                                                    Innocence 68

                                                    NASRULLAH 40 B
                                GREY SOVEREIGN 48 B ¦
                    Fortino II 59   ¦               Kong 33
                    ¦               ¦               Relic 45
                    ¦               Ranavalo III 54 ¦
CARO 67 IC          ¦                               Navarra 48
                    ¦                               PRECIPITATION 33 P
                    ¦               Chamossaire 42  ¦
                    Chambord 55     ¦               Snowberry 37
```

```
                                ¦                       SOLARIO 22 P
                                Life Hill 40            ¦
                                                        Lady Of The Snows 28
```

```
                                                        NATIVE DANCER 50 IC
                                RAISE A NATIVE 61 B     ¦
                MR. PROSPECTOR 70 BC                    Raise You 46
                ¦               ¦                       NASHUA 52 IC
                ¦               Gold Digger 62          ¦
CARSON CITY 87 BI                                       Sequence 46
                ¦                                       Red God 54
                ¦               BLUSHING GROOM 74 BC    ¦
                Blushing Promise 82                     Runaway Bride 62
                                ¦                       NIJINSKY II 67 CS
                                Summertime Promise 72
                                                        Prides Promise 66
```

```
                                                        Cyllene 1895
                                Captivation 02          ¦
                Kircubbin 18    ¦                       Charm 1888
                ¦               ¦                       Hackler 1887
                ¦               Avon Hack 07            ¦
CHATEAU BOUSCAUT 27 P                                   Avonbeg 1896
                ¦                                       Marco 1892
                ¦               Neil Gow 07             ¦
                Ramondie 20     ¦                       Chelandry 1894
                                ¦                       Macdonald II 01
                                La Rille 08             ¦
                                                        Recaldia 1899
```

```
                                                        Vedette 1854
                                Galopin 1872            ¦
                St Simon 1881   ¦                       Flying Duchess 1853
                ¦               ¦                       King Tom 1851
                ¦               St Angela 1865          ¦
CHAUCER 00 S    ¦                                       Adeline 1851
                ¦                                       Hermit 1864
                ¦               Tristan 1878            ¦
                Canterbury Pilgrim 1893                 Thrift 1865
                                ¦                       The Palmer 1864
                                Pilgrimage 1875         ¦
                                                        Lady Audley 1867
```

```
                                                        Nearctic 54
                                NORTHERN DANCER 61 BC
                DANZIG 77 IC    ¦                       Natalma 57
                ¦               ¦                       Admiral's Voyage 59
                ¦               Pas De Nom 68           ¦
CHIEF'S CROWN 82 IS                                     Petitioner 52
                ¦                                       BOLD RULER 54 BI
                ¦               SECRETARIAT 70 IC       ¦
                Six Crowns 76   ¦                       Somethingroyal 52
                                ¦                       Swoon's Son 53
```

```
                                Chris Evert 71      ¦
                                                    Miss Carmie 66

                                                    Bend Or 1877
                                Bona Vista 1889     ¦
                    Cyllene 1895¦                   Vista 1879
                    ¦           ¦                   Isonomy 1875
                    ¦           Arcadia 1887        ¦
CICERO 02 B         ¦                               Distant Shore 1880
                    ¦                               Hampton 1872
                    ¦           Ayrshire 1885       ¦
                    Gas 1892    ¦                   Atalanta 1878
                                ¦                   Rosicrucian 1865
                                Illuminata 1877     ¦
                                                    Paraffin 1870

                                                    Doncaster 1870
                                Bend Or 1877        ¦
                    Radium 03   ¦                   Rouge Rose 1865
                    ¦           ¦                   Donovan 1886
                    ¦           Taia 1892           ¦
CLARISSIMUS 13 C    ¦                               Eira 1881
                    ¦                               St Simon 1881
                    ¦           St Frusquin 1893    ¦
                    Quintessence 00 ¦               Isabel 1879
                                ¦                   Petrarch 1873
                                Margarine 1887      ¦
                                                    Margarita 1873

                                                    Tenerani 44
                                RIBOT 52 CP         ¦
                    Arts and Letters 66             Romanella 43
                    ¦           ¦                   Battlefield 48
                    ¦           All Beautiful 59    ¦
CODEX 77 IC         ¦                               Parlo 51
                    ¦                               ROUGH'N TUMBLE 48 BC
                    ¦           Minnesota Mac 64    ¦
                    Roundup Rose 71 ¦               Cow Girl 41
                                ¦                   Chieftain 61
                                Minnetonka 67       ¦
                                                    Heliolight 57

                                                    Cyllene 1895
                                Polymelus 02        ¦
                    PHALARIS 13 B ¦                 Maid Marian 1886
                    ¦           ¦                   Sainfoin 1887
                    ¦           Bromus 05           ¦
COLORADO 23 I       ¦                               Cheery 1892
                    ¦                               St Simon 1881
                    ¦           CHAUCER 00 S        ¦
                    Canyon 13   ¦                   Canterbury Pilgrim 1893
                                ¦                   Isinglass 1890
                                Glasalt 1898        ¦
```

```
                                                  Broad Corrie 1889
```

```
                                                  ROCK SAND 00 CS
                              TRACERY 09 C        ¦
              Copyright 18    ¦                   Topiary 01
              ¦               ¦                   William The Third 1898
              ¦               Rectify 10          ¦
CONGREVE 24 I ¦                                   Simplify 1897
              ¦                                   Persimmon 1893
              ¦               Perrier 05          ¦
              Per Noi 16      ¦                   Amphora 1893
                              ¦                   Batt 1895
                              My Queen 09         ¦
                                                  Princesa 1896
```

```
                                                  Sundridge 1898
                              Sunreigh 19         ¦
              Reigh Count 25  ¦                   Sweet Briar 08
              ¦               ¦                   Count Schomberg 1892
              ¦               Contessina 09       ¦
COUNT FLEET 40¦C                                  Pitti 1898
              ¦                                   Maintenant 13
              ¦               Haste 23            ¦
              Quickly 30      ¦                   Miss Malaprop 09
                              ¦                   Stefan The Great 16
                              Stephanie 25        ¦
                                                  Malachite 13
```

```
                                                  PHALARIS 13 B
                              FAIRWAY 25 B        ¦
              FAIR TRIAL 32 B ¦                   Scapa Flow 14
              ¦               ¦                   SON-IN-LAW 11 P
              ¦               Lady Juror 19       ¦
COURT MARTIAL 42 B                                Lady Josephine 12
              ¦                                   Marcovil 03
              ¦               HURRY ON 13 P       ¦
              Instantaneous 31¦                   Tout Suite 04
                              ¦                   GAINSBOROUGH 15 C
                              Picture 25          ¦
                                                  Plymstock 18
```

```
                                                  HYPERION 30 BC
                              HELIOPOLIS 36 B     ¦
              OLYMPIA 46 B    ¦                   Drift 26
              ¦               ¦                   Stimulus 22
              ¦               Miss Dolphin 34     ¦
CREME DELA CREME 63 CS                            Tinamou 22
              ¦                                   NEARCO 35 BC
              ¦               NASRULLAH 40 B      ¦
              Judy Rullah 53  ¦                   Mumtaz Begum 32
                              ¦                   Beau Pere 27
                              Judy-Rae 44         ¦
                                                  Betty Derr 28
```

```
                                          BLANDFORD 19 C
                          BLENHEIM II 27 CS   ¦
            DONATELLO II 34 P                 Malva 19
            ¦              ¦                  CLARISSIMUS 13 C
            ¦              Delleana 25        ¦
CREPELLO 54 P ¦                               Duccia Di Buoninse 20
            ¦                                 MASSINE 20 P
            ¦              MIEUXCE 33 P       ¦
            Crepuscule 48  ¦                  L'olivete 25
                           ¦                  SOLARIO 22 P
                           Red Sunset 41      ¦
                                              Dulce 32
```

```
                                              Sun Again 39
                           Sunglow 47         ¦
            Sword Dancer 56 ¦                 Rosern 27
            ¦              ¦                  By Jimminy 41
            ¦              Highland Fling 50  ¦
DAMASCUS 64 IC¦                               Swing Time 35
            ¦                                 DJEBEL 37 I
            ¦              MY BABU 45 B       ¦
            Kerala 58      ¦                  Perfume II 38
                           ¦                  Sickle 24
                           Blade Of Time 38   ¦
                                              Bar Nothing 33
```

```
                                              NEARCO 35 BC
                           Nearctic 54        ¦
            NORTHERN DANCER 61 BC             Lady Angela 44
            ¦              ¦                  NATIVE DANCER 50 IC
            ¦              Natalma 57         ¦
DANZIG 77 IC  ¦                               Almahmoud 47
            ¦                                 Crafty Admiral 48
            ¦              Admiral's Voyage 59 ¦
            Pas De Nom 68  ¦                  Olympia Lou 52
                           ¦                  PETITION 44 I
                           Petitioner 52      ¦
                                              Steady Aim 43
```

```
                                              Lord Clifden 1860
                           Hampton 1872       ¦
            Bay Ronald 1893 ¦                 Lady Langden 1868
            ¦              ¦                  Galliard 1880
            ¦              Black Duchess 1886 ¦
DARK RONALD 05¦P                              Black Corrie 1879
            ¦                                 Cremorne 1869
            ¦              Thurio 1875        ¦
            Darkie 1889    ¦                  Verona 1854
                           ¦                  Blair Athol 1861
                           Insignia 1882      ¦
                                              Decoration 1873
```

```
                                                Hastings 1893
                        FAIR PLAY 05 SP         ¦
              Display 23      ¦                 Fairy Gold 1896
              ¦               ¦                 Nassovian 13
              ¦               Cicuta 19         ¦
DISCOVERY 31 S¦                                 Hemlock 13
              ¦                                 Picton 03
              ¦               Light Brigade 10  ¦
              Ariadne 26      ¦                 Bridge Of Sighs 05
                              ¦                 His Majesty 10
                              Adrienne 19       ¦
                                                Adriana 05
```

```
                                                BRULEUR 10 P
                              Ksar 18           ¦
              TOURBILLON 28 CP¦                 Kizil Kourgan 1899
              ¦               ¦                 Durbar 11
              ¦               Durban 18         ¦
DJEBEL 37 I   ¦                                 Banshee 10
              ¦                                 BAYARDO 06 P
              ¦               Gay Crusader 14   ¦
              Loika 26        ¦                 Gay Laura 09
                              ¦                 TEDDY 13 S
                              Coeur A Coeur 21  ¦
                                                Ballantrae 1899
```

```
                                                SWYNFORD 07 C
                              BLANDFORD 19 C    ¦
              BLENHEIM II 27 CS                 Blanche 12
              ¦               ¦                 Charles O'Malley 07
              ¦               Malva 19          ¦
DONATELLO II 34 P                               Wild Arum 11
              ¦                                 Radium 03
              ¦               CLARISSIMUS 13 C  ¦
              Delleana 25     ¦                 Quintessence 00
                              ¦                 Bridge Of Earn 06
                              Duccia Di Buoninse 20
                                                Dutch Mary 15
```

```
                                                PETER PAN 04 B
                              BLACK TONEY 11 BI ¦
              Balladier 32    ¦                 Belgravia 03
              ¦               ¦                 North Star III 14
              ¦               Blue Warbler 22   ¦
DOUBLE JAY 44 B                                 May Bird 13
              ¦                                 BROOMSTICK 01 I
              ¦               Whisk Broom II 07 ¦
              Broomshot 26    ¦                 Audience 01
                              ¦                 Sain 1894
                              Centre Shot 05    ¦
                                                Grand Shot 00
```

```
                                                Questionnaire 27
```

```
                    Free For All 42     ¦
         ROUGH'N TUMBLE 48 BC           Panay 34
         ¦          ¦                   BULL DOG 27 B
         ¦          Roused 43           ¦
DR FAGER 64 I ¦                         Rude Awakening 36
         ¦                              Bimelech 37
         ¦          Better Self 45      ¦
         Aspidistra 54   ¦              Bee Mac 41
                    ¦                   Bull Brier 38
                    Tilly Rose 48       ¦
                                        Tilly Kate 35
```

```
                                        John O' Gaunt 01
                    SWYNFORD 07 C       ¦
         BLANDFORD 19 C  ¦              Canterbury Pilgrim 1893
         ¦          ¦                   White Eagle 05
         ¦          Blanche 12          ¦
BLENHEIM II 27¦CS                       Black Cherry 1892
         ¦                              Desmond 1896
         ¦          Charles O'Malley 07 ¦
         Malva 19        ¦              Goody-Two-Shoes 1899
                    ¦                   Robert Le Diable 1899
                    Wild Arum 11        ¦
                                        Marliacea 02
```

```
                                        PETER PAN 04 B
                    BLACK TONEY 11 BI   ¦
         Black Servant 18¦              Belgravia 03
         ¦          ¦                   Laveno 1892
         ¦          Padula 06           ¦
BLUE LARKSPUR 26 C                      Padua 1886
         ¦                              SUNSTAR 08 S
         ¦          North Star III 14   ¦
         Blossom Time 20 ¦              Angelic 01
                    ¦                   Fariman 00
                    Vaila 11            ¦
                                        Padilla 00
```

```
                                        ROCK SAND 00 CS
                    Friar Rock 13       ¦
         PILATE 28 C     ¦              Fairy Gold 1896
         ¦          ¦                   THE TETRARCH 11 I
         ¦          Herodias 16         ¦
EIGHT THIRTY 36 I                       Honora 07
         ¦                              ULTIMUS 06 B
         ¦          High Time 16        ¦
         Dinner Time 29  ¦              Noonday 1898
                    ¦                   MAN O' WAR 17 S
                    Seaplane 22         ¦
                                        Bathing Girl 15
```

```
                                        PETITION 44 I
                    Petingo 65          ¦
```

```
                Pitcairn 71      ¦                    Alcazar II 57
                ¦                ¦                    Bounteous 58
                ¦                Border Bounty 65     ¦
ELA-MANA-MOU 76 P                                      B Flat 58
                ¦                                    HYPERION 30 BC
                ¦                High Hat 57         ¦
                Rose Bertin 70   ¦                    Madonna 45
                                 ¦                    Major Portion 55
                                 Wide Awake 64        ¦
                                                      Wake Island 59
```

```
                                                      Commando 1898
                                 PETER PAN 04 B       ¦
                Pennant 11       ¦                    Cinderella 1888
                ¦                ¦                    Royal Hampton 1882
                ¦                Royal Rose 1894      ¦
EQUIPOISE 28 IC                                        Belle Rose 1889
                ¦                                    BEN BRUSH 1893 I
                ¦                BROOMSTICK 01 I      ¦
                Swinging 22      ¦                    Elf 1893
                                 ¦                    Meddler 1890
                                 Balancoire II 11     ¦
                                                      Ballantrae 1899
```

```
                                                    POLYNESIAN 42 I
                                 NATIVE DANCER 50 IC ¦
                RAISE A NATIVE 61 B                  Geisha 43
                ¦                ¦                   Case Ace 34
                ¦                Raise You 46        ¦
EXCLUSIVE NATIVE 65 C                                Lady Glory 34
                ¦                                   EQUIPOISE 28 IC
                ¦                Shut Out 39         ¦
                Exclusive 53     ¦                   Goose Egg 27
                                 ¦                   PILATE 28 C
                                 Good Example 44     ¦
                                                     Parade Girl 33
```

```
                                                      Australian 1858
                                 Spendthrift 1876     ¦
                Hastings 1893    ¦                    Aerolite 1861
                ¦                ¦                    Tomahawk 1863
                ¦                Cinderella 1885      ¦
FAIR PLAY 05 SP                                        Manna 1874
                ¦                                    Doncaster 1870
                ¦                Bend Or 1877        ¦
                Fairy Gold 1896  ¦                    Rouge Rose 1865
                                 ¦                    Galliard 1880
                                 Dame Masham 1889     ¦
                                                      Pauline 1883
```

```
                                                      Polymelus 02
                                 PHALARIS 13 B        ¦
                FAIRWAY 25 B     ¦                    Bromus 05
```

```
                 ¦                  ¦                    CHAUCER 00 S
                 ¦                  Scapa Flow 14        ¦
FAIR TRIAL 32 B                                          Anchora 05
                 ¦                                       DARK RONALD 05 P
                 ¦                  SON-IN-LAW 11 P      ¦
                 Lady Juror 19      ¦                    Mother-In-Law 06
                                    ¦                    Sundridge 1898
                                    Lady Josephine 12    ¦
                                                         Americus Girl 05
```

```
                                                         Cyllene 1895
                                    Polymelus 02         ¦
                 PHALARIS 13 B      ¦                    Maid Marian 1886
                 ¦                  ¦                    Sainfoin 1887
                 ¦                  Bromus 05            ¦
FAIRWAY 25 B     ¦                                       Cheery 1892
                 ¦                                       St Simon 1881
                 ¦                  CHAUCER 00 S         ¦
                 Scapa Flow 14      ¦                    Canterbury Pilgrim 1893
                                    ¦                    Love Wisely 1893
                                    Anchora 05           ¦
                                                         Eryholme 1898
```

```
                                                         NATIVE DANCER 50 IC
                                    RAISE A NATIVE 61 B  ¦
                 MR PROSPECTOR 70   ¦BC                  Raise You 46
                 ¦                  ¦                    NASHUA 52 IC
                 ¦                  Gold Digger 62       ¦
FAPPIANO 77 IC   ¦                                       Sequence 46
                 ¦                                       ROUGH'N TUMBLE 48 BC
                 ¦                  DR FAGER 64 I        ¦
                 Killaloe 70        ¦                    Aspidistra 54
                                    ¦                    Correlation 51
                                    Grand Splendor 62    ¦
                                                         Cequillo 56
```

```
                                                         GAINSBOROUGH 15 C
                                    HYPERION 30 BC       ¦
                 Aristophanes 48    ¦                    Selene 19
                 ¦                  ¦                    MIEUXCE 33 P
                 ¦                  Commotion 38         ¦
FORLI 63 C       ¦                                       Riot 29
                 ¦                                       FAIR TRIAL 32 B
                 ¦                  Advocate 40          ¦
                 Trevisa 51         ¦                    Guiding Star 28
                                    ¦                    Foxglove 35
                                    Veneta 40            ¦
                                                         Dogaresa 23
```

```
                                                         DARK RONALD 05 P
                                    SON-IN-LAW 11 P      ¦
                 Foxlaw 22          ¦                    Mother-In-Law 06
                 ¦                  ¦                    Gallinule 1884
```

```
                ¦                Alope 09           ¦
FOXBRIDGE 30 P  ¦                                   Altoviscar 02
                ¦                                   Cyllene 1895
                ¦                Bridge Of Earn 06  ¦
                Bridgemount 19   ¦                   Santa Brigida 1898
                ¦                                   SPEARMINT 03 P
                ¦                Mountain Mint 09   ¦
                                                    Adula 02
```

```
                                                    Polymelus 02
                                 PHALARIS 13 B      ¦
                FAIRWAY 25 B     ¦                  Bromus 05
                ¦                ¦                  CHAUCER 00 S
                ¦                Scapa Flow 14      ¦
FULL SAIL 34 I  ¦                                   Anchora 05
                ¦                                   THE TETRARCH 11 I
                ¦                Stefan The Great 16¦
                Fancy Free 24    ¦                  Perfect Peach 07
                ¦                ¦                  BACHELOR'S DOUBLE 06 S
                                 Celiba 16          ¦
                                                    Santa Maura 1893
```

```
                                                    Hampton 1872
                                 Bay Ronald 1893    ¦
                BAYARDO 06 P     ¦                  Black Duchess 1886
                ¦                ¦                  Galopin 1872
                ¦                Galicia 1898       ¦
GAINSBOROUGH 15 C                                   Isoletta 1891
                ¦                                   St Simon 1881
                ¦                St Frusquin 1893   ¦
                Rosedrop 07      ¦                  Isabel 1879
                ¦                ¦                  Trenton 1881
                                 Rosaline 01        ¦
                                                    Rosalys 1894
```

```
                                                    VATOUT 26 S
                                 BOIS ROUSSEL 35 S  ¦
                Migoli 44        ¦                  Plucky Liege 12
                ¦                ¦                  BAHRAM 32 C
                ¦                Mah Iran 39        ¦
GALLANT MAN 54  BI                                 #Mah Mahal 28
                ¦                                   BLENHEIM II 27 CS
                ¦                MAHMOUD 33 IC      ¦
                Majideh 39       ¦                 #Mah Mahal 28
                ¦                ¦                  Buchan 16
                                 Qurrat-Al-Ain 27   ¦
                                                    Harpsichord 18
```

```
                                                    NORTHERN DANCER 61 BC
                                 Storm Bird 78      ¦
                Storm Cat 83     ¦                  South Ocean 67
                ¦                ¦                  SECRETARIAT 70 IC
                ¦                Terlingua 76       ¦
```

```
GIANT'S CAUSEWAY 97 C                                  Crimson Saint 69
                    ¦                                  BLUSHING GROOM 74 BC
                    ¦                Rahy 85           ¦
                    Mariah's Storm 91                  Glorious Song 76
                                     ¦                 ROBERTO 69 C
                                     Immense 79        ¦
                                                       Imsodear 67

                                                       NATIVE DANCER 50 IC
                                     RAISE A NATIVE 61 B ¦
                    MR. PROSPECTOR 70 BC               Raise You 46
                    ¦                ¦                 NASHUA 52 IC
                    ¦                Gold Digger 62    ¦
GONE WEST 84 IC                                        Sequence 46
                    ¦                                  BOLD RULER 54 BI
                    ¦                SECRETARIAT 70 IC ¦
                    Secrettame 78    ¦                 Somethingroyal 52
                                     ¦                 Tim Tam 55
                                     Tamerett 62       ¦
                                                       Mixed Marriage 52

                                                       Bellini 37
                                     Tenerani 44       ¦
                    RIBOT 52 CP      ¦                 Tofanella 31
                    ¦                ¦                 El Greco 34
                    ¦                Romanella 43      ¦
GRAUSTARK 63 CS                                        Barbara Burrini 37
                    ¦                                  HYPERION 30 BC
                    ¦                ALIBHAI 38 C      ¦
                    Flower Bowl 52   ¦                 Teresina 20
                                     ¦                 Beau Pere 27
                                     Flower Bed 46     ¦
                                                       Boudoir II 38

                                                       Plassy 32
                                     VANDALE 43 P      ¦
                    HERBAGER 56 CS   ¦                 Vanille 29
                    ¦                ¦                 Escamillo 39
                    ¦                Flagette 51       ¦
GREY DAWN II 62 BI                                     Fidgette 39
                    ¦                                  BLENHEIM II 27 CS
                    ¦                MAHMOUD 33 IC     ¦
                    Polamia 55       ¦                 Mah Mahal 28
                                     ¦                 Pavot 42
                                     Ampola 49         ¦
                                                       Blue Denim 40

                                                       DARK RONALD 05 P
                                     Herold 17         ¦
                    Alchimist 30     ¦                 Hornisse 08
                    ¦                ¦                 Nuage 07
                    ¦                Aversion 14       ¦
GUNDOMAR 42 C       ¦                                  Antwort 07
```

```
                 ¦                               Pergolese 14
                 ¦               Aurelius 23     ¦
                 Grossularia 33  ¦               Augusta Charlotte 15
                                 ¦               Fervor 06
                                 Grolle Nicht 17 ¦
                                                 Grave And Gay 1899
```

```
                                                 ROYAL CHARGER 42 B
                                 TURN-TO 51 BI   ¦
                 SIR GAYLORD 59 IC               Source Sucree 40
                 ¦               ¦               PRINCEQUILLO 40 IS
                 ¦               Somethingroyal 52 ¦
   HABITAT 66 B  ¦                               Imperatrice 38
                 ¦                               BULL DOG 27 B
                 ¦               Occupy 41       ¦
                 Little Hut 52   ¦               Miss Bunting 30
                                 ¦               Challenger II 27
                                 Savage Beauty 34 ¦
                                                 Khara 27
```

```
                                                 NEARCO 35 BC
                                 ROYAL CHARGER 42 B ¦
                 TURN-TO 51 BI   ¦               Sun Princess 37
                 ¦               ¦               ADMIRAL DRAKE 31 P
                 ¦               Source Sucree 40 ¦
   HAIL TO REASON¦58 C                           Lavendula 30
                 ¦                               BLUE LARKSPUR 26 C
                 ¦               Blue Swords 40  ¦
                 Nothirdchance 48¦               Flaming Swords 33
                                 ¦               SIR GALLAHAD III 20 C
                                 Galla Colors 43 ¦
                                                 Rouge Et Noir 34
```

```
                                                 ROYAL CHARGER 42 B
                                 TURN-TO 51 BI   ¦
                 HAIL TO REASON 58 C             Source Sucree 40
                 ¦               ¦               Blue Swords 40
                 ¦               Nothirdchance 48 ¦
   HALO 69 BC    ¦                               Galla Colors 43
                 ¦                               Pharamond II 25
                 ¦               Cosmic Bomb 44  ¦
                 Cosmah 53       ¦               Banish Fear 32
                                 ¦               MAHMOUD 33 IC
                                 Almahmoud 47    ¦
                                                 Arbitrator 37
```

```
                                                 Galopin 1872
                                #St Simon 1881   ¦
                 RABELAIS 00 P   ¦               St Angela 1865
                 ¦               ¦               Satiety 1885
                 ¦               Satirical 1891  ¦
   HAVRESAC II 15¦I                              Chaff 1880
                 ¦                               Flying Fox 1896
```

```
                 ¦                Ajax 01              ¦
                 Hors Concours 06¦                     Amie 1893
                 ¦               ¦                    #St Simon 1881
                 ¦               Simona 1893          ¦
                 ¦                                    Flying Footstep 1884

                                                      BAYARDO 06 P
                 ¦               GAINSBOROUGH 15 C    ¦
                 HYPERION 30 BC  ¦                    Rosedrop 07
                 ¦               ¦                    CHAUCER 00 S
                 ¦               Selene 19            ¦
HELIOPOLIS 36 B                                       Serenissima 13
                 ¦                                    John O' Gaunt 01
                 ¦               SWYNFORD 07 C        ¦
                 Drift 26        ¦                    Canterbury Pilgrim 1893
                 ¦               ¦                    Neil Gow 07
                 ¦               Santa Cruz 16        ¦
                 ¦                                    Santa Brigida 1898

                                                      Bosworth 26
                 ¦               Plassy 32            ¦
                 VANDALE 43 P    ¦                    Pladda 26
                 ¦               ¦                    LA FARINA 11 P
                 ¦               Vanille 29           ¦
HERBAGER 56 CS   ¦                                    Vaya 09
                 ¦                                   #Firdaussi 29
                 ¦               Escamillo 39         ¦
                 Flagette 51     ¦                    Estoril 30
                 ¦               ¦                   #Firdaussi 29
                 ¦               Fidgette 39          ¦
                 ¦                                    Boxeuse 31

                                                      Dante 42
                 ¦               Darius II 51         ¦
                 Derring-Do 61   ¦                    Yasna 36
                 ¦               ¦                    ABERNANT 46 B
                 ¦               Sipsey Bridge 54     ¦
HIGH TOP 69 C    ¦                                    Claudette 49
                 ¦                                    WILD RISK 40 P
                 ¦               Vimy 52              ¦
                 Camenae 61      ¦                    Mimi 43
                 ¦               ¦                    COURT MARTIAL 42 B
                 ¦               Madrilene 51         ¦
                 ¦                                    Marmite 35

                                                      Bellini 37
                 ¦               Tenerani 44          ¦
                 RIBOT 52 CP     ¦                    Tofanella 31
                 ¦               ¦                    El Greco 34
                 ¦               Romanella 43         ¦
HIS MAJESTY 68   ¦C                                   Barbara Burrini 37
                 ¦                                    HYPERION 30 BC
                 ¦               ALIBHAI 38 C         ¦
```

```
                Flower Bowl 52  ¦                   Teresina 20
                                ¦                   Beau Pere 27
                                Flower Bed 46       ¦
                                                    Boudoir II 38

                                                    Tenerani 44
                                RIBOT 52 CP         ¦
                TOM ROLFE 62 CP ¦                   Romanella 43
                ¦               ¦                   ROMAN 37 BI
                ¦               Pocahontas 55       ¦
HOIST THE FLAG  ¦68 BI                              How 48
                ¦                                   MAN O' WAR 17 S
                ¦               WAR ADMIRAL 34 C    ¦
                Wavy Navy 54    ¦                   Brushup 29
                                ¦                   TOURBILLON 28 CP
                                Triomphe 47         ¦
                                                    Melibee 38

                                                    Barcaldine 1878
                                Marco 1892          ¦
                Marcovil 03     ¦                   Novitiate 1882
                ¦               ¦                   Hagioscope 1878
                ¦               Lady Villikins 1885 ¦
HURRY ON 13 P   ¦                                   Dinah 1871
                ¦                                   Springfield 1873
                ¦               Sainfoin 1887       ¦
                Tout Suite 04   ¦                   Sanda 1878
                                ¦                   Thurio 1875
                                Star 1887           ¦
                                                    Meteor 1867

                                                    Bay Ronald 1893
                                BAYARDO 06 P        ¦
                GAINSBOROUGH 15 C                   Galicia 1898
                ¦               ¦                   St Frusquin 1893
                ¦               Rosedrop 07         ¦
HYPERION 30 BC  ¦                                   Rosaline 01
                ¦                                   St Simon 1881
                ¦               CHAUCER 00 S        ¦
                Selene 19       ¦                   Canterbury Pilgrim 1893
                                ¦                   Minoru 06
                                Serenissima 13      ¦
                                                    Gondolette 02

                                                    PHAROS 20 I
                                NEARCO 35 BC        ¦
                Nearctic 54     ¦                   Nogara 28
                ¦               ¦                   HYPERION 30 BC
                ¦               Lady Angela 44      ¦
ICECAPADE 69 BC                                     Sister Sarah 30
                ¦                                   POLYNESIAN 42 I
                ¦               NATIVE DANCER 50 IC ¦
                Shenanigans 63  ¦                   Geisha 43
```

```
                              ¦                    Fighting Fox 35
                              Bold Irish 48        ¦
                                                   Erin 27
```

```
                                                  Klairon 52
                              Lorenzaccio 65       ¦
                 Ahonoora 75  ¦                    Phoenissa 51
                 ¦            ¦                    Martial 57
                 ¦            Helen Nichols 66     ¦
INDIAN RIDGE 85 I                                  Quaker Girl 61
                 ¦                                 Delta Judge 60
                 ¦            Swing Easy 68        ¦
                 Hillbrow 75  ¦                    Free Flowing 58
                 ¦            ¦                    Skymaster 58
                              Golden City 70       ¦
                                                   West Shaw 60
```

```
                                                  #War Relic 38
                              Intent 48            ¦
                 Intentionally 56 BI               Liz F 33
                 ¦            ¦                    DISCOVERY 31 S
                 ¦            My Recipe 47         ¦
IN REALITY 64 BC                                   Perlette 34
                 ¦                                 Free For All 42
                 ¦            ROUGH'N TUMBLE 48 BC¦
                 My Dear Girl 57 ¦                 Roused 43
                 ¦            ¦                   #War Relic 38
                              Iltis 47             ¦
                                                   We Hail 42
```

```
                                                   MAN O' WAR 17 S
                              War Relic 38         ¦
                 Intent 48    ¦                    Friar's Carse 23
                 ¦            ¦                    Bubbling Over 23
                 ¦            Liz F 33             ¦
INTENTIONALLY 56 BI                                Weno 22
                 ¦                                 Display 23
                 ¦            DISCOVERY 31 S       ¦
                 My Recipe 47 ¦                    Ariadne 26
                 ¦            ¦                    Percentage 23
                              Perlette 34          ¦
                                                   Escarpolette 17
```

```
                                                   Nearctic 54
                              NORTHERN DANCER 61 BC
                 SADLER'S WELLS 81 CS              Natalma 57
                 ¦            ¦                    Bold Reason 68
                 ¦            Fairy Bridge 75      ¦
IN THE WINGS 86 CS                                 Special 69
                 ¦                                 MILL REEF 68 CS
                 ¦            SHIRLEY HEIGHTS 75 CP
                 High Hawk 80 ¦                    Hardiemma 69
                 ¦            ¦                    Sea Hawk II 63
```

```
                                Sunbittern 70          ¦
                                                       Pantoufle 64

                                                       Tenerani 44
                                RIBOT 52 CP            ¦
                    GRAUSTARK 63 CS ¦                  Romanella 43
                    ¦               ¦                  ALIBHAI 38 C
                    ¦               Flower Bowl 52     ¦
KEY TO THE MINT 69 BC                                  Flower Bed 46
                    ¦                                  PRINCE ROSE 28 C
                    ¦               PRINCEQUILLO 40 IS ¦
                    Key Bridge 59   ¦                  Cosquilla 33
                                    ¦                  WAR ADMIRAL 34 C
                                    Blue Banner 52     ¦
                                                       Risque Blue 41

                                                       BAYARDO 06 P
                                GAINSBOROUGH 15 C      ¦
                    HYPERION 30 BC  ¦                  Rosedrop 07
                    ¦               ¦                  CHAUCER 00 S
                    ¦               Selene 19          ¦
KHALED 43 I         ¦                                  Serenissima 13
                    ¦                                  THE TETRARCH 11 I
                    ¦               Ethnarch 22        ¦
                    Eclair 30       ¦                  Karenza 10
                                    ¦                  Black Jester 11
                                    Black Ray 19       ¦
                                                       Lady Brilliant 12

                                                       Roi Herode 04
                                THE TETRARCH 11 I      ¦
                    Salmon-Trout 21 ¦                  Vahren 1897
                    ¦               ¦                  St Frusquin 1893
                    ¦               Salamandra 13      ¦
KING SALMON 30 I                                       Electra 06
                    ¦                                  Desmond 1896
                    ¦               Charles O'Malley 07 ¦
                    Malva 19        ¦                  Goody-Two-Shoes 1899
                                    ¦                  Robert Le Diable 1899
                                    Wild Arum 11       ¦
                                                       Marliacea 02

                                                       NATIVE DANCER 50 IC
                                RAISE A NATIVE 61 B    ¦
                    MR PROSPECTOR 70 BC                Raise You 46
                    ¦               ¦                  NASHUA 52 IC
                    ¦               Gold Digger 62     ¦
KINGMAMBO 90 CS                                        Sequence 46
                    ¦                                  NORTHERN DANCER 61 BC
                    ¦               NUREYEV 77 C       ¦
                    Miesque 84      ¦                  Special 69
                                    ¦                  Prove Out 69
                                    Pasodoble 79       ¦
```

```
                                                  Santa Quilla 70

                                                  PRINCE ROSE 28 C
                          PRINCEQUILLO 40 IS      ¦
                ROUND TABLE 54 S¦                 Cosquilla 33
                ¦               ¦                 SIR COSMO 26 B
                ¦               Knight's Daughter 41¦
KING'S BISHOP 69 BI                               Feola 33
                ¦                                 NASRULLAH 40 B
                ¦               Fleet Nasrullah 55  ¦
                Spearfish 63    ¦                 Happy Go Fleet 50
                                ¦                 Determine 51
                                Alabama Gal 57    ¦
                                                  Trojan Lass 49

                                                  Heaume 1887
                          Le Roi Soleil 1895      ¦
                Sans Souci II 04¦                 Mlle De La Vallier 1882
                ¦               ¦                 St Serf 1887
                ¦               Sanctimony 1896   ¦
LA FARINA 11 P¦                                   Golden Iris 1891
                ¦                                 Isonomy 1875
                ¦               Isinglass 1890    ¦
                Malatesta 1898  ¦                 Deadlock 1878
                                ¦                 St Simon 1881
                                Parisina 1889     ¦
                                                  Princess Katinka 1876

                                                  RABELAIS 00 P
                          Rialto 23               ¦
                WILD RISK 40 P  ¦                 La Grelee 18
                ¦               ¦                 BLANDFORD 19 C
                ¦               Wild Violet 35    ¦
LE FABULEUX 61¦P                                  Wood Violet 28
                ¦                                 Pinceau 25
                ¦               Verso II 40       ¦
                Anguar 50       ¦                 Variete 24
                                ¦                 Easton 31
                                La Rochelle 45    ¦
                                                  Sans Tares 39

                                                  RIBOT 52 CP
                          Arts and Letters 66     ¦
                CODEX 77 IC     ¦                 All Beautiful 59
                ¦               ¦                 Minnesota Mac 64
                ¦               Roundup Rose 71   ¦
LOST CODE 84 BI                                   Minnetonka 67
                ¦                                 Battle Joined 59
                ¦               ACK ACK 66 IC     ¦
                Loss or Gain 75 ¦                 Fast Turn 59
                                ¦                 Restless Native 60
                                Gain or Loss 68   ¦
                                                  Nevlina 54
```

```
                                                  DJEBEL 37 I
                              Clarion 44          ¦
              Klairon 52      ¦                   Columba 30
              ¦               ¦                   Kantar 25
              ¦               Kalmia 31           ¦
LUTHIER 65 C  ¦                                   Sweet Lavender 23
              ¦                                   Coronach 23
              ¦               Cranach 38          ¦
              Flute Enchantee 50                  Reine Isaure 31
                              ¦                   BRANTOME 31 C
                              Montagnana 37       ¦
                                                  Mauretania 30
```

```
                                                  NEARCO 35 BC
                              Nearctic 54         ¦
              NORTHERN DANCER 61 BC               Lady Angela 44
              ¦               ¦                   NATIVE DANCER 50 IC
              ¦               Natalma 57          ¦
LYPHARD 69 C  ¦                                   Almahmoud 47
              ¦                                   FAIR TRIAL 32 B
              ¦               COURT MARTIAL 42 B  ¦
              Goofed 60       ¦                   Instantaneous 31
                              ¦                   Formor 34
                              Barra II 50         ¦
                                                  La Favorite 34
```

```
                                                  SWYNFORD 07 C
                              BLANDFORD 19 C      ¦
              BLENHEIM II 27 CS                   Blanche 12
              ¦               ¦                   Charles O'Malley 07
              ¦               Malva 19            ¦
MAHMOUD 33 IC ¦                                   Wild Arum 11
              ¦                                   BAYARDO 06 P
              ¦               GAINSBOROUGH 15 C   ¦
              Mah Mahal 28    ¦                   Rosedrop 07
                              ¦                   THE TETRARCH 11 I
                              Mumtaz Mahal 21     ¦
                                                  Lady Josephine 12
```

```
                                                  Spendthrift 1876
                              Hastings 1893       ¦
              FAIR PLAY 05 SP ¦                   Cinderella 1885
              ¦               ¦                   Bend Or 1877
              ¦               Fairy Gold 1896     ¦
MAN O' WAR 17 S                                   Dame Masham 1889
              ¦                                   Sainfoin 1887
              ¦               ROCK SAND 00 CS     ¦
              Mahubah 10      ¦                   Roquebrune 1893
                              ¦                   Merry Hampton 1884
                              Merry Token 1891    ¦
                                                  Mizpah 1880
```

```
                                                  Florizel II 1891
                              Doricles 1898       ¦
              Consols 08      ¦                   Rosalie 1884
              ¦               ¦                   Bend Or 1877
              ¦               Console 1895        ¦
MASSINE 20 P  ¦                                   Grace Conroy 1888
              ¦                                   Flying Fox 1896
              ¦               Ajax 01             ¦
              Mauri 09        ¦                   Amie 1893
                              ¦                   Childwick 1890
                              La Camargo 1898     ¦
                                                  Belle Et Bonne 1887
```

```
                                                  John O' Gaunt 01
                              SWYNFORD 07 C       ¦
              BLANDFORD 19 C  ¦                   Canterbury Pilgrim 1893
              ¦               ¦                   White Eagle 05
              ¦               Blanche 12          ¦
MIDSTREAM 33 C¦                                   Black Cherry 1892
              ¦                                   TRACERY 09 C
              ¦               Abbots Trace 17     ¦
              Midsummer 24    ¦                   Abbots Anne 1899
                              ¦                   Polymelus 02
                              Dew Of June 13      ¦
                                                  Juana 04
```

```
                                                  Doricles 1898
                              Consols 08          ¦
              MASSINE 20 P    ¦                   Console 1895
              ¦               ¦                   Ajax 01
              ¦               Mauri 09            ¦
MIEUXCE 33 P  ¦                                   La Camargo 1898
              ¦                                   Maximum 1899
              ¦               Opott 10            ¦
              L'olivete 25    ¦                   Oussouri 02
                              ¦                   Saint Just 07
                              Jonicole 20         ¦
                                                  Sainte Fiole 06
```

```
                                                  NEARCO 35 BC
                              NASRULLAH 40 B      ¦
              NEVER BEND 60 BI¦                   Mumtaz Begum 32
              ¦               ¦                   Djeddah 45
              ¦               Lalun 52            ¦
MILL REEF 68 CS                                   Be Faithful 42
              ¦                                   PRINCE ROSE 28 C
              ¦               PRINCEQUILLO 40 IS  ¦
              Milan Mill 62   ¦                   Cosquilla 33
                              ¦                   COUNT FLEET 40 C
                              Virginia Water 53   ¦
                                                  Red Ray 47
```

```
                                                  Tamerlane 52
```

```
                          Dschingis Khan 61   ¦
            Konigsstuhl 76  ¦                    Donna Diana 56
            ¦               ¦                    Tiepoletto 56
            ¦               Konigskronung 65     ¦
MONSUN 90 CS  ¦                                  Kronung 57
            ¦                                    Literat 65
            ¦               Surumu 74            ¦
            Mosella 85      ¦                    Suruma 70
                            ¦                    Authi 70
                            Monasia 79           ¦
                                                 Monacensia 69
```

```
                                                 Nearctic 54
                            NORTHERN DANCER 61   ¦
            SADLER'S WELLS 81                    Natalma 57
            ¦               ¦                    Bold Reason 68
            ¦               Fairy Bridge 75      ¦
MONTJEU 96 CS ¦                                  Special 69
            ¦                                    HIGH TOP 69
            ¦               Top Ville 76         ¦
            Floripedes 85   ¦                    Sega Ville 68
                            ¦                    Tennyson 70
                            Toute Cy 79          ¦
                                                 Adele Toumignon 71
```

```
                                                 PHALARIS 13 B
                            PHAROS 20 I          ¦
            NEARCO 35 BC    ¦                    Scapa Flow 14
            ¦               ¦                    HAVRESAC II 15 I
            ¦               Nogara 28            ¦
MOSSBOROUGH 47¦C                                 Catnip 10
            ¦                                    GAINSBOROUGH 15 C
            ¦               Bobsleigh 32         ¦
            All Moonshine 41¦                    Toboggan 25
                            ¦                    CHAUCER 00 S
                            Selene 19            ¦
                                                 Serenissima 13
```

```
                                                 POLYNESIAN 42 I
                            NATIVE DANCER 50 IC  ¦
            RAISE A NATIVE 61 B                  Geisha 43
            ¦               ¦                    Case Ace 34
            ¦               Raise You 46         ¦
MR. PROSPECTOR 70 BC                             Lady Glory 34
            ¦                                    NASRULLAH 40 B
            ¦               NASHUA 52 IC         ¦
            Gold Digger 62  ¦                    Segula 42
                            ¦                    COUNT FLEET 40 C
                            Sequence 46          ¦
                                                 Miss Dogwood 39
```

```
                                                 Ksar 18
                            TOURBILLON 28 CP     ¦
```

```
                DJEBEL 37 I      ¦                   Durban 18
                ¦                ¦                   Gay Crusader 14
                ¦                Loika 26            ¦
MY BABU 45 B    ¦                                    Coeur A Coeur 21
                ¦                                    BLANDFORD 19 C
                ¦                Badruddin 31        ¦
                Perfume II 38    ¦                   Mumtaz Mahal 21
                                 ¦                   PHAROS 20 I
                                 Lavendula 30        ¦
                                                     Sweet Lavender 23
```

```
                                                     PHAROS 20 I
                                 NEARCO 35 BC        ¦
                NASRULLAH 40 B   ¦                   Nogara 28
                ¦                ¦                   BLENHEIM II 27 CS
                ¦                Mumtaz Begum 32     ¦
NASHUA 52 IC    ¦                                    Mumtaz Mahal 21
                ¦                                    Jamestown 28
                ¦                Johnstown 36        ¦
                Segula 42        ¦                   La France 28
                                 ¦                   SARDANAPALE 11 P
                                 Sekhmet 29          ¦
                                                     Prosopopee 16
```

```
                                                     PHALARIS 13 B
                                 PHAROS 20 I         ¦
                NEARCO 35 BC     ¦                   Scapa Flow 14
                ¦                ¦                   HAVRESAC II 15 I
                ¦                Nogara 28           ¦
NASRULLAH 40 B  ¦                                    Catnip 10
                ¦                                    BLANDFORD 19 C
                ¦                BLENHEIM II 27 CS   ¦
                Mumtaz Begum 32  ¦                   Malva 19
                                 ¦                   THE TETRARCH 11 I
                                 Mumtaz Mahal 21     ¦
                                                     Lady Josephine 12
```

```
                                                     Sickle 24
                                 Unbreakable 35      ¦
                POLYNESIAN 42 I  ¦                   Blue Glass 17
                ¦                ¦                   Polymelian 14
                ¦                Black Polly 36      ¦
NATIVE DANCER 50 IC              ¦                   Black Queen 30
                ¦                                    Display 23
                ¦                DISCOVERY 31 S      ¦
                Geisha 43        ¦                   Ariadne 26
                                 ¦                   John P Grier 17
                                 Miyako 35           ¦
                                                     La Chica 30
```

```
                                                     Best Man 1890
                                 Signorino 02        ¦
                Michelangelo 18  ¦                   Signorina 1887
```

```
                 ¦                 ¦                    SPEARMINT 03 P
                 ¦                 Fausta 11            ¦
NAVARRO 31 C     ¦                                      Madree 04
                 ¦                                      Marcovil 03
                 ¦                 HURRY ON 13 P        ¦
                 Nuvolona 26       ¦                    Tout Suite 04
                                   ¦                    TRACERY 09 C
                                   Nera De Bicci 18     ¦
                                                        Catnip 10
```

```
                                                        Polymelus 02
                                   PHALARIS 13 B        ¦
                 PHAROS 20 I       ¦                    Bromus 05
                 ¦                 ¦                    CHAUCER 00 S
                 ¦                 Scapa Flow 14        ¦
NEARCO 35 BC     ¦                                      Anchora 05
                 ¦                                      RABELAIS 00 P
                 ¦                 HAVRESAC II 15 I     ¦
                 Nogara 28         ¦                    Hors Concours 06
                                   ¦                    SPEARMINT 03 P
                                   Catnip 10            ¦
                                                        Sibola 1896
```

```
                                                        PHAROS 20 I
                                   NEARCO 35 BC         ¦
                 NASRULLAH 40 B    ¦                    Nogara 28
                 ¦                 ¦                    BLENHEIM II 27 CS
                 ¦                 Mumtaz Begum 32      ¦
NEVER BEND 60 BI                                       Mumtaz Mahal 21
                 ¦                                      DJEBEL 37 I
                 ¦                 Djeddah 45           ¦
                 Lalun 52          ¦                    Djezima 33
                                   ¦                    Bimelech 37
                                   Be Faithful 42       ¦
                                                        Bloodroot 32
```

```
                                                        NEARCO 35 BC
                                   Nearctic 54          ¦
                 NORTHERN DANCER 61 BC                  Lady Angela 44
                 ¦                 ¦                    NATIVE DANCER 50 IC
                 ¦                 Natalma 57           ¦
NIJINSKY II 67 CS                                      Almahmoud 47
                 ¦                                      BULL LEA 35 C
                 ¦                 Bull Page 47         ¦
                 Flaming Page 59   ¦                    Our Page 40
                                   ¦                    Menow 35
                                   Flaring Top 47       ¦
                                                        Flaming Top 41
```

```
                                                        Nearctic 54
                                   NORTHERN DANCER 61 BC
                 NIJINSKY II 67 CS                      Natalma 57
                 ¦                 ¦                    Bull Page 47
```

```
                 ¦                 Flaming Page 59     ¦
NINISKI 76 CP    ¦                                     Flaring Top 47
                 ¦                                     RIBOT 52 CP
                 ¦                 TOM ROLFE 62 CP     ¦
                 Virginia Hills 71                     Pocahontas 55
                                   ¦                   Ridan 59
                                   Ridin' Easy 67      ¦
                                                       Easy Eight 54
```

```
                                                       Stardust 37
                                   STAR KINGDOM 46 IC  ¦
                 NOHOLME II 56 BC  ¦                   Impromptu 39
                 ¦                 ¦                   Colombo 31
                 ¦                 Oceana 47           ¦
NODOUBLE 65 CP   ¦                                     Orama 32
                 ¦                                     Balladier 32
                 ¦                 DOUBLE JAY 44 B     ¦
                 Abla-Jay 55       ¦                   Broomshot 26
                                   ¦                   Don Bingo 39
                                   Ablamucha 47        ¦
                                                       Sweet Betty 35
```

```
                                                       HYPERION 30 BC
                                   Stardust 37         ¦
                 STAR KINGDOM 46 IC                    Sister Stella 23
                 ¦                 ¦                   Concerto 28
                 ¦                 Impromptu 39        ¦
NOHOLME II 56 BC                                       Thoughtless 34
                 ¦                                     Manna 22
                 ¦                 Colombo 31          ¦
                 Oceana 47         ¦                   Lady Nairne 19
                                   ¦                   Diophon 21
                                   Orama 32            ¦
                                                       Cantelupe 20
```

```
                                                       PHAROS 20 I
                                   NEARCO 35 BC        ¦
                 Nearctic 54       ¦                   Nogara 28
                 ¦                 ¦                   HYPERION 30 BC
                 ¦                 Lady Angela 44      ¦
NORTHERN DANCER 61 BC                                  Sister Sarah 30
                 ¦                                     POLYNESIAN 42 I
                 ¦                 NATIVE DANCER 50 IC ¦
                 Natalma 57        ¦                   Geisha 43
                                   ¦                   MAHMOUD 33 IC
                                   Almahmoud 47        ¦
                                                       Arbitrator 37
```

```
                                                       NEARCO 35 BC
                                   Nearctic 54         ¦
                 NORTHERN DANCER 61 BC                 Lady Angela 44
                 ¦                 ¦                   NATIVE DANCER 50 IC
                 ¦                 Natalma 57          ¦
```

```
NUREYEV 77 C  ¦                                  Almahmoud 47
              ¦                                  Aristophanes 48
              ¦                FORLI 63 C        ¦
              Special 69       ¦                 Trevisa 51
              ¦                ¦                 Nantallah 53
              ¦                Thong 64          ¦
              ¦                                  Rough Shod II 44

                               DARK RONALD 05 P  Bay Ronald 1893
                               ¦                 ¦
              Prunus 15        ¦                 Darkie 1889
              ¦                ¦                 Persimmon 1893
              ¦                Pomegranate 01    ¦
OLEANDER 24 S ¦                                  Briar-Root 1885
              ¦                                  Kendal 1883
              ¦                Galtee More 1894  ¦
              Orchidee II 10   ¦                 Morganette 1884
              ¦                ¦                 St Serf 1887
              ¦                Orseis 1897       ¦
              ¦                                  Orsova 1888

                               HYPERION 30 BC    GAINSBOROUGH 15 C
                               ¦                 ¦
              HELIOPOLIS 36 B  ¦                 Selene 19
              ¦                ¦                 SWYNFORD 07 C
              ¦                Drift 26          ¦
OLYMPIA 46 B  ¦                                  Santa Cruz 16
              ¦                                  ULTIMUS 06 B
              ¦                Stimulus 22       ¦
              Miss Dolphin 34  ¦                 Hurakan 11
              ¦                ¦                 Light Brigade 10
              ¦                Tinamou 22        ¦
              ¦                                  Casuarina 11

                               Ormonde 1883      Bend Or 1877
                               ¦                 ¦
              Orme 1889        ¦                 Lily Agnes 1871
              ¦                ¦                 Galopin 1872
              ¦                Angelica 1879     ¦
ORBY 04 B     ¦                                  St Angela 1865
              ¦                                  Hindoo 1878
              ¦                Hanover 1884      ¦
              Rhoda B 1895     ¦                 Bourbon Belle 1869
              ¦                ¦                 Algerine 1873
              ¦                Margerine 1893    ¦
              ¦                                  Sweet Songstress 1879

                               Ajax 01           Flying Fox 1896
                               ¦                 ¦
              TEDDY 13 S       ¦                 Amie 1893
              ¦                ¦                 Bay Ronald 1893
              ¦                Rondeau 00        ¦
ORTELLO 26 P  ¦                                  Doremi 1894
```

```
              ¦                              Ladas 1891
              ¦               Gorgos 03      ¦
              Hollebeck 14    ¦              The Gorgon 1897
                              ¦              RABELAIS 00 P
                              Hilda II 07    ¦
                                             Helen Kendal 02
```

```
                                             ORBY 04 B
                              The Boss 10    ¦
              SIR COSMO 26 B  ¦              Southern Cross II 1897
              ¦               ¦              Desmond 1896
              ¦               Ayn Hali 13    ¦
PANORAMA 36 B ¦                              Lalla Rookh 04
              ¦                              Sundridge 1898
              ¦               Happy Warrior 11   ¦
              Happy Climax 21 ¦              Sweet Lassie 06
                              ¦              DARK RONALD 05 P
                              Clio 13        ¦
                                             Mall 1898
```

```
                                             SWYNFORD 07 C
                              BLANDFORD 19 C     ¦
              BAHRAM 32 C     ¦              Blanche 12
              ¦               ¦              Friar Marcus 12
              ¦               Friar's Daughter 21 ¦
PERSIAN GULF 40 C                            Garron Lass 17
              ¦                              Tredennis 1898
              ¦               BACHELOR'S DOUBLE 06¦S
              Double Life 26  ¦              Lady Bawn 02
                              ¦              Willbrook 11
                              Saint Joan 18  ¦
                                             Flo Desmond 13
```

```
                                             Himyar 1875
                              Domino 1891    ¦
              Commando 1898   ¦              Mannie Gray 1874
              ¦               ¦              Darebin 1878
              ¦               Emma C 1892    ¦
PETER PAN 04 B¦                              Guenn 1883
              ¦                              Newminster 1848
              ¦               Hermit 1864    ¦
              Cinderella 1888 ¦              Seclusion 1857
                              ¦              See Saw 1865
                              Mazurka 1878   ¦
                                             Mabille 1868
```

```
                                             PHALARIS 13 B
                              FAIRWAY 25 B   ¦
              FAIR TRIAL 32 B ¦              Scapa Flow 14
              ¦               ¦              SON-IN-LAW 11 P
              ¦               Lady Juror 19  ¦
PETITION 44 I ¦                              Lady Josephine 12
              ¦                              GAINSBOROUGH 15 C
```

```
                ¦                Artist's Proof 26   ¦
                Art Paper 33     ¦                   Clear Evidence 20
                                 ¦                   Fairy King 10
                                 Quire 18            ¦
                                                     Queen Carbine 09
```

```
                                                     Bona Vista 1889
                                 Cyllene 1895        ¦
                Polymelus 02     ¦                   Arcadia 1887
                ¦                ¦                   Hampton 1872
                ¦                Maid Marian 1886    ¦
PHALARIS 13 B   ¦                                    Quiver 1872
                ¦                                    Springfield 1873
                ¦                Sainfoin 1887       ¦
                Bromus 05        ¦                   Sanda 1878
                                 ¦                   St Simon 1881
                                 Cheery 1892         ¦
                                                     Sunrise 1883
```

```
                                                     Polymelus 02
                                 PHALARIS 13 B       ¦
                PHAROS 20 I      ¦                   Bromus 05
                ¦                ¦                   CHAUCER 00 S
                ¦                Scapa Flow 14       ¦
PHARIS II 36 B  ¦                                    Anchora 05
                ¦                                    Radium 03
                ¦                CLARISSIMUS 13 C    ¦
                Carissima 23     ¦                   Quintessence 00
                                 ¦                   Captivation 02
                                 Casquetts 13        ¦
                                                     Cassis 1896
```

```
                                                     Cyllene 1895
                                 Polymelus 02        ¦
                PHALARIS 13 B    ¦                   Maid Marian 1886
                ¦                ¦                   Sainfoin 1887
                ¦                Bromus 05           ¦
PHAROS 20 I     ¦                                    Cheery 1892
                ¦                                    St Simon 1881
                ¦                CHAUCER 00 S        ¦
                Scapa Flow 14    ¦                   Canterbury Pilgrim 1893
                                 ¦                   Love Wisely 1893
                                 Anchora 05          ¦
                                                     Eryholme 1898
```

```
                                                     HYPERION 30 BC
                                 HELIOPOLIS 36 B     ¦
                OLYMPIA 46 B     ¦                   Drift 26
                ¦                ¦                   Stimulus 22
                ¦                Miss Dolphin 34     ¦
PIA STAR 61 S   ¦                                    Tinamou 22
                ¦                                    BLENHEIM II 27 CS
                ¦                MAHMOUD 33 IC       ¦
```

```
                Inquisitive 54  ¦                   Mah Mahal 28
                                ¦                   Pavot 42
                                Swistar 49          ¦
                                                    Schwester 36
```

```
                                                    Sainfoin 1887
                                ROCK SAND 00 CS     ¦
                Friar Rock 13   ¦                   Roquebrune 1893
                ¦               ¦                   Bend Or 1877
                ¦               Fairy Gold 1896     ¦
PILATE 28 C     ¦                                   Dame Masham 1889
                ¦                                   Roi Herode 04
                ¦               THE TETRARCH 11 I   ¦
                Herodias 16     ¦                   Vahren 1897
                                ¦                   Gallinule 1884
                                Honora 07           ¦
                                                    Word Of Honour 1892
```

```
                                                    Tenerani 44
                                RIBOT 52 CP         ¦
                HIS MAJESTY 68 C¦                   Romanella 43
                ¦               ¦                   ALIBHAI 38 C
                ¦               Flower Bowl 52      ¦
PLEASANT COLONY 78 I                                Flower Bed 46
                ¦                                   DOUBLE JAY 44 B
                ¦               Sunrise Flight 59   ¦
                Sun Colony 68   ¦                   Misty Morn 52
                                ¦                   Cockrullah 51
                                Colonia 59          ¦
                                                    Nalga 52
```

```
                                                    PHALARIS 13 B
                                Sickle 24           ¦
                Unbreakable 35  ¦                   Selene 19
                ¦               ¦                   Prince Palatine 08
                ¦               Blue Glass 17       ¦
POLYNESIAN 42 I                                     Hour Glass II 09
                ¦                                   Polymelus 02
                ¦               Polymelian 14       ¦
                Black Polly 36  ¦                   Pasquita 07
                                ¦                   POMPEY 23 B
                                Black Queen 30      ¦
                                                    Black Maria 23
```

```
                                                    Amphion 1886
                                Sundridge 1898      ¦
                Sun Briar 15    ¦                   Sierra 1889
                ¦               ¦                   St Frusquin 1893
                ¦               Sweet Briar 08      ¦
POMPEY 23 B     ¦                                   Presentation 1898
                ¦                                   Polymelus 02
                ¦               Corcyra 11          ¦
                Cleopatra 17    ¦                   Pearmain 05
```

```
                                ¦                   Gallinule 1884
                                Gallice 10          ¦
                                                    St Cecilia 1896

                                                    Marco 1892
                                Marcovil 03         ¦
                    HURRY ON 13 P   ¦               Lady Villikins 1885
                    ¦           ¦   ¦               Sainfoin 1887
                    ¦           Tout Suite 04       ¦
PRECIPITATION 33 P                                  Star 1887
                    ¦                               Tredennis 1898
                    ¦           BACHELOR'S DOUBLE 06¦S
                    Double Life 26  ¦               Lady Bawn 02
                                ¦   ¦               Willbrook 11
                                Saint Joan 18       ¦
                                                    Flo Desmond 13

                                                    Colombo 31
                                BRITISH EMPIRE 37 B ¦
                    Endeavour II 42 ¦               Rose Of England 27
                    ¦           ¦   ¦               Hunter's Moon 26
                    ¦           Himalaya 31         ¦
PRETENSE 63 C       ¦                               Partenope 16
                    ¦                               GAINSBOROUGH 15 C
                    ¦           HYPERION 30 BC      ¦
                    Imitation 51    ¦               Selene 19
                                ¦   ¦               Winalot 21
                                Flattery 38         ¦
                                                    Fickle 29

                                                    Prince Palatine 08
                                Rose Prince 19      ¦
                    PRINCE ROSE 28 C¦               Eglantine 06
                    ¦           ¦   ¦               Gay Crusader 14
                    ¦           Indolence 20        ¦
PRINCE BIO 41 C                                     Barrier 10
                    ¦                               Tetratema 17
                    ¦           Bacteriophage 29    ¦
                    Biologie 35     ¦               Pharmacie 18
                                ¦   ¦               Cadum 21
                                Eponge 29           ¦
                                                    Sea Moss 17

                                                    Prince Palatine 08
                                Rose Prince 19      ¦
                    PRINCE ROSE 28 C¦               Eglantine 06
                    ¦           ¦   ¦               Gay Crusader 14
                    ¦           Indolence 20        ¦
PRINCE CHEVALIER 43 C                               Barrier 10
                    ¦                               Abbots Trace 17
                    ¦           Abbot's Speed 23    ¦
                    Chevalerie 33   ¦               Mary Gaunt 12
                                ¦   ¦               Cylgad 09
```

```
                                Kassala 26          ¦
                                                    Farizade 21

                                                    Rose Prince 19
                                PRINCE ROSE 28 C    ¦
                    PRINCEQUILLO 40 IS              Indolence 20
                    ¦           ¦                   Papyrus 20
                    ¦           Cosquilla 33        ¦
PRINCE JOHN 53      ¦C                              Quick Thought 18
                    ¦                               Reigh Count 25
                    ¦           COUNT FLEET 40 C    ¦
                    Not Afraid 48   ¦               Quickly 30
                                    ¦               BLUE LARKSPUR 26 C
                                Banish Fear 32      ¦
                                                    Herodiade 23

                                                    Prince Palatine 08
                                Rose Prince 19      ¦
                    PRINCE ROSE 28 C¦               Eglantine 06
                    ¦           ¦                   Gay Crusader 14
                    ¦           Indolence 20        ¦
PRINCEQUILLO 40 IS                                  Barrier 10
                    ¦                               TRACERY 09 C
                    ¦           Papyrus 20          ¦
                    Cosquilla 33    ¦               Miss Matty 14
                                    ¦               White Eagle 05
                                Quick Thought 18    ¦
                                                    Mindful 13

                                                    Persimmon 1893
                                Prince Palatine 08  ¦
                    Rose Prince 19  ¦               Lady Lightfoot 00
                    ¦           ¦                   Perth 1896
                    ¦           Eglantine 06        ¦
PRINCE ROSE 28      ¦C                              Rose De Mai 00
                    ¦                               BAYARDO 06 P
                    ¦           Gay Crusader 14     ¦
                    Indolence 20    ¦               Gay Laura 09
                                    ¦               Grey Leg 1891
                                Barrier 10          ¦
                                                    Bar The Way 01

                                                    Sun Teddy 33
                                Sun Again 39        ¦
                    Palestinian 46  ¦               Hug Again 31
                    ¦           ¦                   Whiskaway 19
                    ¦           Dolly Whisk 36      ¦
PROMISED LAND 54 C                                  Dolly Seth 23
                    ¦                               BLENHEIM II 27 CS
                    ¦           MAHMOUD 33 IC       ¦
                    Mahmoudess 42   ¦               Mah Mahal 28
                                    ¦               Toro 25
                                Forever Yours 33    ¦
```

```
                                            Winsome Way 28
```

```
                                            Bold Reasoning 68
                            SEATTLE SLEW 74 BC  ¦
              A.P. INDY 89 IC ¦                 My Charmer 69
              ¦             ¦                   SECRETARIAT 70 IC
              ¦             Weekend Surprise 80 ¦
   PULPIT 94 IC  ¦                              Lassie Dear 74
              ¦                                 RAISE A NATIVE 61 B
              ¦             MR. PROSPECTOR 70 BC¦
              Preach 89     ¦                   Gold Digger 62
                            ¦                   Honest Pleasure 73
                            Narrate 80          ¦
                                                State 74
```

```
                                                Vedette 1854
                            Galopin 1872        ¦
              St Simon 1881   ¦                 Flying Duchess 1853
              ¦             ¦                   King Tom 1851
              ¦             St Angela 1865      ¦
   RABELAIS 00 P ¦                              Adeline 1851
              ¦                                 Isonomy 1875
              ¦             Satiety 1885        ¦
              Satirical 1891  ¦                 Wifey 1876
                            ¦                   Wild Oats 1866
                            Chaff 1880          ¦
                                                Celerrima 1862
```

```
                                                NASRULLAH 40 B
                            Red God 54          ¦
              BLUSHING GROOM 74 BC              Spring Run 48
              ¦             ¦                   WILD RISK 40 P
              ¦             Runaway Bride 62    ¦
   RAINBOW QUEST 81 CS                          Aimee 57
              ¦                                 Isonomy 1875
              ¦             HERBAGER 56 CS      ¦
              I Will Follow 75¦                 Flagette 51
                            ¦                   RAISE A NATIVE 61 B
                            Where You Lead 70   ¦
                                                Noblesse 60
```

```
                                                Unbreakable 35
                            POLYNESIAN 42 I     ¦
              NATIVE DANCER 50¦IC               Black Polly 36
              ¦             ¦                   DISCOVERY 31 S
              ¦             Geisha 43           ¦
   RAISE A NATIVE¦61 B                          Miyako 35
              ¦                                 TEDDY 13 S
              ¦             Case Ace 34         ¦
              Raise You 46  ¦                   Sweetheart 20
                            ¦                   American Flag 22
                            Lady Glory 34       ¦
                                                Beloved 27
```

```
                                                Deiri 28
                          Deux Pour Cent 41     ¦
          TANTIEME 47 S   ¦                     Dix Pour Cent 33
          ¦               ¦                     Indus 28
          ¦               Terka 42              ¦
RELIANCE II 62¦SP                               La Furka 27
          ¦                                     War Relic 38
          ¦               Relic 45              ¦
          Relance 52      ¦                     Bridal Colors 31
                          ¦                     Le Volcan 41
                          Polaire 47            ¦
                                                Stella Polaris 37
```

```
                                                Deux Pour Cent 41
                          TANTIEME 47 S         ¦
          Tanerko 53      ¦                     Terka 42
          ¦               ¦                     Fair Copy 34
          ¦               La Divine 43          ¦
RELKO 60 S¦                                     La Diva 37
          ¦                                     War Relic 38
          ¦               Relic 45              ¦
          Relance 52      ¦                     Bridal Colors 31
                          ¦                     Le Volcan 41
                          Polaire 47            ¦
                                                Stella Polaris 37
```

```
                                                NEARCO 35 BC
                          NASRULLAH 40 B        ¦
          BOLD RULER 54 BI¦                     Mumtaz Begum 32
          ¦               ¦                     DISCOVERY 31 S
          ¦               Miss Disco 44         ¦
REVIEWER 66 BC¦                                 Outdone 36
          ¦                                     ROMAN 37 BI
          ¦               Hasty Road 51         ¦
          Broadway 59     ¦                     Traffic Court 38
                          ¦                     Challedon 36
                          Flitabout 45          ¦
                                                Bird Flower 32
```

```
                                                Cavaliere D'arpino 26
                          Bellini 37            ¦
          Tenerani 44     ¦                     Bella Minna 23
          ¦               ¦                     Apelle 23
          ¦               Tofanella 31          ¦
RIBOT 52 CP¦                                    Try Try Again 22
          ¦                                     PHAROS 20 I
          ¦               El Greco 34           ¦
          Romanella 43    ¦                     Gay Gamp 23
                          ¦                     Papyrus 20
                          Barbara Burrini 37    ¦
                                                Bucolic 26
```

```
                                            GAINSBOROUGH 15 C
                        HYPERION 30 BC      ¦
          Owen Tudor 38   ¦                 Selene 19
          ¦               ¦                 PHAROS 20 I
          ¦             Mary Tudor II 31    ¦
RIGHT ROYAL 58¦S                            Anna Bolena 20
          ¦                                 Kantar 25
          ¦             Victrix 34          ¦
          Bastia 51       ¦                 Victory 28
                          ¦                 Ksar 18
                        Barberybush II 34   ¦
                                            Pervencheres 22
```

```
                                            NEARCO 35 BC
                        NASRULLAH 40 B      ¦
          NEVER BEND 60 BI¦                 Mumtaz Begum 32
          ¦               ¦                 Djeddah 45
          ¦             Lalun 52            ¦
RIVERMAN 69 IC¦                             Be Faithful 42
          ¦                                 PRINCEQUILLO 40 IS
          ¦             PRINCE JOHN 53 C    ¦
          River Lady 63   ¦                 Not Afraid 48
                          ¦                 ROMAN 37 BI
                        Nile Lily 54        ¦
                                            Azalea 44
```

```
                                            ROYAL CHARGER 42 B
                        TURN-TO 51 BI       ¦
          HAIL TO REASON 58 C               Source Sucree 40
          ¦               ¦                 Blue Swords 40
          ¦             Nothirdchance 48    ¦
ROBERTO 69 C  ¦                             Galla Colors 43
          ¦                                 NASRULLAH 40 B
          ¦             NASHUA 52 IC        ¦
          Bramalea 59     ¦                 Segula 42
                          ¦                 BULL LEA 35 C
                        Rarelea 49          ¦
                                            Bleebok 41
```

```
                                            St Albans 1857
                        Springfield 1873    ¦
          Sainfoin 1887   ¦                 Viridis 1864
          ¦               ¦                 Wenlock 1869
          ¦             Sanda 1878          ¦
ROCK SAND 00 CS                             Sandal 1861
          ¦                                 Galopin 1872
          ¦             St Simon 1881       ¦
          Roquebrune 1893 ¦                 St Angela 1865
                          ¦                 Hermit 1864
                        St Marguerite 1879  ¦
                                            Devotion 1869
```

```
                                            Ajax 01
```

```
                    TEDDY 13 S          ¦
SIR GALLAHAD III¦20 C                   Rondeau 00
¦                ¦                      SPEARMINT 03 P
¦                Plucky Liege 12        ¦
ROMAN 37 BI   ¦                         Concertina 1896
¦                                       SUNSTAR 08 S
¦                Buchan 16              ¦
Buckup 28        ¦                      Hamoaze 11
                 ¦                      ULTIMUS 06 B
                 Look Up 22             ¦
                                        Sweeping Glance 16
```

```
                                        Sting 21
                 Questionnaire 27       ¦
Free For All 42 ¦                       Miss Puzzle 13
¦                ¦                      Chicle 13
¦                Panay 34               ¦
ROUGH'N TUMBLE¦48 BC                    Panasette 28
¦                                       TEDDY 13 S
¦                BULL DOG 27 B          ¦
Roused 43        ¦                      Plucky Liege 12
                 ¦                      Upset 17
                 Rude Awakening 36      ¦
                                        Cushion 17
```

```
                                        Rose Prince 19
                 PRINCE ROSE 28 C       ¦
PRINCEQUILLO 40 IS                      Indolence 20
¦                ¦                      Papyrus 20
¦                Cosquilla 33           ¦
ROUND TABLE 54¦S                        Quick Thought 18
¦                                       The Boss 10
¦                SIR COSMO 26 B         ¦
Knight's Daughter 41                    Ayn Hali 13
                 ¦                      Friar Marcus 12
                 Feola 33               ¦
                                        Aloe 26
```

```
                                        Nearctic 54
                 NORTHERN DANCER 61 BC
NIJINSKY II 67 CS                       Natalma 57
¦                ¦                      Bull Page 47
¦                Flaming Page 59        ¦
ROYAL ACADEMY 87 BI                     Flaring Top 47
¦                                       SPY SONG 43 B
¦                Crimson Satan 59       ¦
Crimson Saint 69¦                       Papila 43
                 ¦                      Bolero 46
                 Bolero Rose 58         ¦
                                        First Rose 46
```

```
                                        PHALARIS 13 B
                 PHAROS 20 I            ¦
```

```
                NEARCO 35 BC     ¦                    Scapa Flow 14
                ¦                ¦                    HAVRESAC II 15 I
                ¦                Nogara 28            ¦
ROYAL CHARGER 42 B                                    Catnip 10
                ¦                                    GAINSBOROUGH 15 C
                ¦                SOLARIO 22 P         ¦
                Sun Princess 37  ¦                    Sun Worship 12
                                 ¦                    BLENHEIM II 27 CS
                                 Mumtaz Begum 32      ¦
                                                      Mumtaz Mahal 21
```

```
                                                      Tenerani 44
                                 RIBOT 52 CP          ¦
                TOM ROLFE 62 CP  ¦                    Romanella 43
                ¦                ¦                    ROMAN 37 BI
                ¦                Pocahontas 55        ¦
RUN THE GANTLET 68 P                                  How 48
                ¦                                    TURN-TO 51 BI
                ¦                First Landing 56     ¦
                First Feather 63 ¦                    Hildene 38
                                 ¦                    PRINCEQUILLO 40 IS
                                 Quill 56             ¦
                                                      Quick Touch 46
```

```
                                                      NEARCO 35 BC
                                 Nearctic 54          ¦
                NORTHERN DANCER  61 BC                Lady Angela 44
                ¦                ¦                    NATIVE DANCER 50 IC
                ¦                Natalma 57           ¦
SADLER'S WELLS  ¦81 CS                                Almahmoud 47
                ¦                                    HAIL TO REASON 58 C
                ¦                Bold Reason 68       ¦
                Fairy Bridge 75  ¦                    Lalun 52
                                 ¦                    FORLI 63 C
                                 Special 69           ¦
                                                      Thong 64
```

```
                                                      Fripon 1883
                                 Le Pompon 1891       ¦
                Prestige 03      ¦                    La Foudre 1886
                ¦                ¦                    Reverend 1888
                ¦                Orgueilleuse 1894    ¦
SARDANAPALE 11  ¦P                                    Oroya 1888
                ¦                                    St Simon 1881
                ¦                Florizel II 1891     ¦
                Gemma 03         ¦                    Perdita II 1881
                                 ¦                    Rosicrucian 1865
                                 Agnostic 1884        ¦
                                                      Bonnie Agnes 1875
```

```
                                                      POLYNESIAN 42 I
                                 NATIVE DANCER 50 IC  ¦
                Dan Cupid 56     ¦                    Geisha 43
```

```
                 ¦                 ¦                    Sickle 24
                 ¦                 Vixenette 44         ¦
SEA-BIRD 62 S    ¦                                      Lady Reynard 39
                 ¦                                      PRINCE BIO 41 C
                 ¦                 SICAMBRE 48 C        ¦
                 Sicalade 56       ¦                    Sif 36
                                   ¦                    Maurepas 37
                                   Marmelade 49         ¦
                                                        Couleur 39
```

```
                                                        BOLD RULER 54 BI
                                   Boldnesian 63        ¦
                 Bold Reasoning 68 ¦                    Alanesian 54
                 ¦                 ¦                    HAIL TO REASON 58 C
                 ¦                 Reason To Earn 63    ¦
SEATTLE SLEW 74 BC                                      Sailing Home 48
                 ¦                                      ROUND TABLE 54 S
                 ¦                 Poker 63             ¦
                 My Charmer 69     ¦                    Glamour 53
                                   ¦                    Jet Action 51
                                   Fair Charmer 59      ¦
                                                        Myrtle Charm 46
```

```
                                                        NEARCO 35 BC
                                   NASRULLAH 40 B       ¦
                 BOLD RULER 54 BI  ¦                    Mumtaz Begum 32
                 ¦                 ¦                    DISCOVERY 31 S
                 ¦                 Miss Disco 44        ¦
SECRETARIAT 70   ¦IC                                     Outdone 36
                 ¦                                      PRINCE ROSE 28 C
                 ¦                 PRINCEQUILLO 40 IS   ¦
                 Somethingroyal 52                      Cosquilla 33
                                   ¦                    Caruso 27
                                   Imperatrice 38       ¦
                                                        Cinquepace 34
```

```
                                                        POLYNESIAN 42 I
                                   NATIVE DANCER 50 IC  ¦
                 Atan 61           ¦                    Geisha 43
                 ¦                 ¦                    TUDOR MINSTREL 44 B
                 ¦                 Mixed Marriage 52    ¦
SHARPEN UP 69    BC                                     Persian Maid 47
                 ¦                                      HYPERION 30 BC
                 ¦                 Rockefella 41        ¦
                 Rocchetta 61      ¦                    Rockfel 35
                                   ¦                    Majano 37
                                   Chambiges 49         ¦
                                                        Chanterelle 40
```

```
                                                        NASRULLAH 40 B
                                   NEVER BEND 60 BI     ¦
                 MILL REEF 68 CS   ¦                    Lalun 52
                 ¦                 ¦                    PRINCEQUILLO 40 IS
```

```
                ¦                Milan Mill 62        ¦
SHIRLEY HEIGHTS 75 CP                                 Virginia Water 53
                ¦                                     Hard Ridden 55
                ¦                Hardicanute 62       ¦
                Hardiemma 69     ¦                    Harvest Maid 49
                                 ¦                    Grandmaster 42
                                 Grand Cross 52       ¦
                                                      Blue Cross 46
```

```
                                                      Rose Prince 19
                                 PRINCE ROSE 28 C     ¦
                PRINCE BIO 41 C  ¦                    Indolence 20
                ¦                ¦                    Bacteriophage 29
                ¦                Biologie 35          ¦
SICAMBRE 48 C   ¦                                     Eponge 29
                ¦                                     RABELAIS 00 P
                ¦                Rialto 23            ¦
                Sif 36           ¦                    La Grelee 18
                                 ¦                    ALCANTARA II 08 P
                                 Suavita 28           ¦
                                                      Shocking 19
```

```
                                                      FAIRWAY 25 B
                                 FULL SAIL 34 I       ¦
                Seductor 43      ¦                    Fancy Free 24
                ¦                ¦                    Macon 22
                ¦                Suma 37              ¦
SIDERAL 48 C    ¦                                     Sweet Peggy 20
                ¦                                     Hapsburg 11
                ¦                Noble Star 27        ¦
                Starling 39      ¦                    Hesper 23
                                 ¦                    Friar Marcus 12
                                 Feola 33             ¦
                                                      Aloe 26
```

```
                                                      Orme 1889
                                 ORBY 04 B            ¦
                The Boss 10      ¦                    Rhoda B 1895
                ¦                ¦                    Meteor 1880
                ¦                Southern Cross II 1897
SIR COSMO 26 B  ¦                                     Resplendent 1891
                ¦                                     St Simon 1881
                ¦                Desmond 1896         ¦
                Ayn Hali 13      ¦                    L'abbesse De Jouar 1886
                                 ¦                    Hackler 1887
                                 Lalla Rookh 04       ¦
                                                      Lady Gough 1888
```

```
                                                      Flying Fox 1896
                                 Ajax 01              ¦
                TEDDY 13 S       ¦                    Amie 1893
                ¦                ¦                    Bay Ronald 1893
                ¦                Rondeau 00           ¦
```

```
SIR GALLAHAD III 20 C                                  Doremi 1894
              ¦                                        Carbine 1885
              ¦               SPEARMINT 03 P           ¦
              Plucky Liege 12 ¦                        Maid Of The Mint 1897
                              ¦                        St Simon 1881
                              Concertina 1896          ¦
                                                       Comic Song 1884
```

```
                                                       NEARCO 35 BC
                              ROYAL CHARGER 42 B       ¦
              TURN-TO 51 BI   ¦                        Sun Princess 37
              ¦               ¦                        ADMIRAL DRAKE 31 P
              ¦               Source Sucree 40         ¦
SIR GAYLORD 59¦IC                                      Lavendula 30
              ¦                                        PRINCE ROSE 28 C
              ¦               PRINCEQUILLO 40 IS       ¦
              Somethingroyal 52                        Cosquilla 33
                              ¦                        Caruso 27
                              Imperatrice 38           ¦
                                                       Cinquepace 34
```

```
                                                       ROYAL CHARGER 42 B
                              TURN-TO 51 BI            ¦
              SIR GAYLORD 59 IC                        Source Sucree 40
              ¦               ¦                        PRINCEQUILLO 40 IS
              ¦               Somethingroyal 52        ¦
SIR IVOR 65 IC¦                                        Imperatrice 38
              ¦                                        MAHMOUD 33 IC
              ¦               Mr Trouble 47            ¦
              Attica 53       ¦                        Motto 32
                              ¦                        Pharamond II 25
                              Athenia 43               ¦
                                                       Salaminia 37
```

```
                                                       NATIVE DANCER 50 IC
                              RAISE A NATIVE 61 B      ¦
              MR PROSPECTOR 70¦BC                      Raise You 46
              ¦               ¦                        NASHUA 52 IC
              ¦               Gold Digger 62           ¦
SMART STRIKE 92 IC                                     Sequence 46
              ¦                                        Cyane 59
              ¦               Smarten 76               ¦
              Classy 'n Smart 81                       Smartaire 62
                              ¦                        NODOUBLE 65 CP
                              No Class 74              ¦
                                                       Classy Quillo 69
```

```
                                                       Bay Ronald 1893
                              BAYARDO 06 P             ¦
              GAINSBOROUGH 15 C                        Galicia 1898
              ¦               ¦                        St Frusquin 1893
              ¦               Rosedrop 07              ¦
SOLARIO 22 P  ¦                                        Rosaline 01
```

```
               ¦                                    Amphion 1886
               ¦                Sundridge 1898      ¦
               Sun Worship 12  ¦                    Sierra 1889
                                ¦                   Ayrshire 1885
                                Doctrine 1899       ¦
                                                    Axiom 1888
```

```
                                                    Hampton 1872
                                Bay Ronald 1893     ¦
               DARK RONALD 05 P¦                    Black Duchess 1886
               ¦                ¦                   Thurio 1875
               ¦                Darkie 1889         ¦
SON-IN-LAW 11 P                                     Insignia 1882
               ¦                                    Donovan 1886
               ¦                Matchmaker 1892     ¦
               Mother-In-Law 06¦                    Match Girl 1882
                                ¦                   Jock Of Oran 1869
                                Be Cannie 1891      ¦
                                                    Reticence 1874
```

```
                                                    PRINCE ROSE 28 C
                                PRINCEQUILLO 40 IS  ¦
               PRINCE JOHN 53 C¦                    Cosquilla 33
               ¦                ¦                   COUNT FLEET 40 C
               ¦                Not Afraid 48       ¦
SPEAK JOHN 58 BI                                    Banish Fear 32
               ¦                                    TOURBILLON 28 CP
               ¦                Tornado 39          ¦
               Nuit De Folies 47                    Roseola 23
                                ¦                   Astrophel 31
                                Folle Nuit 40       ¦
                                                    Folle Passion 31
```

```
                                                    Toxophilite 1855
                                Musket 1867         ¦
               Carbine 1885    ¦                    Sister To Ada 1857
               ¦                ¦                   Knowsley 1859
               ¦                The Mersey 1874     ¦
SPEARMINT 03 P¦                                     Clemence 1865
               ¦                                    Lord Lyon 1863
               ¦                Minting 1883        ¦
               Maid Of The Mint¦1897                Mint Sauce 1875
                                ¦                   Skylark 1873
                                Warble 1884         ¦
                                                    Coturnix 1871
```

```
                                                   #PETER PAN 04 B
                                BLACK TONEY 11 BI   ¦
               Balladier 32    ¦                    Belgravia 03
               ¦                ¦                   North Star III 14
               ¦                Blue Warbler 22     ¦
SPY SONG 43 B ¦                                     May Bird 13
               ¦                                   #PETER PAN 04 B
```

```
                ¦                Peter Hastings 25   ¦
               Mata Hari 31      ¦                   Nettie Hastings 12
                                 ¦                   MAN O' WAR 17 S
                                 War Woman 26        ¦
                                                     Topaz 18
```

```
                                                     PRINCE ROSE 28 C
                                 PRINCEQUILLO 40 IS  ¦
                PRINCE JOHN 53 C¦                    Cosquilla 33
                ¦                ¦                   COUNT FLEET 40 C
                ¦                Not Afraid 48       ¦
STAGE DOOR JOHNNY 65 SP                              Banish Fear 32
                ¦                                    MOSSBOROUGH 47 C
                ¦                BALLYMOSS 54 S      ¦
                Peroxide Blonde 60                   Indian Call 36
                                 ¦                   Caldarium 39
                                 Folie Douce 49      ¦
                                                     Folle Nuit 40
```

```
                                                     GAINSBOROUGH 15 C
                                 HYPERION 30 BC      ¦
                Stardust 37      ¦                   Selene 19
                ¦                ¦                   Friar Marcus 12
                ¦                Sister Stella 23    ¦
STAR KINGDOM 46 IC                                   Etoile 15
                ¦                                    Orpheus 17
                ¦                Concerto 28         ¦
                Impromptu 39     ¦                   Constellation 22
                                 ¦                   Papyrus 20
                                 Thoughtless 34      ¦
                                                     Virgin's Folly 28
```

```
                                                     Sterling 1868
                                 Isonomy 1875        ¦
                Isinglass 1890   ¦                   Isola Bella 1868
                ¦                ¦                   Wenlock 1869
                ¦                Deadlock 1878       ¦
STAR SHOOT 1898 I                                    Malpractice 1864
                ¦                                    Newminster 1848
                ¦                Hermit 1864         ¦
                Astrology 1887   ¦                   Seclusion 1857
                                 ¦                   Brother To Straffo 1860
                                 Stella 1879         ¦
                                                     Toxophilite Mare 1861
```

```
                                                     TEDDY 13 S
                                 ASTERUS 23 S        ¦
                Jock II 36       ¦                   Astrella 12
                ¦                ¦                  #GAINSBOROUGH 15 C
                ¦                Naic 28             ¦
SUNNY BOY 44 P¦                                      Only One 14
                ¦                                   #GAINSBOROUGH 15 C
                ¦                SOLARIO 22 P        ¦
```

```
                Fille De Soleil 35                  Sun Worship 12
                                ¦                   Sansovino 21
                                Fille De Salut 28   ¦
                                                    Friar's Daughter 21
```

```
                                                    Rosebery 1872
                                Amphion 1886        ¦
                Sundridge 1898  ¦                   Suicide 1876
                ¦               ¦                   Springfield 1873
                ¦               Sierra 1889         ¦
SUNSTAR 08 S    ¦                                   Sanda 1878
                ¦                                   See Saw 1865
                ¦               Loved One 1883      ¦
                Doris 1898      ¦                   Pilgrimage 1875
                                ¦                   Petrarch 1873
                                Lauretta 1883       ¦
                                                    Ambuscade 1875
```

```
                                                    Bonnie Scotland 1853
                                Bramble 1875        ¦
                BEN BRUSH 1893 I¦                   Ivy Leaf 1867
                ¦               ¦                   Reform 1871
                ¦               Roseville 1888      ¦
SWEEP 07 I      ¦                                   Albia 1881
                ¦                                   Himyar 1875
                ¦               Domino 1891         ¦
                Pink Domino 1897¦                   Mannie Gray 1874
                                ¦                   Beaudesert 1877
                                Belle Rose 1889     ¦
                                                    Monte Rosa 1882
```

```
                                                    Isonomy 1875
                                Isinglass 1890      ¦
                John O' Gaunt 01¦                   Deadlock 1878
                ¦               ¦                   St Simon 1881
                ¦               La Fleche 1889      ¦
SWYNFORD 07 C   ¦                                   Quiver 1872
                ¦                                   Hermit 1864
                ¦               Tristan 1878        ¦
                Canterbury Pilgrim 1893             Thrift 1865
                                ¦                   The Palmer 1864
                                Pilgrimage 1875     ¦
                                                    Lady Audley 1867
```

```
                                                    NEARCO 35 BC
                                NASRULLAH 40 B      ¦
                Indian Hemp 49  ¦                   Mumtaz Begum 32
                ¦               ¦                   Stardust 37
                ¦               Sabzy 43            ¦
T V LARK 57 I   ¦                                   Sarita 24
                ¦                                   Royal Ford 26
                ¦               Heelfly 34          ¦
                Miss Larksfly 48¦                   Canfli 28
```

```
                                ¦                   BULL DOG 27 B
                                Larksnest 43        ¦
                                                    Light Lark 37
```

```
                                                    Aethelstan 22
                                Deiri 28            ¦
                    Deux Pour Cent 41               Desra 20
                    ¦           ¦                   Feridoon 25
                    ¦           Dix Pour Cent 33    ¦
TANTIEME 47 S       ¦                               La Chansonnerie 23
                    ¦                               ALCANTARA II 08 P
                    ¦           Indus 28            ¦
                    Terka 42    ¦                   Himalaya 20
                                ¦                   BLANDFORD 19 C
                                La Furka 27         ¦
                                                    Brenta 20
```

```
                                                    Orme 1889
                                Flying Fox 1896     ¦
                    Ajax 01     ¦                   Vampire 1889
                    ¦           ¦                   Clamart 1888
                    ¦           Amie 1893           ¦
TEDDY 13 S          ¦                               Alice 1887
                    ¦                               Hampton 1872
                    ¦           Bay Ronald 1893     ¦
                    Rondeau 00  ¦                   Black Duchess 1886
                                ¦                   Bend Or 1877
                                Doremi 1894         ¦
                                                    Lady Emily 1879
```

```
                                                    Le Sancy 1884
                                Le Samaritain 1895  ¦
                    Roi Herode 04   ¦               Clementina 1880
                    ¦           ¦                   War Dance 1887
                    ¦           Roxelane 1894       ¦
THE TETRARCH 11 I                                   Rose Of York 1880
                    ¦                               Bend Or 1877
                    ¦           Bona Vista 1889     ¦
                    Vahren 1897 ¦                   Vista 1879
                                ¦                   Hagioscope 1878
                                Castania 1889       ¦
                                                    Rose Garden 1878
```

```
                                                    Landgraf 14
                                Ferro 23            ¦
                    Athanasius 31   ¦               Frauenlob 15
                    ¦           ¦                   Laland 17
                    ¦           Athanasie 24        ¦
TICINO 39 CS        ¦                               Athene 18
                    ¦                               DARK RONALD 05 P
                    ¦           Aditi 22            ¦
                    Terra 29    ¦                   Aversion 14
                                ¦                   Robert Le Diable 1899
```

```
                                Teufelsrose 18      ¦
                                                    Rosanna 12
```

```
                                                    PHALARIS 13 B
                                Pharamond II 25     ¦
                    Menow 35    ¦                   Selene 19
                    ¦           ¦                   Supremus 22
                    ¦           Alcibiades 27       ¦
TOM FOOL 49 IC      ¦                               Regal Roman 21
                    ¦                               TEDDY 13 S
                    ¦           BULL DOG 27 B       ¦
                    Gaga 42     ¦                   Plucky Liege 12
                                ¦                   EQUIPOISE 28 IC
                                Alpoise 37          ¦
                                                    Laughing Queen 29
```

```
                                                    Bellini 37
                                Tenerani 44         ¦
                    RIBOT 52 CP ¦                   Tofanella 31
                    ¦           ¦                   El Greco 34
                    ¦           Romanella 43        ¦
TOM ROLFE 62 CP                                     Barbara Burrini 37
                    ¦                               SIR GALLAHAD III 20 C
                    ¦           ROMAN 37 BI         ¦
                    Pocahontas 55 ¦                 Buckup 28
                                ¦                   PRINCEQUILLO 40 IS
                                How 48              ¦
                                                    The Squaw II 39
```

```
                                                    Chouberski 02
                                BRULEUR 10 P        ¦
                    Ksar 18     ¦                   Basse Terre 1899
                    ¦           ¦                   Omnium II 1892
                    ¦           Kizil Kourgan 1899  ¦
TOURBILLON 28 CP                                    Kasbah 1892
                    ¦                               RABELAIS 00 P
                    ¦           Durbar 11           ¦
                    Durban 18   ¦                   Armenia 01
                                ¦                   Irish Lad 00
                                Banshee 10          ¦
                                                    Frizette 05
```

```
                                                    Springfield 1873
                                Sainfoin 1887       ¦
                    ROCK SAND 00 CS ¦               Sanda 1878
                    ¦           ¦                   St Simon 1881
                    ¦           Roquebrune 1893     ¦
TRACERY 09 C        ¦                               St Marguerite 1879
                    ¦                               Ormonde 1883
                    ¦           Orme 1889           ¦
                    Topiary 01  ¦                   Angelica 1879
                                ¦                   Wellingtonia 1869
                                Plaisanterie 1882   ¦
```

```
                                                Poetess 1875
```

```
                                                RABELAIS 00 P
                                HAVRESAC II 15 I    ¦
              Cavaliere D'arpino 26             Hors Concours 06
              ¦                 ¦               CICERO 02 B
              ¦                 Chuette 16      ¦
  TRAGHETTO 42 I¦                               Chute 05
              ¦                                 TRACERY 09 C
              ¦                 Papyrus 20      ¦
              Talma 33          ¦               Miss Matty 14
                                ¦               Buchan 16
                                Tolbooth 29     ¦
                                                Popingaol 13
```

```
                                                GAINSBOROUGH 15 C
                                HYPERION 30 BC  ¦
              Owen Tudor 38     ¦               Selene 19
              ¦                 ¦               PHAROS 20 I
              ¦                 Mary Tudor II 31    ¦
  TUDOR MINSTREL¦44 B                           Anna Bolena 20
              ¦                                 SWYNFORD 07 C
              ¦                 Sansovino 21    ¦
              Sansonnet 33      ¦               Gondolette 02
                                ¦               SON-IN-LAW 11 P
                                Lady Juror 19   ¦
                                                Lady Josephine 12
```

```
                                               #PHAROS 20 I
                                NEARCO 35 BC    ¦
              ROYAL CHARGER 42¦B                Nogara 28
              ¦                 ¦               SOLARIO 22 P
              ¦                 Sun Princess 37 ¦
  TURN-TO 51 BI ¦                               Mumtaz Begum 32
              ¦                                 Craig An Eran 18
              ¦                 ADMIRAL DRAKE 31 P  ¦
              Source Sucree 40¦                 Plucky Liege 12
                                ¦              #PHAROS 20 I
                                Lavendula 30    ¦
                                                Sweet Lavender 23
```

```
                                               #Himyar 1875
                               #Domino 1891     ¦
              Commando 1898     ¦              #Mannie Gray 1874
              ¦                 ¦               Darebin 1878
              ¦                 Emma C 1892     ¦
  ULTIMUS 06 B  ¦                               Guenn 1883
              ¦                                #Himyar 1875
              ¦                #Domino 1891     ¦
              Running Stream 1898              #Mannie Gray 1874
                                ¦               Isonomy 1875
                                Dancing Water 1887  ¦
                                                Pretty Dance 1878
```

```
                                        Raise a Native 1961
                    Mr. Prospector 1970 ¦
          Fappiano 1977   ¦             Gold Digger 1962
          ¦               ¦             Dr. Fager 1964
          ¦               Killaloe 1970 ¦
UNBRIDLED 87 BI                         Grand Splendor 1962
          ¦                             Wild Risk 1940
          ¦               Le Fabuleux 1961 ¦
          Gana Facil 1981 ¦             Anguar 1950
                          ¦             In Reality 1964
                          Charedi 19767 ¦
                                        Magic 1969
```

```
                                        HYPERION 30 BC
                          AUREOLE 50 C  ¦
          Vienna 57       ¦             Angelola 45
          ¦               ¦             Turkhan 37
          ¦               Turkish Blood 44 ¦
VAGUELY NOBLE 65 CP                     Rusk 35
          ¦                             PHAROS 20 I
          ¦               NEARCO 35 BC  ¦
          Noble Lassie 56 ¦             Nogara 28
                          ¦             BIG GAME 39 I
                          Belle Sauvage 49 ¦
                                        Tropical Sun 40
```

```
                                        SON-IN-LAW 11 P
                          Bosworth 26   ¦
          Plassy 32       ¦             Serenissima 13
          ¦               ¦             PHALARIS 13 B
          ¦               Pladda 26     ¦
VANDALE 43 P ¦                          Rothesay Bay 16
          ¦                             Sans Souci II 04
          ¦               LA FARINA 11 P ¦
          Vanille 29      ¦             Malatesta 1898
                          ¦             Beppo 03
                          Vaya 09       ¦
                                        Waterhen 1894
```

```
                                        CHAUCER 00 S
                          Prince Chimay 15 ¦
          VATOUT 26 S     ¦             Gallorette 07
          ¦               ¦             Sans Souci II 04
          ¦               Vasthi 21     ¦
VATELLOR 33 P ¦                         Vaya 09
          ¦                             Ajax 01
          ¦               TEDDY 13 S    ¦
          Lady Elinor 19  ¦             Rondeau 00
                          ¦             Tarquin 01
                          Madame Royale 08 ¦
                                        Royal Abbess 1897
```

```
                                                    St Simon 1881
                              CHAUCER 00 S          ¦
              Prince Chimay 15¦                     Canterbury Pilgrim 1893
              ¦               ¦                     Gallinule 1884
              ¦               Gallorette 07         ¦
VATOUT 26 S   ¦                                     Orlet 1891
              ¦                                     Le Roi Soleil 1895
              ¦               Sans Souci II 04      ¦
              Vasthi 21       ¦                     Sanctimony 1896
                              ¦                     Beppo 03
                              Vaya 09               ¦
                                                    Waterhen 1894
```

```
                                                    SWYNFORD 07 C
                              BLANDFORD 19 C        ¦
              BRANTOME 31 C   ¦                     Blanche 12
              ¦               ¦                     CLARISSIMUS 13 C
              ¦               Vitamine 24           ¦
VIEUX MANOIR 47 C                                   Viridiflora 12
              ¦                                     BRULEUR 10 P
              ¦               Finglas 23            ¦
              Vieille Maison 36                     Fair Simone 17
                              ¦                     Zionist 22
                              Vieille Canaille 30 ¦
                                                    Ficelle 23
```

```
                                                    Hastings 1893
                              FAIR PLAY 05 SP       ¦
              MAN O' WAR 17 S ¦                     Fairy Gold 1896
              ¦               ¦                     ROCK SAND 00 CS
              ¦               Mahubah 10            ¦
WAR ADMIRAL 34¦C                                    Merry Token 1891
              ¦                                     BEN BRUSH 1893 I
              ¦               SWEEP 07 I            ¦
              Brushup 29      ¦                     Pink Domino 1897
                              ¦                     Harry Of Hereford 10
                              Annette K 21          ¦
                                                    Bathing Girl 15
```

```
                                                    NEARCO 35 BC
                              NASRULLAH 40 B        ¦
              BOLD RULER 54 BI¦                     Mumtaz Begum 32
              ¦               ¦                     DISCOVERY 31 S
              ¦               Miss Disco 44         ¦
WHAT A PLEASURE 65 B                                Outdone 36
              ¦                                     BLENHEIM II 27 CS
              ¦               MAHMOUD 33 IC         ¦
              Grey Flight 45  ¦                     Mah Mahal 28
                              ¦                     Ariel 25
                              Planetoid 34          ¦
                                                    La Chica 30
```

```
                                                    St Simon 1881
                                RABELAIS 00 P       ¦
                Rialto 23       ¦                   Satirical 1891
                ¦               ¦                   Helicon 08
                ¦               La Grelee 18        ¦
WILD RISK 40 P¦                                     Grignouse 10
                ¦                                   SWYNFORD 07 C
                ¦               BLANDFORD 19 C      ¦
                Wild Violet 35  ¦                   Blanche 12
                                ¦                   Ksar 18
                                Wood Violet 28      ¦
                                                    Pervencheres 22
```

```
                                                    RABELAIS 00 P
                                Rialto 23           ¦
                WILD RISK 40 P  ¦                   La Grelee 18
                ¦               ¦                   BLANDFORD 19 C
                ¦               Wild Violet 35      ¦
WORDEN 49 S     ¦                                   Wood Violet 28
                ¦                                   SOLARIO 22 P
                ¦               Sind 33             ¦
                Sans Tares 39   ¦                   Mirawala 23
                                ¦                   TEDDY 13 S
                                Tara 32             ¦
                                                    Jean Gow 20
```

Appendix II

Speed/Stamina Characteristics of Prominent Non-*Chef-de-Race* Sires

SPEED INFLUENCE	STAMINA INFLUENCE
Beau Genius	Afleet Alex
Benchmark	Alphabet Soup
Bernstein	Arch
Cactus Ridge	Artie Schiller
Candy Ride	Badge Of Silver
Cherokee Run	Bernardini
City Zip	Broken Vow
Congrats	Cozzene
Devil His Due	Curlin
Discreet Cat	Dansili
Dixie Union	Distorted Humor
E Dubai	Dynaformer
Elusive Quality	Empire Maker
Exchange Rate	English Channel
First Samurai	Flower Alley
Five Star Day	Fusaichi Pegasus
Flatter	Galileo
Forestry	Include
Freud	Into Mischief
Graeme Hall	Johar
Grand Slam	Kafwain
Hard Spun	Kitten's Joy
Harlan's Holiday	Langfuhr
Henny Hughes	Lemon Drop Kid
Holy Bull	Louis Quatorze
Indian Charlie	Maria's Mon
Johannesburg	Medaglia D'oro
Lion Heart	Mineshaft
Lost Soldier	Pleasant Tap
Monarchos	Point Given
More Than Ready	Pure Prize
Mr. Greeley	Quiet American
Not For Love	Royal Academy
Officer	Scat Daddy
Orientate	Selkirk
Posse	Sligo Bay
Put It Back	Stephen Got Even
Red Bullet	Street Cry
Roar	Tapit
Rockport Harbor	Theatrical
Roman Ruler	Tiznow
Salt Lake	Unusual Heat
Sharp Humor	Victory Gallop
Silver Deputy	Wiseman's Ferry
Smoke Glacken	
Songandaprayer	
Speightstown	

SPEED INFLUENCE	STAMINA INFLUENCE
Storm Cat	
Stormy Atlantic	
Stravinsky	
Street Sense	
Successful Appeal	
Tale Of The Cat	
Touch Gold	
Tribal Rule	
Trippi	
Two Punch	
Valid Expectations	
Wildcat Heir	
Yankee Gentleman	
Yes It's True	

Appendix III

Leading Sire Statistics

The following table displays summary data through 2014 for all sires in our database whose progeny have won at least ten major North American open stakes wins since 1983 and which sired at least one North American open stakes winner since 2013. The sires are arranged alphabetically and the columns represent number of stakes wins (RACES), average winning distance in furlongs (AWD), % stakes wins on turf (TURF), % juvenile stakes wins (2YOs), % graded stakes wins (GSWs), % wins at sprint distances (SPRINT), % wins at distances beyond a mile and an eighth (CLASSIC) and % wins on other than a fast or firm surface (OFF). The off-track data includes only graded stakes wins since 1999.

The averages for all sires in the database are AWD 8.09, TURF 31.8%, 2YOs 13.1%, GSWs 52.6%, SPRINT 31.5%, CLASSIC 11.1% and OFF 16.2%.

SIRE	YEAR	RACES	AWD	TURF	2YOs	GSWs	SPRINT	CLASSIC	OFF
A.P. Indy	1989	218	8.77	12.8%	10.1%	71.6%	8.7%	17.0%	15.2%
Afleet Alex	2002	29	8.61	20.7%	13.8%	58.6%	10.3%	10.3%	6.3%
After Market	2003	10	8.95	30.0%	30.0%	60.0%	0.0%	20.0%	16.7%
Albert the Great	1997	11	8.77	27.3%	9.1%	81.8%	0.0%	0.0%	0.0%
Aldebaran	1998	10	9.45	90.0%	0.0%	70.0%	10.0%	40.0%	33.3%
Alphabet Soup	1991	38	8.18	26.3%	0.0%	55.3%	23.7%	7.9%	10.0%
Any Given Saturday	2004	12	7.96	41.7%	41.7%	33.3%	25.0%	0.0%	25.0%
Arch	1995	48	9.06	52.1%	12.5%	75.0%	6.3%	22.9%	17.6%
Artie Schiller	2001	19	8.18	68.4%	26.3%	47.4%	10.5%	0.0%	0.0%
Awesome Again	1994	89	8.53	9.0%	9.0%	85.4%	14.6%	14.6%	6.9%
Badge Of Silver	2000	17	8.29	76.5%	17.6%	58.8%	11.8%	0.0%	30.0%
Beau Genius	1985	24	7.31	25.0%	25.0%	25.0%	50.0%	0.0%	0.0%
Bellamy Road	2002	10	8.00	0.0%	20.0%	70.0%	30.0%	0.0%	0.0%
Belong to Me	1989	63	7.93	46.0%	11.1%	54.0%	30.2%	4.8%	20.0%
Benchmark	1991	22	7.64	0.0%	9.1%	68.2%	36.4%	0.0%	6.7%
Bernardini	2003	36	8.53	5.6%	13.9%	80.6%	11.1%	8.3%	11.5%
Bernstein	1997	36	7.39	33.3%	22.2%	47.2%	41.7%	2.8%	28.6%
Bertrando	1989	38	7.95	34.2%	15.8%	68.4%	23.7%	0.0%	0.0%
Birdstone	2001	13	8.92	0.0%	30.8%	69.2%	30.8%	46.2%	33.3%
Bluegrass Cat	2003	15	7.94	20.0%	40.0%	40.0%	20.0%	0.0%	0.0%
Brahms	1997	12	8.50	16.7%	16.7%	50.0%	8.3%	8.3%	0.0%
Broken Vow	1997	56	8.19	30.4%	17.9%	69.6%	26.8%	12.5%	11.8%
Bwana Charlie	2001	10	7.05	10.0%	30.0%	40.0%	50.0%	0.0%	0.0%
Cactus Ridge	2001	15	7.17	33.3%	13.3%	40.0%	66.7%	0.0%	0.0%
Candy Ride	1999	60	7.80	15.0%	11.7%	68.3%	43.3%	3.3%	0.0%
Cherokee Run	1990	63	7.59	17.5%	22.2%	55.6%	42.9%	0.0%	9.4%
City Zip	1998	71	7.38	52.1%	11.3%	57.7%	47.9%	4.2%	16.2%
Concorde's Tune	1989	13	7.23	38.5%	0.0%	46.2%	53.8%	0.0%	16.7%
Congaree	1998	22	8.02	36.4%	13.6%	59.1%	18.2%	0.0%	7.7%
Congrats	2000	15	7.35	0.0%	33.3%	66.7%	60.0%	0.0%	11.1%
Cozzene	1980	113	9.14	67.3%	2.7%	61.1%	7.1%	28.3%	22.2%

SIRE	YEAR	RACES	AWD	TURF	2YOs	GSWs	SPRINT	CLASSIC	OFF
Curlin	2004	15	8.33	20.0%	13.3%	46.7%	13.3%	6.7%	0.0%
Danehill Dancer	1993	12	9.21	100.0%	0.0%	58.3%	0.0%	25.0%	28.6%
Dansili	1996	20	9.30	100.0%	0.0%	85.0%	0.0%	35.0%	6.3%
Devil His Due	1989	16	7.41	0.0%	31.3%	37.5%	43.8%	0.0%	0.0%
Discreet Cat	2003	17	7.53	35.3%	35.3%	58.8%	41.2%	5.9%	10.0%
Distorted Humor	1993	110	8.46	22.7%	10.0%	68.2%	22.7%	17.3%	25.4%
Dixie Union	1997	44	7.75	6.8%	40.9%	70.5%	38.6%	2.3%	6.5%
D'wildcat	1998	14	6.75	0.0%	35.7%	57.1%	85.7%	0.0%	0.0%
Dynaformer	1985	160	9.00	72.5%	5.6%	71.3%	4.4%	22.5%	26.2%
E Dubai	1998	27	7.85	18.5%	14.8%	55.6%	40.7%	7.4%	0.0%
El Prado	1997	109	8.35	60.6%	7.3%	67.9%	19.3%	11.9%	28.6%
Elusive Quality	1989	59	7.40	23.7%	11.9%	42.4%	49.2%	6.8%	13.0%
Empire Maker	1993	70	8.76	17.1%	12.9%	80.0%	10.0%	15.7%	9.8%
English Channel	2000	30	9.03	76.7%	0.0%	63.3%	0.0%	13.3%	21.4%
Exchange Rate	1997	38	7.14	21.1%	44.7%	39.5%	52.6%	0.0%	25.0%
First Samurai	2003	37	7.88	29.7%	18.9%	48.6%	35.1%	2.7%	27.8%
Five Star Day	1996	16	6.41	6.3%	25.0%	37.5%	93.8%	0.0%	0.0%
Flatter	1999	32	7.75	3.1%	15.6%	53.1%	43.8%	6.3%	26.7%
Flower Alley	2002	23	8.38	4.3%	8.7%	56.5%	8.7%	13.0%	0.0%
Forestry	1996	45	7.27	26.7%	15.6%	64.4%	57.8%	4.4%	34.6%
Freud	1998	15	7.25	46.7%	20.0%	60.0%	60.0%	0.0%	50.0%
Fusaichi Pegasus	1997	25	8.36	12.0%	28.0%	64.0%	24.0%	12.0%	6.7%
Galileo	1998	16	10.41	100.0%	6.3%	100.0%	0.0%	68.8%	46.7%
Ghostzapper	2000	48	8.02	31.3%	2.1%	72.9%	31.3%	8.3%	3.1%
Giant's Causeway	1997	137	8.82	43.1%	10.9%	74.5%	9.5%	18.2%	12.6%
Gone West	1984	96	8.08	33.3%	11.5%	74.0%	37.5%	13.5%	12.1%
Graeme Hall	1997	21	7.71	9.5%	19.0%	47.6%	33.3%	0.0%	22.2%
Grand Slam	1995	56	7.24	16.1%	16.1%	58.9%	58.9%	0.0%	21.4%
Greatness	1999	14	5.82	28.6%	0.0%	14.3%	85.7%	0.0%	0.0%
Hard Spun	2004	29	7.88	44.8%	3.4%	44.8%	31.0%	10.3%	36.4%
Harlan's Holiday	1999	54	7.88	35.2%	31.5%	61.1%	33.3%	5.6%	24.1%
Henny Hughes	2003	18	7.50	5.6%	16.7%	61.1%	50.0%	0.0%	0.0%
Hold That Tiger	2000	13	6.96	30.8%	23.1%	69.2%	69.2%	0.0%	0.0%
Holy Bull	1991	40	7.76	20.0%	12.5%	65.0%	40.0%	7.5%	8.7%
Include	1997	31	8.68	6.5%	9.7%	51.6%	9.7%	9.7%	0.0%
Indian Charlie	1995	82	7.10	17.1%	22.0%	59.8%	62.2%	2.4%	14.3%
Into Mischief	2005	16	8.20	0.0%	12.5%	81.3%	12.5%	0.0%	0.0%
Johannesburg	1999	38	7.66	36.8%	21.1%	55.3%	42.1%	2.6%	20.0%
Johar	1999	19	8.42	63.2%	26.3%	42.1%	31.6%	26.3%	28.6%
Jump Start	1999	35	8.01	0.0%	5.7%	57.1%	31.4%	5.7%	0.0%
Kafwain	2000	16	8.19	25.0%	18.8%	68.8%	12.5%	0.0%	9.1%
King Cugat	1997	12	8.46	66.7%	8.3%	50.0%	0.0%	8.3%	20.0%
Kitten's Joy	2001	73	8.59	74.0%	23.3%	46.6%	8.2%	11.0%	20.8%
Langfuhr	1992	67	8.46	44.8%	4.5%	55.2%	26.9%	20.9%	17.6%
Lawyer Ron	2003	13	8.11	0.0%	15.4%	61.5%	23.1%	0.0%	14.3%
Lemon Drop Kid	1996	79	8.69	44.3%	8.9%	67.1%	12.7%	12.7%	26.7%
Limehouse	2001	11	6.77	27.3%	54.5%	45.5%	63.6%	0.0%	0.0%

SIRE	YEAR	RACES	AWD	TURF	2YOs	GSWs	SPRINT	CLASSIC	OFF
Lion Heart	2001	38	7.30	10.5%	23.7%	57.9%	57.9%	2.6%	9.5%
Lost Soldier	1990	24	7.71	33.3%	4.2%	45.8%	41.7%	0.0%	10.0%
Louis Quatorze	1993	23	8.12	8.7%	17.4%	47.8%	17.4%	0.0%	9.1%
Macho Uno	1998	31	8.02	19.4%	9.7%	67.7%	25.8%	3.2%	10.0%
Majestic Warrior	2005	11	8.19	0.0%	0.0%	45.5%	27.3%	9.1%	25.0%
Malibu Moon	1997	93	8.03	12.9%	19.4%	66.7%	29.0%	8.6%	7.4%
Maria's Mon	1993	86	8.60	37.2%	8.1%	69.8%	15.1%	15.1%	21.8%
Medaglia d'Oro	1999	78	8.46	35.9%	7.7%	64.1%	14.1%	12.8%	11.1%
Midnight Lute	1996	12	8.04	0.0%	8.3%	66.7%	25.0%	0.0%	0.0%
Mineshaft	1999	38	8.38	15.8%	10.5%	65.8%	18.4%	7.9%	12.0%
Mizzen Mast	1998	35	8.04	68.6%	5.7%	65.7%	31.4%	11.4%	5.3%
Monarchos	1998	25	7.69	0.0%	20.0%	48.0%	44.0%	0.0%	18.2%
More Than Ready	1997	69	7.79	58.0%	17.4%	55.1%	27.5%	4.3%	23.5%
Mr. Greeley	1992	64	7.58	25.0%	12.5%	56.3%	46.9%	4.7%	15.6%
Northern Afleet	1993	43	7.93	37.2%	14.0%	58.1%	34.9%	9.3%	17.4%
Not For Love	1990	38	7.60	23.7%	13.2%	36.8%	42.1%	5.3%	0.0%
Oasis Dream	2000	13	8.81	100.0%	0.0%	92.3%	7.7%	30.8%	0.0%
Officer	1999	19	6.68	10.5%	31.6%	31.6%	78.9%	0.0%	20.0%
Offlee Wild	2000	13	7.92	7.7%	38.5%	61.5%	30.8%	7.7%	0.0%
Orientate	1998	20	7.70	20.0%	20.0%	60.0%	45.0%	10.0%	10.0%
Out of Place	1987	28	8.09	14.3%	28.6%	46.4%	42.9%	21.4%	22.2%
Outflanker	1994	12	7.71	50.0%	16.7%	41.7%	50.0%	0.0%	25.0%
Parker's Storm Cat	2000	11	5.36	63.6%	0.0%	36.4%	100.0%	0.0%	100.0%
Pioneerof the Nile	2006	10	8.35	10.0%	30.0%	80.0%	10.0%	0.0%	0.0%
Pleasant Tap	1987	53	8.32	18.9%	1.9%	60.4%	20.8%	5.7%	4.0%
Point Given	1998	17	8.41	23.5%	11.8%	76.5%	17.6%	11.8%	8.3%
Pollard's Vision	2001	14	8.32	14.3%	28.6%	71.4%	14.3%	14.3%	11.1%
Pomeroy	2001	11	6.68	0.0%	18.2%	45.5%	72.7%	0.0%	40.0%
Posse	2000	30	6.89	0.0%	23.3%	56.7%	73.3%	0.0%	5.9%
Proud Citizen	1999	32	7.99	28.1%	12.5%	50.0%	28.1%	3.1%	23.1%
Pulpit	1994	110	8.31	40.0%	20.0%	67.3%	18.2%	6.4%	16.9%
Pure Prize	1998	22	8.20	50.0%	40.9%	72.7%	13.6%	13.6%	26.7%
Put It Back	1998	22	6.52	4.5%	22.7%	50.0%	77.3%	4.5%	0.0%
Quiet American	1986	63	8.55	9.5%	12.7%	57.1%	12.7%	17.5%	16.7%
Rahy	1985	126	8.09	53.2%	11.1%	67.5%	29.4%	11.9%	11.1%
Real Quiet	1995	20	7.91	5.0%	5.0%	55.0%	45.0%	10.0%	25.0%
Red Bullet	1997	15	6.92	6.7%	6.7%	13.3%	80.0%	6.7%	0.0%
Roar	1993	18	7.19	11.1%	11.1%	22.2%	50.0%	0.0%	33.3%
Rock Hard Ten	2001	14	8.61	78.6%	21.4%	78.6%	7.1%	21.4%	0.0%
Rock of Gibraltar	1999	12	7.38	100.0%	0.0%	41.7%	41.7%	0.0%	40.0%
Rockport Harbor	2002	23	7.72	4.3%	43.5%	39.1%	43.5%	8.7%	16.7%
Roman Ruler	2002	15	7.70	0.0%	33.3%	60.0%	40.0%	6.7%	12.5%
Royal Academy	1987	48	8.26	70.8%	0.0%	52.1%	18.8%	10.4%	9.5%
Salt Lake	1989	43	6.99	9.3%	20.9%	23.3%	69.8%	4.7%	16.7%
Scat Daddy	2004	24	8.13	45.8%	33.3%	70.8%	25.0%	8.3%	18.8%
Selkirk	1988	16	9.41	93.8%	0.0%	93.8%	0.0%	43.8%	40.0%
Sharp Humor	2003	21	7.50	47.6%	4.8%	38.1%	42.9%	0.0%	50.0%

SIRE	YEAR	RACES	AWD	TURF	2YOs	GSWs	SPRINT	CLASSIC	OFF
Silver Deputy	1985	104	7.89	16.3%	19.2%	59.6%	38.5%	7.7%	17.9%
Sky Mesa	2000	40	7.93	25.0%	32.5%	52.5%	27.5%	7.5%	11.8%
Sligo Bay	1984	17	10.21	70.6%	11.8%	76.5%	0.0%	47.1%	15.4%
Smart Strike	1992	168	8.44	50.0%	10.1%	71.4%	20.2%	16.7%	25.2%
Smarty Jones	2001	20	7.95	15.0%	15.0%	45.0%	50.0%	10.0%	14.3%
Smoke Glacken	1994	48	7.17	4.2%	33.3%	60.4%	60.4%	2.1%	3.7%
Songandaprayer	1998	26	6.46	0.0%	30.8%	38.5%	84.6%	0.0%	11.1%
Southern Image	2000	13	6.12	0.0%	0.0%	38.5%	100.0%	0.0%	20.0%
Soviet Star	1984	19	8.03	68.4%	10.5%	52.6%	42.1%	15.8%	0.0%
Spanish Steps	2001	10	8.98	90.0%	10.0%	70.0%	10.0%	30.0%	28.6%
Speightstown	1998	78	6.74	23.1%	7.7%	43.6%	78.2%	6.4%	16.1%
Stephen Got Even	1996	20	8.19	10.0%	15.0%	60.0%	25.0%	5.0%	10.0%
Storm Cat	1983	249	7.85	27.3%	23.7%	67.1%	33.7%	4.0%	15.3%
Stormy Atlantic	1994	86	7.78	58.1%	22.1%	53.5%	31.4%	2.3%	18.6%
Stravinsky	1996	19	7.71	89.5%	0.0%	36.8%	31.6%	5.3%	60.0%
Street Cry	1998	60	8.31	18.3%	13.3%	80.0%	20.0%	8.3%	6.8%
Street Sense	2004	26	7.71	23.1%	26.9%	53.8%	34.6%	3.8%	14.3%
Successful Appeal	1996	41	7.35	22.0%	39.0%	56.1%	43.9%	0.0%	13.0%
Tale Of The Cat	1994	77	7.62	23.4%	24.7%	63.6%	42.9%	9.1%	9.1%
Tapit	2001	89	8.44	15.7%	16.9%	71.9%	13.5%	6.7%	9.7%
Theatrical	1992	102	9.28	90.2%	2.0%	72.5%	3.9%	34.3%	18.2%
Tiznow	1996	88	8.51	15.9%	15.9%	67.0%	11.4%	6.8%	9.6%
Toccet	1997	12	8.61	0.0%	0.0%	33.3%	16.7%	16.7%	0.0%
Touch Gold	2000	29	7.84	13.8%	6.9%	69.0%	37.9%	0.0%	11.1%
Tribal Rule	1996	23	6.93	21.7%	17.4%	34.8%	73.9%	0.0%	0.0%
Trippi	1997	24	7.20	12.5%	25.0%	41.7%	58.3%	0.0%	0.0%
Two Punch	1983	50	7.00	0.0%	14.0%	36.0%	66.0%	2.0%	0.0%
Unbridled's Song	1993	128	7.96	25.8%	11.7%	65.6%	28.1%	3.1%	14.3%
Unusual Heat	1990	35	8.50	65.7%	11.4%	68.6%	28.6%	28.6%	0.0%
Val Royal	1995	10	8.80	100.0%	20.0%	70.0%	0.0%	30.0%	0.0%
Valid Expectations	2000	15	6.90	13.3%	60.0%	33.3%	60.0%	6.7%	20.0%
Victory Gallop	1997	32	8.84	40.6%	18.8%	43.8%	12.5%	18.8%	27.3%
War Front	2002	49	7.98	65.3%	14.3%	67.3%	24.5%	4.1%	13.8%
Wildcat Heir	2000	22	6.64	40.9%	9.1%	36.4%	72.7%	0.0%	37.5%
Wiseman's Ferry	1999	23	8.21	69.6%	8.7%	87.0%	4.3%	0.0%	23.8%
With Distinction	2001	10	6.55	0.0%	30.0%	10.0%	70.0%	0.0%	0.0%
Yankee Gentleman	1999	16	7.72	25.0%	18.8%	31.3%	31.3%	0.0%	0.0%
Yes It's True	1996	31	6.98	19.4%	32.3%	38.7%	67.7%	0.0%	16.7%

Appendix IV

Leading Broodmare Sire Statistics

The following table displays summary data through 2014 for all broodmare sires in our database whose daughters' foals have won at least ten major North American open stakes wins since 1983 and were represented by at least one North American open stakes winner since 2013. The sires are arranged alphabetically and the columns represent number of stakes wins (RACES), average winning distance in furlongs (AWD), % stakes wins on turf (TURF), % juvenile stakes wins (2YOs), % graded stakes wins (GSWs), % wins at sprint distances (SPRINT), % wins at distances beyond a mile and an eighth (CLASSIC) and % wins on other than a fast or firm surface (OFF). The off-track data includes only graded stakes wins since 1999.

The averages for all sires in the database are AWD 8.09, TURF 31.8%, 2YOs 13.1%, GSWs 52.6%, SPRINT 31.5%, CLASSIC 11.1% and OFF 16.2%.

BROODMARE SIRE	YEAR	RACES	AWD	TURF	2YO	GSW	SPR	CLASSIC	OFF
A.P. Indy	1989	150	8.47	27.3%	10.7%	68.7%	15.3%	10.7%	16.5%
Affirmed	1975	103	8.49	38.8%	16.5%	58.3%	20.4%	18.4%	10.8%
Afternoon Deelites	1992	15	7.25	13.3%	20.0%	40.0%	53.3%	0.0%	0.0%
Allen's Prospect	1982	17	7.08	23.5%	17.6%	47.1%	64.7%	5.9%	14.3%
Alysheba	1984	21	8.42	52.4%	9.5%	61.9%	19.0%	9.5%	9.1%
Arch	1995	19	8.05	5.3%	26.3%	78.9%	31.6%	10.5%	6.7%
Ascot Knight	1984	21	8.00	33.3%	23.8%	71.4%	23.8%	4.8%	18.8%
Avenue Of Flags	1988	10	7.73	60.0%	20.0%	60.0%	40.0%	0.0%	0.0%
Awesome Again	1994	30	7.99	16.7%	20.0%	36.7%	23.3%	0.0%	0.0%
Bailjumper	1974	17	8.44	11.8%	0.0%	76.5%	11.8%	5.9%	12.5%
Beau Genius	1985	16	7.69	6.3%	25.0%	56.3%	50.0%	6.3%	12.5%
Belong to Me	1989	32	8.09	12.5%	28.1%	81.3%	31.3%	9.4%	13.0%
Bertrando	1989	15	7.93	13.3%	6.7%	66.7%	33.3%	6.7%	0.0%
Bold Ruckus	1976	49	7.05	14.3%	18.4%	38.8%	67.3%	2.0%	0.0%
Broad Brush	1983	67	8.45	32.8%	13.4%	61.2%	16.4%	13.4%	19.4%
Caerleon	1980	71	9.19	67.6%	1.4%	70.4%	7.0%	29.6%	6.5%
Caller I. D.	1989	12	6.75	25.0%	33.3%	58.3%	83.3%	0.0%	20.0%
Capote	1984	79	7.60	27.8%	11.4%	62.0%	51.9%	10.1%	11.4%
Carson City	1987	81	8.03	17.3%	17.3%	58.0%	27.2%	3.7%	9.3%
Catienus	1994	16	8.73	43.8%	12.5%	62.5%	0.0%	12.5%	50.0%
Cherokee Run	1990	13	7.50	7.7%	23.1%	15.4%	46.2%	0.0%	50.0%
Chester House	1995	13	8.31	61.5%	15.4%	53.8%	15.4%	0.0%	14.3%
Chief's Crown	1982	34	8.66	32.4%	17.6%	64.7%	17.6%	23.5%	20.0%
Citidancer	1987	28	7.96	14.3%	3.6%	64.3%	35.7%	14.3%	18.8%
Conquistador Cielo	1979	95	8.16	28.4%	17.9%	52.6%	37.9%	13.7%	14.3%
Coronado's Quest	1995	31	7.53	22.6%	32.3%	71.0%	58.1%	6.5%	11.1%
Cozzene	1980	34	7.54	47.1%	32.4%	52.9%	44.1%	2.9%	42.1%
Cryptoclearance	1984	38	8.32	18.4%	7.9%	65.8%	23.7%	7.9%	28.0%
Cure the Blues	1978	63	7.82	36.5%	12.7%	50.8%	36.5%	9.5%	20.0%

BROODMARE SIRE	YEAR	RACES	AWD	TURF	2YO	GSW	SPR	CLASSIC	OFF
Danehill	1979	12	8.46	75.0%	8.3%	100.0%	25.0%	25.0%	10.0%
Danzig	1977	161	8.01	44.1%	9.9%	60.2%	27.3%	8.7%	17.6%
Dehere	1991	44	8.00	13.6%	13.6%	61.4%	29.5%	4.5%	8.0%
Deputy Minister	1979	206	8.62	21.8%	17.0%	55.8%	17.0%	18.0%	16.2%
Devil His Due	1989	17	8.97	5.9%	11.8%	88.2%	11.8%	35.3%	0.0%
Distant View	1991	15	8.10	13.3%	20.0%	26.7%	26.7%	6.7%	0.0%
Distorted Humor	1993	24	7.77	20.8%	12.5%	70.8%	41.7%	4.2%	12.5%
Dixieland Band	1980	162	7.84	21.0%	19.1%	62.3%	36.4%	7.4%	18.0%
Doc's Leader	1986	10	8.35	70.0%	10.0%	70.0%	10.0%	10.0%	20.0%
Doneraile Court	1996	13	7.90	7.7%	23.1%	53.8%	30.8%	7.7%	0.0%
Dr. Blum	1977	27	8.15	18.5%	14.8%	51.9%	29.6%	14.8%	10.0%
Dynaformer	1985	72	8.51	47.2%	13.9%	50.0%	12.5%	8.3%	20.0%
El Corredor	1997	11	7.68	9.1%	18.2%	54.5%	45.5%	9.1%	0.0%
El Gran Senor	1981	36	8.21	41.7%	8.3%	75.0%	25.0%	11.1%	15.0%
El Prado	1989	48	7.79	43.8%	16.7%	56.3%	37.5%	4.2%	12.0%
Elusive Quality	1993	11	7.32	18.2%	45.5%	9.1%	45.5%	0.0%	100.0%
Farma Way	1987	13	7.06	15.4%	30.8%	15.4%	53.8%	0.0%	0.0%
Fly So Free	1988	15	6.67	33.3%	40.0%	26.7%	73.3%	0.0%	0.0%
Flying Paster	1976	53	8.35	30.2%	5.7%	49.1%	22.6%	7.5%	18.8%
Forest Wildcat	1991	24	6.58	16.7%	29.2%	37.5%	83.3%	0.0%	11.1%
Forestry	1996	18	7.63	44.4%	22.2%	61.1%	61.1%	11.1%	18.2%
Fortunate Prospect	1981	36	7.92	30.6%	8.3%	66.7%	30.6%	13.9%	15.0%
Forty Niner	1985	77	8.03	22.1%	19.5%	58.4%	23.4%	1.3%	11.4%
French Deputy	1992	48	7.65	12.5%	14.6%	70.8%	47.9%	8.3%	6.9%
Giant's Causeway	1997	20	8.43	40.0%	15.0%	60.0%	5.0%	0.0%	0.0%
Gilded Time	1981	13	8.16	0.0%	46.2%	76.9%	15.4%	0.0%	0.0%
Go For Gin	1990	16	7.68	25.0%	6.3%	43.8%	37.5%	0.0%	0.0%
Gone West	1979	77	8.02	29.9%	14.3%	64.9%	33.8%	9.1%	9.1%
Grand Slam	1984	27	7.85	48.1%	25.9%	59.3%	29.6%	3.7%	15.4%
Green Dancer	1972	93	8.74	58.1%	14.0%	72.0%	15.1%	22.6%	15.2%
Green Desert	1983	15	7.80	66.7%	13.3%	66.7%	40.0%	6.7%	42.9%
Grindstone	1993	15	6.97	6.7%	20.0%	40.0%	73.3%	0.0%	16.7%
Gulch	1984	26	7.85	34.6%	23.1%	42.3%	50.0%	11.5%	0.0%
Hennessy	1993	26	7.56	15.4%	38.5%	57.7%	38.5%	3.8%	30.8%
Holy Bull	1991	33	7.30	15.2%	15.2%	57.6%	51.5%	0.0%	0.0%
Honour and Glory	1993	18	6.99	16.7%	33.3%	38.9%	61.1%	0.0%	28.6%
Horse Chestnut	1995	10	7.30	40.0%	50.0%	40.0%	50.0%	0.0%	0.0%
Housebuster	1987	20	7.31	40.0%	5.0%	60.0%	60.0%	5.0%	27.3%
In Excess	1987	25	7.26	28.0%	16.0%	48.0%	52.0%	0.0%	9.1%
Indian Charlie	1995	21	7.15	19.0%	23.8%	42.9%	57.1%	0.0%	0.0%
Interprete	1988	10	8.70	10.0%	10.0%	50.0%	10.0%	30.0%	0.0%
Jeblar	1982	10	8.40	80.0%	10.0%	80.0%	10.0%	0.0%	12.5%
King Of Kings	1995	14	7.17	71.4%	0.0%	42.9%	50.0%	0.0%	33.3%
Kingmambo	1990	39	8.76	61.5%	5.1%	61.5%	2.6%	20.5%	33.3%
Kissin Kris	1990	20	8.40	70.0%	0.0%	75.0%	25.0%	15.0%	38.5%
Kris S.	1977	122	8.39	42.6%	10.7%	63.9%	14.8%	9.8%	6.1%
Langfuhr	1992	13	7.62	15.4%	15.4%	76.9%	46.2%	7.7%	22.2%

BROODMARE SIRE	YEAR	RACES	AWD	TURF	2YO	GSW	SPR	CLASSIC	OFF
Lear Fan	1981	44	9.14	84.1%	2.3%	65.9%	4.5%	25.0%	19.2%
Lord at War	1980	61	8.88	44.3%	13.1%	78.7%	6.6%	19.7%	17.1%
Machiavellian	1987	16	8.63	50.0%	6.3%	62.5%	37.5%	25.0%	10.0%
Majestic Light	1973	58	8.49	51.7%	17.2%	51.7%	19.0%	12.1%	18.8%
Maria's Mon	1993	23	7.61	30.4%	43.5%	52.2%	34.8%	0.0%	0.0%
Marlin	1993	10	8.10	70.0%	10.0%	50.0%	0.0%	0.0%	0.0%
Marquetry	1987	32	8.39	71.9%	21.9%	43.8%	31.3%	28.1%	30.8%
Meadowlake	1983	49	7.14	14.3%	24.5%	51.0%	57.1%	2.0%	13.6%
Mining	1984	22	7.93	27.3%	18.2%	50.0%	36.4%	4.5%	10.0%
Miswaki	1978	63	8.36	57.1%	7.9%	68.3%	23.8%	15.9%	27.3%
Montbrook	1990	16	7.28	6.3%	31.3%	68.8%	56.3%	6.3%	18.2%
Mr. Greeley	1992	15	8.60	33.3%	13.3%	80.0%	6.7%	6.7%	30.0%
Mr. Prospector	1970	332	8.01	28.6%	15.1%	59.0%	28.3%	6.0%	13.5%
Mt. Livermore	1981	50	7.15	28.0%	16.0%	42.0%	54.0%	4.0%	15.8%
Not for Love	1990	14	7.45	21.4%	0.0%	42.9%	50.0%	14.3%	0.0%
Notebook	1985	24	7.17	12.5%	8.3%	54.2%	58.3%	4.2%	23.1%
Nureyev	1977	125	8.52	50.4%	5.6%	70.4%	16.8%	12.0%	13.2%
Old Trieste	1995	10	8.35	20.0%	40.0%	80.0%	20.0%	20.0%	14.3%
Olympio	1988	18	7.36	11.1%	22.2%	72.2%	55.6%	0.0%	8.3%
Orientate	1998	13	7.26	15.4%	46.2%	46.2%	61.5%	0.0%	0.0%
Personal Flag	1983	21	8.24	0.0%	9.5%	42.9%	23.8%	9.5%	33.3%
Phone Trick	1982	29	7.50	13.8%	17.2%	44.8%	55.2%	6.9%	16.7%
Pleasant Colony	1978	107	8.75	34.6%	9.3%	62.6%	14.0%	23.4%	29.4%
Pleasant Tap	1987	20	9.18	25.0%	5.0%	60.0%	5.0%	15.0%	22.2%
Point Given	1998	10	7.00	40.0%	0.0%	50.0%	80.0%	10.0%	20.0%
Private Terms	1985	16	6.71	18.8%	12.5%	12.5%	62.5%	6.3%	50.0%
Prized	1986	35	8.80	42.9%	14.3%	65.7%	14.3%	20.0%	13.6%
Prospectors Gamble	1985	12	6.46	41.7%	0.0%	41.7%	83.3%	0.0%	40.0%
Pulpit	1994	23	8.48	47.8%	30.4%	60.9%	17.4%	17.4%	15.4%
Quiet American	1986	66	8.03	10.6%	15.2%	60.6%	27.3%	10.6%	13.9%
Rahy	1985	109	8.23	61.5%	9.2%	67.9%	24.8%	13.8%	13.2%
Rainbow Quest	1981	18	9.78	88.9%	5.6%	77.8%	0.0%	44.4%	36.4%
Red Ransom	1987	53	8.50	54.7%	15.1%	60.4%	11.3%	15.1%	14.3%
Royal Academy	1987	32	7.82	53.1%	12.5%	53.1%	25.0%	3.1%	20.0%
Sadler's Wells	1981	52	9.55	73.1%	3.8%	80.8%	5.8%	44.2%	32.4%
Saint Ballado	1989	35	7.47	28.6%	20.0%	60.0%	48.6%	0.0%	15.8%
Salt Lake	1989	30	7.62	26.7%	13.3%	33.3%	43.3%	10.0%	12.5%
Seattle Slew	1974	184	8.15	25.5%	16.8%	69.0%	27.7%	11.4%	14.3%
Seeking the Gold	1985	129	8.38	31.8%	14.0%	72.9%	20.9%	14.0%	15.2%
Silver Deputy	1985	80	7.34	10.0%	12.5%	57.5%	52.5%	0.0%	7.9%
Silver Ghost	1982	31	8.32	29.0%	19.4%	61.3%	45.2%	25.8%	15.8%
Silver Hawk	1979	58	8.79	67.2%	10.3%	65.5%	1.7%	12.1%	41.9%
Sir Cat	1993	11	8.73	0.0%	18.2%	72.7%	0.0%	9.1%	12.5%
Sky Classic	1987	22	8.45	36.4%	4.5%	40.9%	13.6%	4.5%	16.7%
Slew O' Gold	1980	49	7.05	14.3%	16.3%	53.1%	65.3%	4.1%	0.0%
Slewacide	1992	17	8.15	5.9%	17.6%	64.7%	35.3%	23.5%	18.2%
Slewpy	1976	29	8.00	51.7%	3.4%	51.7%	24.1%	0.0%	15.4%

BROODMARE SIRE	YEAR	RACES	AWD	TURF	2YO	GSW	SPR	CLASSIC	OFF
Smart Strike	1982	42	8.60	33.3%	14.3%	61.9%	14.3%	14.3%	13.6%
Southern Halo	1983	34	7.16	29.4%	8.8%	35.3%	52.9%	0.0%	25.0%
Stop the Music	1970	82	8.30	23.2%	13.4%	56.1%	25.6%	13.4%	8.3%
Storm Bird	1978	121	8.09	38.0%	15.7%	66.1%	26.4%	7.4%	12.7%
Storm Boot	1989	10	8.10	20.0%	20.0%	40.0%	20.0%	0.0%	33.3%
Storm Cat	1983	197	7.92	38.1%	14.7%	68.0%	34.0%	3.6%	16.9%
Storm Creek	1993	11	7.50	36.4%	27.3%	63.6%	45.5%	0.0%	0.0%
Tabasco Cat	1991	36	8.01	33.3%	11.1%	55.6%	41.7%	13.9%	20.0%
Tale of the Cat	1994	32	7.75	31.3%	15.6%	53.1%	34.4%	0.0%	18.8%
Theatrical	1982	66	8.91	57.6%	7.6%	56.1%	9.1%	24.2%	18.8%
Thirty Eight Paces	1978	18	6.14	38.9%	0.0%	33.3%	83.3%	0.0%	66.7%
Thunder Gulch	1992	31	8.34	54.8%	3.2%	61.3%	19.4%	3.2%	15.8%
Time for a Change	1981	38	7.90	28.9%	2.6%	42.1%	34.2%	13.2%	16.7%
Touch Gold	1994	19	8.04	21.1%	10.5%	63.2%	42.1%	15.8%	8.3%
Tough Knight	1984	10	7.45	0.0%	20.0%	50.0%	40.0%	0.0%	0.0%
Trempolino	1984	32	7.61	75.0%	12.5%	65.6%	31.3%	6.3%	5.9%
Tricky Creek	1986	12	7.96	0.0%	16.7%	75.0%	33.3%	0.0%	0.0%
Unaccounted For	1991	19	8.32	21.1%	42.1%	68.4%	31.6%	15.8%	7.7%
Unbridled	1987	73	8.24	26.0%	11.0%	71.2%	21.9%	9.6%	11.4%
Unbridled's Song	1993	48	7.86	20.8%	29.2%	66.7%	37.5%	6.3%	19.4%
Valid Appeal	1972	146	7.60	19.9%	20.5%	56.8%	50.0%	5.5%	12.5%
Valid Expectations	1993	10	7.75	0.0%	10.0%	40.0%	30.0%	0.0%	0.0%
Victory Gallop	1995	16	7.50	25.0%	31.3%	50.0%	50.0%	6.3%	0.0%
Wavering Monarch	1979	65	8.37	44.6%	9.2%	58.5%	20.0%	13.8%	27.3%
Well Decorated	1978	29	7.48	6.9%	24.1%	41.4%	51.7%	6.9%	16.7%
Wild Again	1980	68	8.39	23.5%	7.4%	58.8%	17.6%	5.9%	13.2%
Wild Rush	1994	13	7.33	7.7%	30.8%	23.1%	46.2%	0.0%	0.0%
With Approval	1986	57	8.64	70.2%	15.8%	70.2%	10.5%	12.3%	16.7%
Wolf Power	1978	41	8.23	51.2%	2.4%	85.4%	12.2%	4.9%	15.2%
Woodman	1983	94	8.06	36.2%	19.1%	58.5%	30.9%	7.4%	6.3%
You and I	1991	11	7.53	18.2%	0.0%	36.4%	36.4%	0.0%	25.0%

Appendix V

Bruce Lowe Families of U.S. Classic, English Derby & Prix de l'Arc de Triomphe Winners Since 1940

A1 (Ella Crump)	A4 (Fanny Maria)	A5 (The Kirtly Mare)	1 (Tregonwell's Natural Barb mare)
Gato del Sol	Bayern	Concern	All Along
Counterpoint	California Chrome		Allez France
			Alphabet Soup
			Animal Kingdom
			Ardan
			Arts and Letters
			Awesome Again
			Bimelech
			Bold
			Bon Mot
			Bounding Home
			Celtic Ash
			Dr Devious
			Erhaab
			Genuine Risk
			Go For Gin
			Greek Money
			Grindstone
			Hail to All
			High Chapparal
			High Gun
			Hurricane Run
			Larkspur
			Levmoss
			Master Derby
			Montjeu
			Never Say Die
			Oath
			Ocean Swell
			Pass Catcher
			Pensive
			Personality
			Prairie Bayou
			Proud Clarion
			Rachel Alexandra
			Riva Ridge
			Royal Palace
			Sea Hero
			Shaamit
			Shirley Heights
			Smarty Jones
			Spend a Buck
			Stage Door Johnny
			Straight Deal
			Summing
			Super Saver
			Swale
			Sword Dancer
			Three Troikas
			Tomy Lee
			Troy

1 (Tregonwell's Natural Barb mare), cont.
Unbridled
Vaguely Noble

2 (Burton's Barb mare)	3 (Dam of Two True Blues)	4 (Layton Barb mare)	5 (Dtr. of Massy's Black Barb)
Alleged	A.P. Indy	Assault	Afleet Alex
Bago	Caveat	Bernardini	Avatar
Ballymoss	Citation	Camelot	Big Brown
Candy Spots	Dancing Brave	Canonero II	Blame
Cannonade	Dante	Faultless	Capot
Cavan	Dark Star	Gallahadion	Da' Tara
Charlottown	Dust Commander	Generous	Determine
Cigar	Fabius	Lavandin	Djebel
Elocutionist	Gate Dancer	Majestic Prince	Gallant Man
Empery	Hasty Road	Middleground	Kahyasi
Exbury	Henbit	Monarchos	Native Dancer
Giacomo	Lemon Drop Kid	Mucho Macho Man	Needles
Hansel	Louis Quatorze	Nikellora	North Light
High Echelon	Lucky Debonair	Nuccio	Pleasant Colony
Nashwan	Nashua	Quest for Fame	Star Appeal
Northern Dancer	Pinza	Real Quiet	
Palace Malice	Pont l'Eveque	Ribot	
Parthia	Prince Royal	Secreto	
Point Given	Ruler of the World	Suave Dancer	
Quadrangle	Santa Claus	Subotica	
Sea-Bird	Shahrastani	Sunny's Halo	
Secretariat	Sherluck	Temperence hill	
Shackleford	Silver Charm	Timber Country	
Skywalker	Sir Percy	Treve	
Spectacular Bid	Summer Bird	Venetian Way	
Touch Gold	Summer Squall	Zenyatta	
	Sunday Silence		
	Teenoso		
	Tonalist		
	Verso		
	Wild Again		

6 (Old Bald Peg)	7 (Darcy's Black-Legged Royal mare)	8 (Bustler mare)	9 (Old Vintner mare)
Count Fleet	Kris Kin	Amberoid	Aloma's Ruler
Empire Maker	La Sorellina	Arcangues	Bee Bee Bee
Funny Cide	My Love	Birdstone	Benny the Dip
Nimbus	Royal Orbit	Bold Ruler	Bet Twice
Snow Knight	San San	Conquistador Cielo	Black Tie Affair
	Topyo	Damascus	Bold Forbes
	Watling Street	Editor's Note	Caracalla
		Fusaichi Pegasus	Coastal
		Grundy	Codex
		Jaipur	Creme Fraiche
		Jazil	Dalakhani
		Motivator	Dylan Thomas

8 (Bustler mare), cont.	9 (Old Vintner mare), cont.
Nijinsky II	Fort Larned
Orb	Forward Pass
Phil Drake	Galcador
Pine Bluff	Galileo
Proud Truth	High-Rise
Rags to Riches	Hill Prince
Sassafras	Hoop Jr.
Sir Ivor	Lookin at Lucky
The Minstrel	Migoli
Whirlaway	Peintre Celebre
	Risen Star
	Sea The Stars
	Shergar
	Snow Chief
	Tom Rolfe
	Urban Sea
	Zarkava

10 (Dtr. of Gower's Stallion)	11 (Sedbury Royal mare)	12 (Montagu mare)	13 (Darcy's Royal mare)
Airborne	Hill Gail	Bally Ache	Akiyda
Arctic Prince	Sagamix	Ivanjica	Blue Man
Charismatic	Soltikoff	Marienbard	Cat Thief
Drosselmeyer	Thunder Gulch	Oroso	Colonial Affair
Go and Go		Puissant Chef	Ferdinand
Helissio		Roberto	Jet Pilot
Owen Tudor		Ruler of the World	Rail Link
Pavot		Tabasco Cat	Seattle Slew
Reference Point		Victory Gallop	Sinndar
Rheingold			Union Rags
Sarava			

14 (Oldfield mare)	16 (Sis. To Stripling by Hutton's Spot)	17 (Byerly Turk mare)	19 (Dtr. Of Davill's Old Woodcock)
Carroll House	Authorized	Danzig Connection	Curlin
Commander in Chief	Barbaro	Decidedly	New Approach
Coronation	Carnegie	Phalanx	Sica Boy
Danedream	Chateaugay	Raven's Pass	Tony Bin
Foolish Pleasure	Commendable	Saint Liam	
Invasor	Crepello		
Le Paillon	Detroit		
Polynesian	Hard Ridden		
Psidium	Le Pacha		
Rainbow Quest	Little Current		
Ruler on Ice	Molvedo		
Skip Away	Pearl Diver		
St. Paddy	Pleasantly Perfect		
Workforce	Red Bullet		
	Relko		
	Sagace		
	Saumarez		
	Shut Out		
	Slip Anchor		

16 (Sis. To Stripling by Hutton's Spot)
Solemia
Strike the Gold
Volponi

20 (Dtr. Of Gascoigne's Foreign horse)	21 (Moona Barb mare)	22 (Belgrade Turk mare)	23 (Piping Peg)
Alysheba	Deputed Testamony	Count Turf	Affirmed
Blakeney	Sakhee	Gold River	Ghostzapper
Morston	Tank's Prospect	Lammtarra	I'll Have Another
Tantieme		Mill Reef	Lil E. Tee
War Emblem		Pour Moi	Mine That Bird
		Saint Crespin	Ponder
		Street Sense	Tim Tam
		Tulyar	Winning Colors

24 (Helmsley Turk mare)	25 (Brimmer mare)	26 (Dtr. of Merlin)
Carry Back	One Count	Oxbow
		Tiznow
		Trempolino

Appendix VI

Kentucky Broodmares of the Year Since 1946

2014 FUN HOUSE, 1999 (Prized-Bistra, by Classic Go Go)
Sire line: Turn-to
5 wins, $432,922, Stakes Winner
DP 1-2-6-1-0, DI 1.50, CD 0.30
Untapable, by Tapit; Paddy O'Prado, by El Prado

2013 TAKE CHARGE LADY, 1999 (Dehere-Felicita, by Rubiano)
Sire line: Northern Dancer
11 wins, $2,480,377, Stakes Winner
DP 5-6-10-1-0, DI 2.67, CD 0.68
Will Take Charge, by Unbridled's Song; Take Charge Indy, by A.P. Indy

2012 LISA DANIELLE, 1994 (Wolf Power-Askmysecretary, by Secretariat)
Sire line: Princequillo
1 win, $20,120, Winner
DP 5-8-11-6-0, DI 1.61, CD 0.40
Wise Dan, by Wiseman's Ferry; Successful Dan, by Successful Appeal; Our Royal Dancer, by Roy

2011 OATSEE, 1997 (Unbridled-With Every Wish, by Lear Fan)
Sire line: Raise a Native
2 wins, $106,945, Stakes Placed
DP 15-15-14-0-6, DI 2.85, CD 0.66
Shackleford, by Forestry; Lady Joanne, by Orientate; Afleeting Lady, by Afleet Alex; Stephanoatsee, by A.P. Indy; Baghdaria, by Royal Academy

2010 LIABLE, 1995 (Seeking the Gold-Bound, by Nijinsky II)
Sire line: Raise a Native
6 wins, $235,021, Stakes Placed
DP 10-3-21-4-0, DI 1.62, CD 0.50
Blame, by Arch; Tend, by Dynaformer

2009 SWEET LIFE, 1996 (Kris S.-Symbolically, by Flying Paster)
Sire line: Turn-to
4 wins, $223,486, Stakes Winner
DP 3-4-15-2-0, DI 1.53, CD 0.33
Sweet Catomine, by Storm Cat; Life is Sweet, by Storm Cat; Calimonco, by Storm Cat

2008 VERTIGINEUX, 1995 (Kris S.-For The Flag, by Forli)
Sire line: Turn-to
2 wins, $60,480, Winner
DP 4-7-26-2-1, DI 1.50, CD 0.28
Zenyatta, by Street Cry; Balance, by Thunder Gulch; Where's Bailey, by Aljabr

2007 BETTER THEN HONOUR, 1996 (Deputy Minister-Blush With Pride, by Blushing Groom)
Sire line: Northern Dancer
2 wins, $250,920, Stakes Winner
DP 8-0-8-0-2, DI 2.00, CD 0.67
Rags to Riches, by A.P. Indy; Jazil, by Seeking the Gold; Casino Drive, by Mineshaft; Man of Iron, by Giant's Causeway

2006 CARA RAFAELA, 1993 (Quiet American-Oil Fable, by Spectacular Bid)
Sire line: Raise a Native
4 wins, $884,452, Stakes Winner
DP 9-14-13-0-0, DI 4.54, CD 0.89
Bernardini, by A.P. Indy

2005 BABY ZIP, 1991 (Relaunch-Thirty Zip, by Tri Jet)
Sire line: In Reality
4 wins, $60,395, Stakes Winner
DP 9-4-7-0-0, DI 4.71, CD 1.10
Ghostzapper, by Awesone Again; City Zip, by Carson City

2004 DEAR BIRDIE, 1987 (Storm Bird-Hush Dear, by Silent Screen)
Sire line: Northern Dancer
2 wins, $30,430, Winner
DP 7-4-12-1-0, DI 2.43, CD 0.71
Bird Town, by Cape Town; Birdstone, by Grindstone

2003 PROSPECTORS DELITE, 1989 (Mr. Prospector-Up the Flagpole, by Hoist the Flag)
Sire line: Raise a Native
6 wins, $432,953, Stakes Winner
DP 24-10-21-2-5, DI 2.54, CD 0.74
Mineshaft, by A.P. Indy; Tomisue's Delight, by A.P. Indy; Rock Slide, by A.P. Indy; Delta Music, by Dixieland Band; Monashee Mountain, by Danzig

2002 TOUSSAUD, 1989 (El Gran Senor-Image of Reality, by In Reality)
Sire line: Northern Dancer
7 wins, $552,751, Stakes Winner
DP 13-5-16-0-0, DI 3.25, CD 0.91
Empire Maker, by Unbridled; Chester House, by Mr. Prospector; Honest Lady, by Seattle Slew; Chiselling, by Woodman; Decarchy, by Distant View

2001 TURKO'S TURN, 1992 (Turkoman-Turbo Launch, by Relaunch)
Sire line: Raise a Native
4 wins, $117,850, Stakes Winner
DP 7-2-11-2-0, DI 1.93, CD 0.64
Point Given, by Thunder Gulch

2000 PRIMAL FORCE, 1987 (Blushing Groom-Prime Prospect, by Mr. Prospector)
Sire line: Nasrullah
4 wins, $74,251, Winner
DP 23-2-15-0-4, DI 2.81, CD 0.91
Awesome Again, by Deputy Minister; Macho Uno, by Holy Bull

1999 ANNE CAMPBELL, 1973 (Never Bend-Repercussion, by Tatan)
Sire line: Nasrullah
5 wins, $37,386, Stakes Winner
DP 20-14-7-1-2, DI 5.77, CD 1.11
Desert Wine, by Damascus; Arsaan, by Nureyev; Menifee, by Harlan

1998 IN NEON, 1982 (Ack Ack-Shamara, by Dewan)
Sire line: Domino
5 wins, $111,595, Stakes Winner
DP 8-13-8-1-0, DI 5.00, CD 0.93
Star Recruit, by Al Nasr; Sharp Cat, by Storm Cat; Royal Anthem, by Theatrical

1997 SLIGHTLY DANGEROUS, 1979 (Roberto-Where You Lead, by Raise a Native)
Sire line: Turn-to
2 wins, $95,063, Stakes Winner
DP 15-8-35-0-0, DI 2.31, CD 0.66
Warning, by Known Fact; Commander In Chief, by Dancing Brave; Dushyantor, by Sadler's Wells; Yashmak, by Danzig

1996 PERSONAL ENSIGN, 1984 (Private Account-Grecian Banner, by Hoist the Flag)
Sire line: Damascus
13 wins, $1,679,880, Stakes Winner
DP 7-9-15-0-3, DI 2.24, CD 0.50
My Flag, by Easy Goer; Miner's Mark, by Mr. Prospector; Traditionally, by Mr. Prospector

1995 NORTHERN SUNSET, 1977 (Northfields-Moss Greine, by Ballymoss)
Sire line: Northern Dancer
2 wins, $3,804, Winner
DP 10-1-11-8-2, DI 1.06, CD 0.28
St. Jovite, by Pleasant Colony; L'Carriere, by Carr de Naskra; Salem Drive, by Darby Creek Road; Lac Ouimet, by Pleasant Colony
Sire line: Northern Dancer

1994 FALL ASPEN, 1976 (Pretense-Change Water, by Swaps)
Sire line: Manna
8 wins, $198,037, Stakes Winner
DP 7-4-25-2-0, DI 1.62, CD 0.42
Northern Aspen, by Northern Dancer; Elle Seule, by Exclusive Native; Mazzacano, by Alleged; Colorado Dancer, by Shareef Dancer; Hamas, by Danzig; Fort Wood, by Sadler's Wells; Timber Country, by Woodman; Prince of Thieves, by Hansel

1993 GLOWING TRIBUTE, 1973 (Graustark-Admiring, by Hail to Reason)
Sire line: Ribot
9 wins, $230,819, Stakes Winner
DP 6-3-29-10-4, DI 0.82, CD –0.06
Hero's Honor, by Northern Dancer; Wild Applause, by Northern Dancer; Glowing Honor, by Seattle Slew; Seattle Glow, by Seattle Slew; Sea Hero, by Polish Navy; Coronation Cup, by Chief's Crown; Mackie, by Summer Squall

1992 WEEKEND SURPRISE, 1980 (Secretariat-Lassie Dear, by Buckpasser)
Sire line: Bold Ruler
7 wins, $402,892, Stakes Winner
DP 12-11-17- 4- 0 DI 2.52 CD 0.70
Summer Squall, by Storm Bird; A. P. Indy, by Seattle Slew

1991 TOLL BOOTH, 1971 (Buckpasser-Missy Baba, by My Babu)
Sire line: Tom Fool
3 wins, $32,330, Winner
DP 10- 8-29- 2- 3 DI 1.67 CD 0.38
Plugged Nickle, by Key to the Mint; Tokens Only, by Youth; Idle Gossip, by Lyphard; Toll Key, by Nodouble; Key to the Bridge, by Key to the Mint; Toll Fee, by Topsider; Christiecat, by Majestic Light

1990 KAMAR, 1976 (Key to the Mint-Square Angel, by Quadrangle)
Sire line: Ribot
7 wins, $140,747, Stakes Winner
DP 1- 3-12- 6- 3 DI 0.71 CD -0.21
Key to the Moon, by Wajima; Hiaam, by Alydar; Gorgeous, by Slew o' Gold; Seaside Attraction, by Seattle Slew

1989 RELAXING, 1976 (Buckpasser-Marking Time, by To Market)
Sire line: Tom Fool
13 wins, $589,906, Stakes Winner
DP 3- 5-28- 2- 0 DI 1.38 CD 0.24
Easy Goer, by Alydar; Cadillacing, by Alydar

1988 GRECIAN BANNER, 1974 (Hoist the Flag-Dorine, by Aristophanes)
Sire line: Ribot
1 win, $9,020, Winner
DP 13-11-15- 3- 8 DI 1.70 CD 0.36
Personal Flag, by Private Account; Personal Ensign, by Private Account

1987 BANJA LUKA, 1968 (Double Jay-Legato, by Dark Star)
Sire line: Peter Pan
0 wins, $1,440
DP 22- 4- 2- 0- 0 DI 27.00 CD 1.71
Ferdinand, by Nijinsky II; Donna Inez, by Herbager; Jayston, by Le Fabuleux; Dancing, by Forli; Ancient Art by Tell; Plinth by Tom Rolfe

1986 TOO BALD, 1964 (Bald Eagle-Hidden Talent, by Dark Star)
Sire Line: Nasrullah
13 wins, $174,722, Stakes Winner
DP 19- 2- 4- 1- 0 DI 7.67 CD 1.50
Exceller, by Vaguely Noble; Capote, by Seattle Slew; American Standard, by In Reality; Baldski, by Nijinsky II

1985 DUNCE CAP II, 1960 (Tom Fool-Bright Coronet, by Bull Lea)
Sire line: Pharamond II
3 wins, $21,662, Stakes Winner
DP 8- 9-18- 5- 0 DI 2.14 CD 0.64
Late Bloomer, by Stage Door Johnny; Late Act, by Stage Door Johnny; Johnny Appleseed by Stage Door Johnny

1984 HASTY QUEEN II, 1963 (One Count-Queen Hopeful, by Roman)
Sire line: Sundridge
Unraced
DP 5- 5-12- 7- 1 DI 1.14 CD 0.20
Fit to Fight, by Chieftain; Hasty Flyer, by Misty Flight; Hasty Tam, by Tentam; Playful Queen, by Majestic Prince; Michael Navonod, by Misty Flight; Hasty Cutie, by Hasty Road

1983 COURTLY DEE, 1968 (Never Bend-Tulle, by War Admiral)
Sire line: Nasrullah
4 wins, $19,426, Winner
DP 18-14-13- 6- 3 DI 2.48 CD 0.70
Althea, by Alydar; Native Courier, by Exclusive Native; Ali Oop, by Al Hattab; Ketoh, by Exclusive Native; Princess Oola, by Al Hattab

1982 BEST IN SHOW, 1965 (Traffic Judge-Stolen Hour, by Mr. Busher)
Sire line: Hyperion
5 wins, $53,880, Stakes Winner
DP 2- 2-18- 6- 0 DI 0.87 CD 0.00
Malinowski, by Sir Ivor; Blush with Pride, by Blushing Groom; Gielgud, by Sir Ivor; Monroe, by Sir Ivor

1981 NATASHKA, 1963 (Dedicate-Natasha, by Nasrullah)
Sire line: Princequillo
8 wins, $151,673, Stakes Winner
DP 10- 6-11- 9- 0 DI 1.48 CD 0.47
Truly Bound, by In Reality; Gregorian, by Graustark; Ivory Wand, by Sir Ivor; Arkadina, by Ribot; Blood Royal, by Ribot

1980 KEY BRIDGE, 1959 (Princequillo-Blue Banner, by War Admiral)
Sire line: Prince Rose
Unraced
DP 0-10-22-13- 1 DI 0.84 CD -0.11
Fort Marcy, by Amerigo; Key to the Mint, by Graustark; Key to Content, by Forli; Key to the Kingdom, by Bold Ruler

1979 SMARTAIRE, 1962 (Quibu-Art Teacher, by Olympia)
Sire line: Fairway
4 wins, $13,925, Winner
DP 19- 0- 1- 0- 2 DI 7.80 CD 1.55
Smart Angle, by Quadrangle; Smarten, by Cyane; Quadratic, by Quadrangle; Smart Heiress, by Vaguely Noble

1978 PRIMONETTA, 1958 (Swaps-Banquet Bell, by Polynesian)
Sire line: Hyperion
17 wins, $306,690, Stakes Winner
DP 4-16- 6- 0- 4 DI 3.29 CD 0.88
Cum Laude Laurie, by Hail to Reason; Prince Thou Art, by Hail to Reason; Maud Muller, by Graustark; Grenfall, by Graustark

1977 SWEET TOOTH, 1965 (On-and-On -Plum Cake, by Ponder)
Sire line: Nasrullah
10 wins, $86,004, Stakes Placed
DP 15- 2-15- 2- 0 DI 2.58 CD 0.53
Our Mims, by Herbager; Alydar, by Raise a Native; Sugar and Spice, by Key to the Mint

1976 GAZALA II, 1964 (Dark Star-Belle Angevine, by L'Amiral)
Sire line: Gainsborough
5 wins, $239,517, Stakes Winner
DP 4- 0- 0- 2- 6 DI 0.50 CD -0.50
Youth, by Ack Ack; Mississippian, by Vaguely Noble; Gonzales, by Vaguely Noble; Silky Baby, by What a Pleasure; Best of Both, by J. O. Tobin

1975 SHENANIGANS, 1963 (Native Dancer-Bold Irish, by Fighting Fox)
Sire line: Sickle
3 wins, $18,120, Stakes Placed
DP 0-18-12- 6- 0 DI 2.00 CD 0.33
Ruffian, by Reviewer; Icecapade, by Nearctic; Buckfinder, by Buckpasser

1974 COSMAH, 1953 (Cosmic Bomb-Almahmoud, by Mahmoud)
Sire line: Pharamond II
9 wins, $85,525, Stakes Winner
DP 4- 4-14- 4- 0 DI 1.36 CD 0.31
Tosmah, by Tim Tam; Halo, by Hail to Reason; Fathers Image, by Swaps; Maribeau, by Ribot

1973 SOMETHINGROYAL, 1952 (Princequillo-Imperatrice, by Caruso)
Sire line: Prince Rose
0 wins, $0
DP 0- 8-10-10- 0 DI 0.87 CD -0.07
Secretariat, by Bold Ruler; Sir Gaylord, by Turn-to; First Family, by First Landing; Syrian Sea, by Bold Ruler

1972 MOMENT OF TRUTH II, 1959 (Matador-Kingsworthy, by Kingstone)
Sire line: Orby
Unraced
DP 1- 4- 3- 0- 2 DI 1.86 CD 0.20
Convenience, by Fleet Nasrullah; Indulto, by Royal Coinage; Proliferation, by Warfare; Puntilla, by Never Bend; Night Alert, by Nijinsky II

1971 IBERIA, 1954 (Heliopolis-War East, by Easton)
Sire line: Hyperion
3 wins, $9,925, Winner
DP 24- 0-12- 7- 5 DI 1.67 CD 0.65
Riva Ridge, by First Landing; Hydrologist, by Tatan; Potomac, by First Landing

1970 LEVEE, 1953 (Hill Prince-Bourtai, by Stimulus)
Sire line: Princequillo
8 wins, $223,305, Stakes Winner
DP 4- 4- 8- 6- 0 DI 1.20 CD 0.27
Shuvee, by Nashua; Royal Gunner, by Royal Charger; Nalee, by Nashua; A. T's Olie, by Mongo

1969 ALL BEAUTIFUL, 1959 (Battlefield-Parlo, by Heliopolis)
Sire line: Man o' War
1 win, $2,275, Winner
DP 10- 0-10- 6- 2 DI 1.15 CD 0.36
Arts and Letters, by Ribot

1968 DELTA, 1952 (Nasrullah-Bourtai, by Stimulus
Sire line: Nearco
16 wins, $269,215, Stakes Winner
DP 26- 8-12- 2- 0 DI 5.00 CD 1.21
Dike, by Herbager; Canal, by Round Table; Cabildo, by Round Table; Okavango, by Herbager; Shore, by Round Table

1967 KERALA, 1958 (My Babu-Blade of Time, by Sickle)
Sire line: Tourbillon
Unraced
DP 20-12- 8- 2- 2 DI 4.50 CD 1.05
Damascus, by Sword Dancer

1966 JULIETS NURSE, 1948 (Count Fleet-Nursemaid, by Luke McLuke)
Sire line: Sundridge
6 wins, $35,010, Stakes Winner
DP 4- 2-16- 0- 0 DI 1.75 CD 0.45
Run For Nurse, by Hasty Road; Gallant Romeo, by Gallant Man; Woozem, by Hail to Reason; Dutiful, by Hail to Reason

1965 POCAHONTAS, 1955 (Roman-How, by Princequillo)
Sire line: Teddy
3 wins, $27,835, Stakes Winner
DP 12-12-16- 8- 2 DI 1.78 CD 0.48
Tom Rolfe, by Ribot; Chieftain, by Bold Ruler; Wenona, by Larkspur; Lady Rebecca, by Sir Ivor

1964 MAID OF FLIGHT, 1951 (Count Fleet-Maidoduntreath, by Man o' War)
Sire line: Sundridge
3 wins, $21,827, Stakes Placed
DP 1- 1-17-11- 2 DI 0.49 CD -0.38
Kelso, by Your Host

1963 MISTY MORN, 1952 (Princequillo-Grey Flight, by Mahmoud)
Sire line: Prince Rose
11 wins, $212,575, Stakes Winner
DP 0-14-20-10- 0 DI 1.20 CD 0.09
Successor, by Bold Ruler; Bold Lad, by Bold Ruler; Sunrise Flight, by Double Jay; Beautiful Day, by Bold Ruler; Bold Consort, by Bold Ruler

1962 TRACK MEDAL, 1950 (Khaled-Iron Reward, by Beau Pere)
Sire line: Hyperion
3 wins, $13,625, Winner
DP 4-18-14- 4- 8 DI 1.53 CD 0.13
Outing Class, by Nasrullah; O'Hara, by Ballymoss; Tutankhamen, by Nasrullah; Fool's Gold, by Tom Fool

1961 STRIKING, 1947 (War Admiral-Baby League, by Bubbling Over)
Sire line: Man o' War
3 wins, $32,625, Stakes Winner
DP 0- 8-17-11- 2 DI 0.60 CD -0.32
Hitting Away, by Ambiorix; Batter Up, by Tom Fool; My Boss Lady, by Bold Ruler; Glamour, by Nasrullah; Bases Full, by Ambiorix

1960 SIAMA, 1947 (Tiger-China Face, by Display)
Sire line: Teddy
9 wins, $79,785, Stakes Winner
DP 9- 7- 0- 8- 4 DI 1.33 CD 0.32
Bald Eagle, by Nasrullah; One-Eyed King, by Nasrullah; Dead Ahead, by Turn-to

1959 KNIGHT'S DAUGHTER, 1941 (Sir Cosmo-Feola, by Friar Marcus)
Sire line: Orby
3 wins, $4,219, Winner
DP 24- 0- 0- 0- 6 DI 4.00 CD 1.20
Round Table, by Princequillo; Monarchy, by Princequillo; Love Game, by Big Game

1958 MISS DISCO, 1944 (Discovery-Outdone, by Pompey)
Sire line: Fair Play
10 wins, $80,250, Stakes Winner
DP 8- 2- 0-18- 2 DI 0.50 CD -0.13
Bold Ruler, by Nasrullah; Independence, by Nasrullah; Nasco, by Nasrullah

1957 BELLE JEEP, 1949 (War Jeep-Model Beauty, by Blenheim II)
Sire line: Man o' War
Unraced
DP 0- 2-26-11- 1 DI 0.60 CD -0.28
Jewel's Reward, by Jet Jewel; Triple Crown, by Hawaii; Lord Jeep, by Lord Boswell; Evasive Action, by Get Around

1956 SWOON, 1942 (Sweep Like-Sadie Greenock, by Greenock)
Sire line: Ben Brush
5 wins, $11,425, Winner
DP 0-16- 0- 0- 0 DI Inf. CD 1.00
Swoon's Son, by The Doge; Dogoon, by The Doge

1955 IRON REWARD, 1946 (Beau Pere-Iron Maiden, by War Admiral)
Sire line: Dark Ronald
0 wins, $425
DP 0- 2-12- 7-13 DI 0.31 CD -0.91
Swaps, by Khaled; The Shoe, by Khaled; Like Magic, by Khaled

1954 TRAFFIC COURT, 1938 (Discovery-Traffic, by Broomstick)
Sire line: Fair Play
11 wins, $50,650, Stakes Winner
DP 0-12- 5-19- 2 DI 0.62 CD -0.29
Hasty Road, by Roman; Traffic Judge, by Alibhai

1953 GAGA, 1942 (Bull Dog-Alpoise, by Equipoise)
Sire line: Teddy
7 wins, $15,875, Stakes Placed
DP 18- 6- 4- 8- 4 DI 1.86 CD 0.65
Tom Fool, by Menow; Aunt Jinny, by Heliopolis

1952 ACE CARD, 1942 (Case Ace-Furlough, by Man o' War)
Sire line: Teddy
5 wins, $30,370, Stakes Winner
DP 4- 0- 1-19- 2 DI 0.21 CD -0.58
One Count, by Count Fleet; Post Card, by Firethorn; My Card, by My Babu; Yildiz, by Mahmoud

1951 ALPENSTOCK III, 1936 (Apelle-Plymstock, by Polymelus)
Sire line: Sardanapale
1 win, $610, Winner
DP 0- 0- 0- 0- 8 DI 0.00 CD -2.00
Ruhe, by Menow; Sturdy One, by Unbreakable; Alladier, by Balladier

1950 HILDENE, 1938 (Bubbling Over-Fancy Racket, by Wrack)
Sire line: Sundridge
0 wins, $100
DP 4- 8- 0- 4- 0 DI 3.00 CD 0.75
First Landing, by Turn-to; Hill Prince, by Princequillo; Third Brother, by Princequillo; Mangochick, by Sun Beau; Prince Hill, by Princequillo

1949 EASY LASS, 1940 (Blenheim II-Slow and Easy, by Colin)
Sire line: Swynford
3 wins, $2,950, Winner
DP 0- 0-20- 8- 0 DI 0.56 CD -0.29
Coaltown, by Bull Lea; Wistful, by Sun Again; Rosewood, by Bull Lea; Fanfare, by Pensive

1948 OUR PAGE, 1940 (Blue Larkspur-Occult, by Dis Donc)
Sire line: Peter Pan
3 wins, $11,285, Stakes Winner
DP 4-10-16- 2- 4 DI 1.57 CD 0.22
Navy Page, by War Admiral; Sport Page, by Our Boots; Page Boots, by Our Boots; Bull Page, by Bull Lea; Brother Tex, by War Admiral

1947 POTHEEN, 1928 (Wildair-Rosie O'Grady, by Hamburg)
Sire line: Ben Brush
1 win, $1,250, Stakes Placed
DP 8-12- 0- 0- 0 DI Inf. CD 1.40
Bewitch, by Bull Lea; Pot O' Luck, by Chance Play; Lot O Luck, by Chance Play; Theen, by Sickle

1946 BLOODROOT, 1932 (Blue Larkspur-Knockaney Bridge, by Bridge of Earn)
Sire line: Peter Pan
8 wins, $13,100, Stakes Placed
DP 4- 2-16- 2- 0 DI 1.40 CD 0.33
Ancestor, by Challedon; Be Faithful, by Bimelech; Bric a Brac, by War Admiral; Bimlette, by Bimelech

Appendix VII

Articles

The Gallant Story of Business Is Boomin

This is a tale of inner strength and determination. It is a story about everything that's good in racing. It symbolizes a triumph of the spirit and the struggle to overcome adversity. This is about the personal side of racing, as far from the glamour of Claiborne Farm or Wayne Lukas or Gary Stevens as one can get. In my view, it captures the essence of why we love horses and are enthralled by their accomplishments.

In the spring of 1991, my associate and I identified a young two-year-old colt as a potential purchase for a client. He had just comfortably broken his maiden second time out in a $30,000 claiming sprint at Churchill Downs. There were aspects to his performance that we found especially encouraging, and a subsequent physical inspection confirmed our optimism. He had the look, the personality, and the demeanor. In fact, we were convinced he was going to be a star. His name was Business Is Boomin, by an undistinguished son of Secretariat named Businessisbusiness, and out of a Mr. Leader mare. Boomer, as we called him, made his initial start for his new owner in the Budweiser Breeders' Cup Handicap at Churchill Downs, coupled as the favored 6-5 entry with eventual race winner Hippomenes, another two-year-old we had just bought. Boomer bowed a tendon in the race and was beaten about six lengths after racing prominently in the early stages. As with all injuries of this type, there were serious questions about his ability to race again. Eventually, under the care of his trainer, Michael Dickinson, Boomer resurfaced eleven months later to finish a close second in two consecutive New York turf allowance routes. In the first he lost by less than a length to Kiri's Clown, a future Grade 1 stakes winner on the grass and an earner of over a million dollars. In the second he was beaten just over two lengths by Gary Gumbo, who later that year became a Grade 3 stakes winner. And then disaster struck. During the course of training, Boomer re-injured himself. His short-lived and promising career looked to be finished after just five races. Over

the next two years, Michael and his assistant, Joan Wakefield, actually brought Boomer to within a week or so of a race on a couple of occasions, only to be disappointed by one problem or another. In the interim, Michael took ownership of Boomer, and it looked like the Dickinson stable had a new pony. End of story? No way! Michael and Joan persevered for three more years, caring for Boomer and slowly, ever so slowly, nurturing him back to health.

On May 8, 1997, five years to the day of his last start, Boomer, now eight years old, entered the gate for the seventh race at Garden State Park, a $15,000 claiming race for older horses, non-winners of two races lifetime, at a mile and seventy yards on the grass. He broke last of twelve, and after a half mile was galloping eleven lengths from the lead in tenth place. A quarter of a mile later he was fifth, just two and a half lengths behind. By the time the field reached the quarter pole, Boomer was in front and drawing away. He cruised down the stretch, increasing his lead as he wished, going under the wire almost seven lengths clear and winning easily. Amazingly, and out of respect for the well-known training exploits of Michael Dickinson, Boomer went to PP as the 6-5 favorite. Imagine that, after a five year layoff!

Boomer won his next two starts, a mile and a sixteenth turf allowance at Monmouth Park, and a mile and an eighth turf allowance at Laurel Park. In the latter race, he went wire-to-wire. After three straight victories, he finally finished second by a nose after rallying from ten lengths back in a mile and three-sixteenths turf allowance, also at Laurel. Things were not quite right next time out, dropping back to a mile and a sixteenth allowance on the grass at the same track. Boomer took the lead at the start, but weakened dramatically in the last furlong to finish fourth beaten 4 ½ lengths. With no excuse other than wear and tear, it looked as though this could be the end of the fairy tale…until June 9, 1998 in the fourth race at Delaware Park, an allowance on the grass at a mile and an eighth. After another ten months on the sideline, and now nine years old, Boomer came back again. Favored at 9-5 against eleven rivals, he settled mid-pack early, worked his way through the field, reached contention at the quarter pole, wore down the leaders, and drew away to a three length win. He got the distance in 1:48.4, going the last eighth in :11.3. After the win, Boomer returned home to Michael's new training facility at Tapeta Farm to spend the day loafing around a big field, relaxing, eating grass, and just enjoying himself. According to Michael, you would never know that hours earlier he had been in a race. I don't know where the story goes from here, but it really doesn't matter. The miracle has already been accomplished.

Even though I have been associated with many good horses in my career, no wins were ever more gratifying or poignant than the seventh at Garden State on May 8, 1997 and the fourth at Delaware Park on June 9, 1998. These races affirmed my belief in dreams, and they made me realize once more that the horses we often take for granted, or are quick to criticize, are truly the embodiment of grace, beauty, and courage. The win pictures from those races will always hang prominently on my office wall.

P.S. - Boomer ended his career with a lifetime record of 18-7-4-2, $123,592 and a turf record of 15-6-4-2, $116,078. His Dosage Figures are DP 7-8-10-1-0, DI 3.33, CD 0.81. After his retirement, he enjoyed hanging out at the farm with his best buddy, Da Hoss.

Breeding Theories and Statistics

Occasionally, and through various outlets, we publish articles that try to place modern Dosage methodology in its proper perspective. Invariably we caution against unwarranted extension of its basic premises. For example, the confirmed relationship between pedigree type and performance applies technically only to large populations of runners and not necessarily to individuals, although the conclusions derived from the data may be considered as would any conclusions drawn from statistical studies. For example, five-pack-a-day smokers generally don't live as long as non-smokers. Nevertheless, there are undoubtedly some that live well beyond the age that statistics suggest. On the other hand, refraining from smoking does increase the probability of longer-term survival. One should not conclude that every heavy smoker dies young or that every non-smoker lives a very long life even though the statistics tell us that heavy smokers as a group tend to die earlier than do non-smokers as a group.

We describe Dosage as a technique for classifying Thoroughbred pedigree type in terms of inherited prepotent qualities of speed and endurance. Research through the years has unequivocally demonstrated that the pedigree type of successful performers in any particular performance category, i.e., by distance, age, racing surface, class of race, etc, can be statistically differentiated from the pedigree type of successful performers in another performance category. Furthermore, in virtually all cases these differences can be correlated with the average distance of the races in the respective categories. Over the years, however, this simple concept has been extended, modified, and manipulated by some to justify their own perceptions of racing reality. This has been done without malicious intent in most cases, but rather reflects a general human trait that often leads us to oversimplify a problem that is, in fact, extraordinarily complex. This desire for simplicity is understandable and seems to occur whenever some theory about racing or breeding is offered up for discussion. Whether it be Dosage, nicking, inbreeding, LH-X or a multitude of other theories, its application is often naive and misguided, leading to disappointment and ultimate dismissal of the theory's valid points. In this article we will present our views about the currently fashionable theory of nicking, an idea that seems attractive on the surface but upon critical examination has, with some exceptions, a marginal scientific basis and is subject to gross misuse when accepted at face value.

The concept of two bloodlines or individuals having a unique compatibility is quite appealing because the decision-making process is that much easier. The fundamental problem with individual nicking patterns, however, is that only rarely are there enough examples to provide a statistically significant sample size. By statistically significant we are referring to the established statistical criteria affording a meaningful confidence level where the observed pattern has only a small probability of being a random event. For example, suppose sire A is bred to mares by sire B and ten foals are produced. If two of these, or 20%, become listed stakes winners and sire A gets 10% overall stakes winners, i.e., regardless of his mares' bloodlines, then this A/B cross surpasses sire A's overall

stakes winner production by two to one, which some would consider evidence of a positive nick. On the other hand, suppose that none of the ten foals (0%) won any stakes but three placed in Grade I's. Zero stakes winners from ten foals is a red flag. But here the truth may be that the Grade I stakes-placed runners are far superior to the two listed stakes winners in the first case. Do 20% stakes winners represent a positive nick while 0% stakes winners represent a negative nick? Probably not. Actually, depending on how you measure the quality of runners (and we all do it differently), you might conclude that the second case indicates a greater affinity between sires A and B than does the first. In extreme cases such as five Grade I stakes winners from five foals produced by the A/B cross or, at the other end, five maiden claimers, the conclusions are more obvious. But these circumstances are so rare that to generalize about the validity of individual nicking patterns on this basis stretches credibility. Ten or even twenty or thirty specific examples of a cross between A and B may still not be sufficient to establish statistical significance simply because there is no objective universal measure of the success of that cross.

An example of the danger inherent in the use of small sample sizes for defining nicks is the breeding of Baldski to Diplomat Way mares. In 1989, The Blood-Horse published tables of nicking patterns for many North American sires. Included were the records of sires which had gotten at least five foals from daughters of a particular broodmare sire. At that time the Baldski/Diplomat Way pattern had resulted in no stakes winners from 19 foals, seemingly supporting the notion of an inferior cross. However, the AEI (Average Earnings Index) for these foals was 1.84 while the CI (Comparable Index) was 1.64. So although there were no stakes winners, Baldski did upgrade the Diplomat Way mares to which he was bred. Perhaps the situation wasn't so bad after all. Subsequently, there appeared a Baldski/Diplomat Way stakes winner named Express Star which ultimately won seven stakes races with lifetime earnings of over $450,000. One out of twenty, or five percent stakes winners was not statistically different from Baldski's 7% lifetime stakes winner production rate at the time. Suddenly the prospect of Baldski being bred to Diplomat Way mares wasn't so terrifying. As of October 2000 there were 28 foals representing the Baldski/Diplomat way cross. Of these, three (11%) are stakes winners, exceeding Baldski's 9% lifetime percentage of stakes winners. The combined AEI of the 28 foals is 2.03 (which exceeds Baldski's lifetime AEI of 1.77 through 1999), with a CI of 1.62.

The issue raised here relates more to timing than it does to any genetic compatibility. Does a nick change if the one stakes winner from 20 foals is the first foal or the last one? Obviously not. The total record after 20 foals is the same. Bloodline compatibilities can change over long periods of time as new breeding stock from those bloodlines emerge. But the idea that the compatibility between a specific sire and a specific broodmare sire can change over time is suspect.

Another problem with the small sample sizes used in defining individual nicking patterns is the tendency to revert to close up ancestors if there are no specific examples involving the particular sire and broodmare sire. This is

more often the case than not. For example, millionaire Dispersal was one of the very best colts in America several years ago and presumably evidence of a superior nick. Dispersal was by Sunny's Halo and out of a Johnny Appleseed mare, certainly not a well-established breeding pattern and for which there is no basis for drawing meaningful conclusions about the viability of the cross. Even today there are only three examples, and Dispersal remains the one stakes winner. If we now look at the record of Sunny's Halo's sire, the deceased Halo, who was a superior stallion of long-standing, we find that he has sired at least five foals from mares representing only one branch of the Prince Rose broodmare sire line (like Johnny Appleseed). From six Prince John mares he has gotten one minor stakes winner, but overall he has seriously downgraded these mares with AEI 0.93 compared to CI 1.97. This is not the stuff that great nicks are made of. Apparently, using any other representative of a bloodline as a basis for the compatibility of another member of that bloodline is a dangerous practice because with each succeeding generation there is a significant dilution of the genetic relationship between the two.

One can look at nicking patterns more globally by focusing only on bloodlines rather than individuals. For example, it can easily be determined what percentage of Nearctic line sires and Royal Charger line broodmare sires are present in a population of stakes winners. For argument's sake let's say that 20% of all stakes winners are by Nearctic line sires and that 10% are out of Royal Charger line mares. In a random world, then, we could expect that one in ten stakes winners sired by a Nearctic line stallion would be produced from a Royal Charger line mare. Conversely, one in five stakes winners produced from Royal Charger line mares would be sired by Nearctic line stallions. To avoid confusion, we'll use real numbers to illustrate. In a population of 100 stakes winners, a total of 20 would represent the Nearctic sire line. If, randomly, 10% of all stakes winners are from Royal Charger line mares then two of the twenty Nearctic sire line stakes winners would be expected to represent the Nearctic/Royal Charger cross. Similarly, since 20% of all stakes winners are by Nearctic line sires then two of the ten stakes winners from Royal Charger line mares would be by those sires. Thus, from either direction, we expect two out of 100 stakes winners in the population to represent the Nearctic/Royal Charger cross. If, however, we find that there are actually four or six of the hundred that are bred Nearctic/Royal Charger, then we have a situation in which two or three times as many representatives of that cross have been produced than had been anticipated from the total population statistics. This might be construed as a positive nick. But here, too, there are problems associated with interpreting the data.

First, the derived statistics and nicking patterns, as is the case with Dosage, would apply only to large populations and not necessarily to individuals. In fact, we breed individuals, not bloodlines. Second, do the statistics really reflect general compatibility of bloodlines or the quality of individuals that make up the population? Bloodlines rise and fall for many reasons. But a characteristic of ascending bloodlines is that the individuals representing that bloodline are superior breeding animals relative to the remainder of the population. Declining bloodlines are similarly characterized by inferior breeding animals. Therefore, dominating the situation is the fact that breeding

superior sires to mares by superior broodmare sires increases the probability of producing superior foals. This returns us to the concept of individual nicking patterns and the problems associated with statistical significance.

Bloodline compatibilities are statistically meaningful only in terms of large populations and in that context are useful in assessing general trends within bloodlines. On the other hand, individual nicking patterns almost never meet the criteria for statistical significance.

The overall concept of nicking must be placed in perspective. It can not and should not replace a careful analysis of the quality of the breeding stock being evaluated. Good breeding stallions get good foals. Bad breeding stallions do not. Good mares produce good foals. Bad mares do not. It isn't an accident that typically just 1% of all the sires of starters in North America account for about 25 to 30% of all stakes wins and available purses. With that in mind, bloodlines are of secondary importance when compared to individual sires and dams. The stallion and the mare must be considered in terms of their individual attributes.

Because individual nicking patterns in the vast majority of instances are statistically insignificant and because the general compatibility of bloodlines ignores individual contribution, our view is that the best way to proceed in selecting a mating is to identify the most productive sires that are economically consistent with a particular mare and, for comfort's sake if nothing else, look for an indication that either the sire has gotten at least one or two good runners from the mare's sire line or, conversely, that the mare has already produced at least one good runner from the sire's sire line. The breeder can then invoke secondary analyses relating to potential commercial value of the offspring or, if racing rather than sales is the goal, racing type (including distance potential, surface preference, rate of maturity, etc).

Equally important is a thorough understanding of the physical compatibility of the stallion and the mare, especially with regard to conformational attributes and the degree to which these conformational characteristics have affected the performance of the progeny produced. Some form of nicking may serve as a preliminary focal point, but in the end it should never be the basis for selection. Barrera is not Mr. Prospector, although both are sons of Raise a Native. Wajima is not Secretariat, although both are sons of Bold Ruler. Anyone who believes a Barrera/Wajima foal represents the same nicking significance as a Mr. Prospector/Secretariat foal had better go back to basics.

The Relationship Between Time, Distance and Fatigue: Evidence for a Record-Breaking Preakness

The following is an update of an unpublished article originally written in 1982 about the fatigue characteristics of race horses. It presents a mathematical model of fatigue in the race horse and applies it to a real-world situation that many racing fans will recall. As the example, the described methodology was applied to Secretariat's Preakness Stakes in an effort to mathematically confirm what we already know - that he broke the track record despite the "official" result. The article is technical in nature, but hopefully the principles behind the numbers and equations will be clear. The intent is to show that time, distance and fatigue are inextricably intertwined.

At 5:40 PM Eastern Daylight Time, in Maryland on a Saturday in May, a chestnut colt of imposing physical and historical stature broke from the gate and leisurely settled in behind the other horses racing to the clubhouse turn. Within a few seconds, the colt would initiate a move of such spectacular proportions that he would circle the entire field and take command entering the backstretch, to be hand-ridden the rest of the way to an overwhelming victory. In one of racing's most memorable displays of power and grace, Secretariat had won the second leg of the Triple Crown on his march toward immortality. A malfunctioning teletimer clicked off 1:55 for the mile and three—sixteenths, one second slower than Canonero II's mark set two years earlier. An immediate controversy arose as two Daily Racing Form clockers had separately timed the race one and three-fifths seconds faster. A debate followed, and evidence was presented in an attempt to resolve the dispute. Two days after the race it was learned that the official track clocker had timed the race manually, catching Secretariat under the wire in 1:54.2, still over the track mark. Pimlico officials compromised and lowered the time to that recorded by the track clocker. To this day, the result chart of the race lists the track time as official but includes, parenthetically, the faster Daily Racing Form time.

Secretariat's reputation as a runner is not challenged if the official time is correct, just as Mark Spitz's reputation as a swimmer would be secure had he gotten only six world records rather than seven in his sweep of the 1972 Olympics. On the other hand, a record Preakness in 1:53.2 combined with the record-shattering performances in the Derby and the Belmont would elevate the 1973 Triple Crown to an even higher plane of unparalleled achievement. The purity and romance of the thing is so compelling that it should not be ignored.

Events such as this, and the discussion which surrounds them, add zest to the already colorful world of the turf. Hearts beat more rapidly when people argue whether Codex really did foul Genuine Risk or whether Ruffian would have beaten Foolish Pleasure. But these are judgment calls, never to be resolved. Secretariat's Preakness is another matter. The time of a race transcends judgment since time is intimately woven into the fabric of physical

laws. It exists independently of a malfunctioning electronic timer or stopwatch on any given day. Is it possible, then, to predict the time of a race based on scientific calculations? Perhaps so.

In the spring of 1981, Peter S. Riegel, a research engineer at Batelle Memorial Institute and a competitive long-distance runner, published an article in American Scientist magazine (Volume 69, p 285) in which he derived an equation to express the relationship between distance and the time of world-record performances in several human athletic events. The equation takes the form $T=bD^M$ [note the resemblance to the famous Einstein equation $e=mc^2$] where T=time, D=distance, b is a constant which provides a measure of relative speed, and M is a "fatigue factor", so-called because its value determines the rate at which average speed changes with distance, and the time required to finish a race. A mathematically equivalent form of the equation is log T=log b + Mlog D, which many will recognize as the equation for a straight line. The best way to explain a log (short for logarithm) for those unfamiliar with the term is by example. We know that $10^2=100$ and that $10^3=1000$. A log, in this case, is simply the power to which the number 10 must be raised to get another number. In the examples, log 100=2 and log 1000=3 since these are the powers to which 10 must be raised to get 100 and 1000, respectively. It is not necessary to understand the mathematical significance of the concept. It is more important to understand that logs can be used as mathematical tools and are simply alternative expressions of common numbers.

Riegel found that when plotting log T versus log D for a number of events, the results did, in fact, approximate a straight line, confirming the correctness of the equation as a description of the relationship between distance and time. Thus, if one knows the times of races run at various distances, these values can be plotted in a straight line and log b and M can be calculated.

Figure 1 is a graphical representation of the log-log equation. The vertical axis is log T and the horizontal axis is log D. Line A is derived by an operation called linear regression in which the data points (shown as the x-marks along either side of line A) are used to generate the best straight line defined by the points. A measure of how closely the points fit the theoretical line generated is called the correlation coefficient. The maximum value for the correlation coefficient is 1.00000, in which case all of the data points lie exactly on the line. In all other cases where data points deviate from the line, the correlation coefficient is something less than 1.00000 but can be relatively close to it. In a log-log plot, small differences in the correlation coefficient reflect rather large deviations of time and distance from the line. The point at which line A crosses the vertical axis is the intercept, equal to log b in our straight line equation. The "fatigue factor", M, is called the slope of the line and is the change in log T per unit of log D. For example, point 1 on line A is defined by the coordinates of log T1 and log D1. Similarly, point 2 on line A is defined by the coordinates of log T2 and log D2. The slope of line A is then the difference between log T2 and log T1 divided by the difference between log D2 and log D1. If log T increases at the same rate as log D, then the slope is 1. If log T increases twice as fast as log D, then the slope is 2, and so on.

The higher the value for M (the greater the slope), the more time it takes to cover an additional distance relative to a lower value of M. Therefore, large slopes imply a greater fatigue with increasing distance. For our purpose it is only important to recognize the concepts of slope and intercept since these two values define the characteristics of any straight line. If we plug these values into the log-log equation, we can calculate the distance associated with any given time, and vice versa.

FIGURE 1.

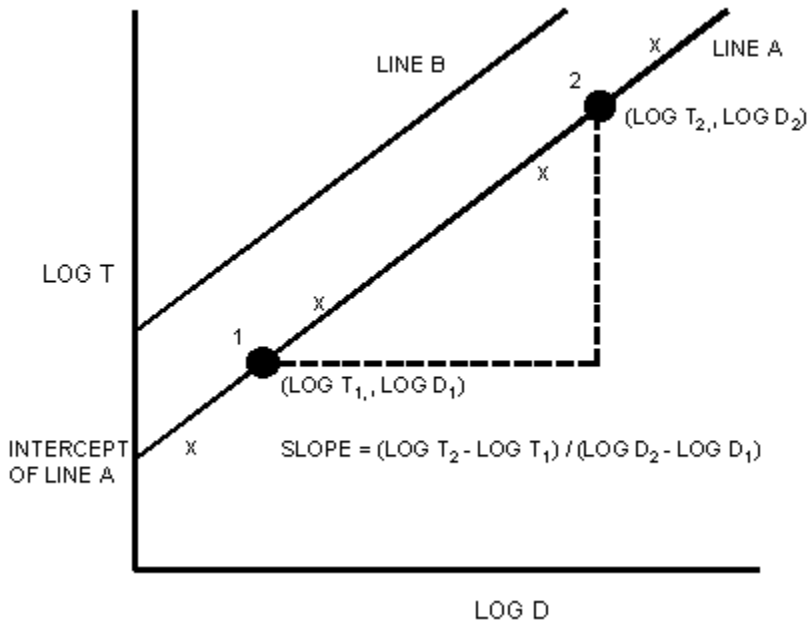


Figure 1 also contains a second line, B. The reader will note that line B is parallel to line A but has a higher intercept. The implication here is that, if lines A and B represent the time-distance equations derived from separate races for two runners, both have the same value for M (the same slope) or the same "fatigue factor". They differ only in terms of relative speed (different intercepts). The runner represented by line A is faster at all distances along the log D scale. The key to comprehension of the differences in the two lines lies in the fact that the further up the log T scale we go, the slower the time, while the further to the right we go on the log D scale, the longer the distance.

Whereas Mr. Riegel's interests lie in human racing, mine lies in horse racing, and we have applied his equation to American records on dirt and grass to see if the correlations hold. Tables 1 and 2 list the respective records and include the slopes, intercepts, and correlation coefficients for the lines produced by the data via regression analysis. The fit in both cases is outstanding, with correlation coefficients in excess of 0.9999. In fact, over the range from five furlongs to one and one-half miles, no American dirt record deviates by more than two-fifths of a

second, and no American turf record deviates by more then three-fifths of a second, from the times predicted by the lines. The applicability of the equation to horse racing is, therefore, confirmed.

TABLE 1. Best Straight Line Derived from American Dirt Records

DISTANCE	ACTUAL TIME	PROJECTED TIME
5f	:55.1	:54.4
6f	1:06.3	1:07.0
7f	1:19.2	1:19.3
8f	1:32.1	1:32.1
9f	1:45.0	1:44.4
10f	1:57.4	1:57.4
12f	2:24.0	2:24.0
Slope	1.1013	
Intercept	0.9697	
Correlation Coefficient	0.99993	

TABLE 2. Best Straight Line Derived from American Turf Records

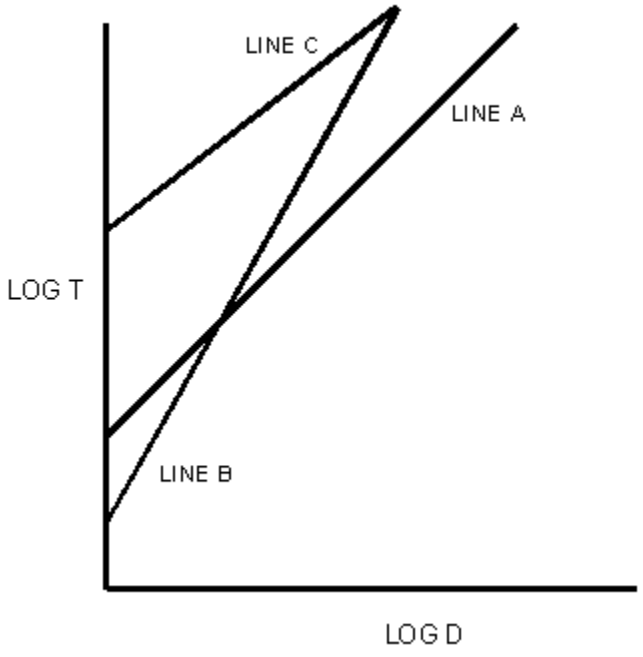
DISTANCE	ACTUAL TIME	PROJECTED TIME
5f	:54.4	:55.0
6f	1:07.0	1:07.0
7f	1:20.0	1:19.2
8f	1:31.4	1:31.4
9f	1:43.4	1:44.2
10f	1:57.2	1:57.1
12f	2:22.4	2:23.0
Slope	1.0917	
Intercept	0.9770	
Correlation Coefficient	0.99991	

What, you may ask, does any of this have to do with Secretariat's Preakness? Well, we have available, in one form or another, records of the time it has taken for individual horses to run various distances. Correlations may be derived from the information analogous to those from the American records just discussed. From the correlation we may predict what time it should take to cover a given distance based on demonstrated ability at other distances. Furthermore, fractional time, or pace, is another set of data points relating time to distance, but now in one race. Similar correlations here may also lead to some predictive capability. In the following discussion, we will attempt to show that on the basis of overall form and pace, Secretariat did actually set a new track and Preakness record, and in so doing, completed the greatest three-race feat in the history of American racing.

Before presenting arguments in support of the hypothesis, I would emphasize that the slope and intercept obtained from a set of time-distance data points are uniquely characteristic of a horse's performance. They are a model of his performance over a number of races through analysis of several races run at different distances or they define his performance in one race through an analysis of the pace. The method then becomes a powerful tool for comparison of time-distance relationships among different horses or for one horse in different races. A relative measure of speed, as well as an absolute indication of running style, is contained in the values of the slope and intercept.

In Figure 2 we have other examples which illustrate the point. Represented in this graph are three lines, A, B, and C, defined by the time-distance equations for three horses, A, B, and C. The slope of line B is greater than the slope for line A while the intercepts are the reverse. Thus, when comparing horse A to horse B we conclude that to the left of the crossover point of the two lines (at shorter distances), horse B is faster. To the right of the crossover point (at longer distances), horse A is faster. There may be some relationship here to competitive distance potential.

FIGURE 2.



Let us assume that horses B and C are racing against one another over a distance corresponding to the point where lines B and C intersect and that these lines signify the time-distance equations for their pace in the race. It is apparent that they finish in the same time. Furthermore, we can recognize from the different slopes of lines B and

C that horse B is a front-runner since he is faster at the intermediate distances while horse C comes from behind. These illustrations provide some idea of the possible utility of this kind of analysis as a mathematical model of performance.

Table 3 lists the times recorded for three Triple Crown winners - Seattle Slew, Affirmed, and Secretariat - in their best routes as three-year-olds through the Belmont Stakes but excluding the Preakness. We select their best times in winning races in order to ensure a consistency of effort along with optimum form. Since they each won the Preakness, that race would fall in the same category. In addition, we consider only routes so that the discontinuity in time observed by speed handicappers between sprints and routes does not become a complicating factor. For each horse, we solve the equation for the best straight line defined by the data, and from it project a time at the Preakness distance of nine and one-half furlongs.

TABLE 3. Final Time of Preakness Predicyed from Best Straight Line Determined by Best Three-year-old Form Through the Belmont Stakes

DISTANCE	SEATTLE SLEW	AFFIRMED	SECRETARIAT
8f			1:33.2 [6]
8 1/2f		1:42.3 [4]	
9f	1:47.2 [1]	1:48.0 [5]	
10f	2:02.1 [2]	2:01.1 [2]	1:59.2 [2]
12f	2:29.3 [3]	2:26.4 [3]	2:24.0 [3]
9 1/2f (predicted)	1:54.3	1:54.4	1:52.3
9 1/2f (actual)	1:54.2 [7]	1:54.2 [7]	1:54.2 or 1:53.2 [7]
Slope	1.1473	1.0480	1.0689
Intercept	0.9376	1.0354	1.0060
Correlation Coefficient	0.99965	0.99975	0.99981

1) Flamingo Stakes
2) Kentucky Derby
3) Belmont Stakes
4) San Felipe Stakes
5) Santa Anita Derby
6) Gotham Stakes
7) Preakness Stakes

The results show that the final predicted times for Seattle Slew and Affirmed fall within two-fifths of a second of their actual official times - a very good approximation. Secretariat, by contrast, shows a predicted final time one and four-fifths seconds under the official track time and four-fifths of a second under the Daily Racing Form time. None of Secretariat's final times in his other routes is more than three-fifths of a second off the time predicted from the line: 1:33.3 for eight furlongs, 1:58.4 for 10 furlongs, and 2:24.2 for 12 furlongs. A deviation of four-fifths of a second is reasonable for the hand timing of the Daily Racing Form clockers, but one and four-fifths seconds seems extremely unlikely. Subsequent incorporation of the 1:54.2 time into the data for Secretariat's

other routes affords a correlation coefficient of 0.99869, compared to the 1:53.2 time giving a line with a correlation coefficient of 0.99955, a much better fit.

Pace analysis of each of the classics won by the three most recent Triple Crown winners using the same methodology also supports the faster Preakness for Secretariat. Table 4 contains the recorded fractions of the three champions in each of the races, including the track and Daily Racing Form times in the 1973 edition of the Preakness. Comparison of correlation coefficients for the nine races reveals that the 1:54.2 Preakness for Secretariat provides the only value below 0.9999; in other words, the poorest fit of the data among all of these races. A 1:53.2 Preakness gives a correlation coefficient right in line with the others. More compelling than better fit, however, is the implied finishing power of Secretariat in his classics. The Preakness, at nine and one-half furlongs, is the only race of the three in which fractions are recorded for the last three-sixteenths of a mile (i.e., at one mile and at the wire). The slower Preakness time requires :18.4 seconds for the last three sixteenths of a mile while the Daily Racing Form time requires :17.4 seconds. Calculation of the running times for the last three-sixteenths of a mile in the Derby and the Belmont (using the best straight line equation for these races) indicates fractions of :17.2 and :18.3, respectively. If Secretariat, noted for his powerful stretch moves, had covered the distance in 1:54.2, he would have had to have registered a final fraction slower than that for the Belmont, a race which is five-sixteenths of a mile longer than the Preakness. The last fraction of :17.4 seconds associated with the Daily Racing Form time is certainly more consistent with Secretariat's other classic performances.

TABLE 4. Fractional Times and Best Straight Line Parameters for the Preakness Stakes
(SS = Seattle Slew; AFF = Affirmed; SEC = Secretariat)

	KENTUCKY DERBY			BELMONT STAKES			PREAKNESS STAKES			
DISTANCE	SS	AFF	SEC	SS	AFF	SEC	SS	AFF	SEC	SEC[2)]
4f	:45.4	:46.4	:49.2	:48.2	:50.0	:46.1	:45.3	:47.3	:48.1	:48.1
6f	1:10.0	1:11.3	1:13.0	1:14.0	1:14.0	1:09.4	1:10.0	1:11.4	1:11.2	1:11.2
8f	1:36.0	1:35.4	1:36.2	1:38.4	1:37.2	1:34.1	1:34.4	1:36.1	1:35.3	1:35.3
9 1/2f							1:54.2	1:54.2	1:54.2	1:53.2
10f	2:02.1	2:01.1	1:59.2	2:03.4	2:01.3	1:59.0				
12f				2:29.3	2:26.4	2:24.0				
Slope	1.0698	1.0362	0.9635	1.0242	0.9770	1.0356	1.0614	1.0142	0.9880	0.9903
Intercept	1.0169	1.0469	1.1163	1.0697	1.1092	1.0398	1.0195	1.0670	1.0803	1.0856
Correlation Coefficient	0.99999	0.99997	1.00000	0.99997	0.99992	0.99998	0.99998	1.00000	0.99987	0.99995
Final 3/16ths			:17.2[3)]			:18.3[3)]				:17.4[3)]

1) Official final time

2) DRF final time

3) Calculated from the equation for the best straight-line fit of the data

4) Actual time from the 3/16ths pole to the finish

A third analysis, also using pace, involves prediction of final time based on the best straight line determined by the early fractions. In this case we exclude the final time and project it from the line obtained by consideration of the early calls only - an application of the concept that "pace makes the race". The fractions are those presented in Table 4 and the results are listed in Table 5. Each of Secretariat's Triple Crown races is included. Also included, for direct comparison, are the Preakness results for Seattle Slew and Affirmed. In every example other than Secretariat's Preakness, the predicted time is no more than three-fifths of a second off the actual final time. The Daily Racing Form time for Secretariat is just two-fifths of a second from the predicted time, while the official track time deviates by one and two-fifths seconds. The latter result is inconsistent with the other data.

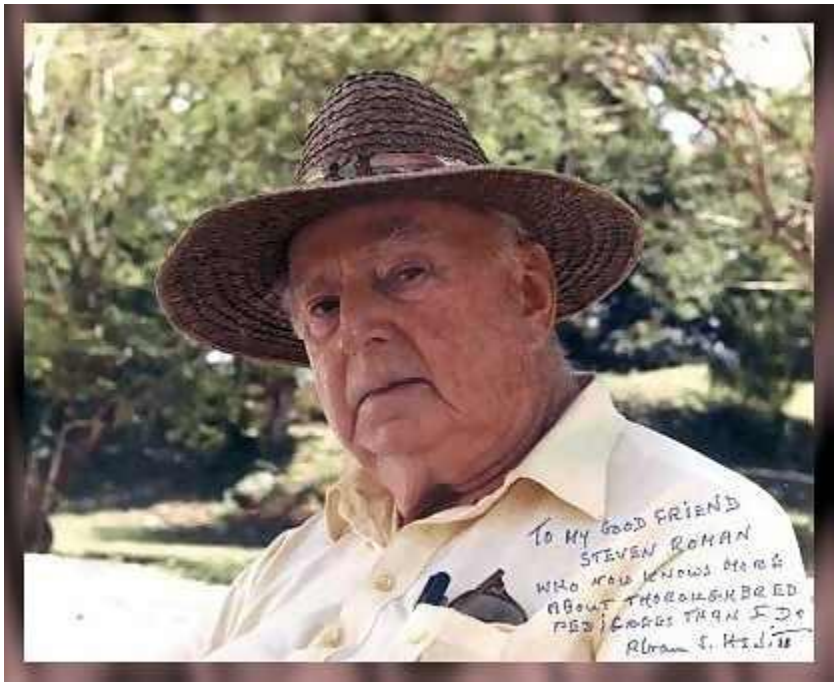
TABLE 5. Final Times of Classic Races Predicted from Best Straight Determined by Early Pace*

HORSE	RACE	PREDICTED FINAL TIME	ACTUAL FINAL TIME
Secretariat	Kentucky Derby	1:59.3	1:59.2
Secretariat	Belmont Stakes	2:23.2	2:24.0
Secretariat	Preakness Stakes	1:53.0	1:54.2 or 1:53.2
Seattle Slew	Preakness Stakes	1:53.4	1:54.2
Affirmed	Preakness Stakes	1:54.3	1:54.2

* Calculated from early fractions only, excluding final time.

These analyses don't necessarily prove that the track and stakes records were shattered in the 1973 Preakness. They do provide, however, convincing evidence that such a conclusion is correct. The possibility remains that Secretariat ran a bad race even while winning. The power of his stretch drive may have been an illusion. If so, then Sham, which finished second in a "game effort" according to the result chart and equaled the track record in the Derby while second in that one, must have fallen apart at the end as well. This hypothetical scenario is not a likely one. Secretariat maintained his two and one-half length advantage through the lane while Sham was drawing clear from the remainder of the field to finish eight lengths ahead of the third place finisher, Our Native. These were convincing, decisive performances. The evidence is strong that the Daily Racing Form clockers came closer to recording the real time of the race than did the Pimlico clocker. Many of us who witnessed the race will always believe that Secretariat swept the Triple Crown with three record-breaking efforts. The techniques outlined above support that belief.

Abram S. Hewitt



1902-1987

Abe Hewitt was my mentor and father figure. He was among the earliest and most avid supporters of my research into the relationship between pedigree and race track performance. Between 1982 and his death five years later, we spent many days together, first at his home in Midway, Kentucky and then at his home on a mountain top in Port Antonio, Jamaica. I learned more from him (and not only about Thoroughbreds) than from anyone else. He was a boundlessly creative and original thinker, a supreme wit and one of the most intelligent people I've known - a true "Renaissance man".

The photo above was taken on the beach in Port Antonio in 1985.

The following is the text of Abe Hewitt's obituary from The Blood-Horse, June 27, 1987, pp. 3901-3902. It is printed here with permission of the publisher (copyright 1987, The Blood-Horse, Inc). To me, it accurately portrays the character and style of an extraordinary man.

The child Abram S. Hewitt discovered some photographs of English race horses in a book one day, and thus was born a lifelong fascination for the Thoroughbred. This interest was not confined to any one element of the game, for Hewitt grew to be comfortable with everything from breeding theories and history to association with the

characters of the game. Hewitt, who died recently in his 80s at his home in Jamaica, was a huge man of impressive mien, a kind of John Houseman in country tweeds. When he drew himself up to his full height—serious countenance vying for precedence with a twinkling eye—and took hold of his lapels to launch into a story or a declaration, the moment seemed to em-body all that he was and had been.

Aristocratic grandson and namesake of a mayor of New York; Oxford man in the days of Evelyn Waugh; professor of law at Columbia and Johns Hopkins; member of the OSS (forerunner of the CIA) who tried to convince FDR the Russians would get too much the way the Normandy Invasion was designed; bon vivant and confidant of Prince Aly Khan; formidable international lawyer; master of Montana Hall farm in Virginia; breeder of a classic winner, Phalanx; astute dealer who bought Some Chance from Ben Jones for $7,000 and won over $90,000 with him and who decades later imported Sirlad; economist; proud and bemused father; raconteur; pedigree expert, and author. When Hewitt spoke of Atty Persse, George Lambton, or other mainstays of the British Turf of an earlier day, he did so from the memory of acquaintance, not merely history books. When he spoke of breeding theories, he did so from the perspective of having applied them, not merely thought of them, and until the end—long past the age when many men's minds have been set on all matters—he was ever ready to examine a new idea, a novel approach.

Hewitt first owned race horses in the 1920s. Then, beginning in 1937, he bred a dozen stakes winners in less than two decades before selling his bloodstock in 1950. The best was Pha-lanx, son of Pilate, a stallion Hewitt had acquired to stand at stud. Phalanx, raced in partnership with C. V. Whitney, won the Belmont Stakes and was champion 3-year-old in 1947. The others included Royal Governor, earner of $360,920; Cornwall, Prefect, Quiet Step, and The Pimpernel. In 1946, he sold at Saratoga for $35,000 the sale topper in the filly Grey Flight, which later was to foal nine stakes winners.

During the 1930s, Hewitt became a scholarly and sprightly contributor to the pages of The Blood-Horse, and on his many travels occasionally sent a dispatch to the Morning Telegraph. One such communique in 1948 brought American readers up to date on the Arab races in the Sudan, where he "was amused to read that in a race of four furlongs for maiden Arabs, the horse Azim was said to be 'speedy, but will probably not get the last furlong.

By 1973, Hewitt had not been promi-nent in racing for some years and had undergone various financial setbacks. That year, he reappeared in these pages as the author of Sire Lines, 86 ar-ticles on prominent names in pedigrees which was published as a book under the same name. His energy undaunted, he launched more or less immediately into another series, on breeders, which was completed and published in book form elsewhere.

Hewitt moved to Lexington during that period and served for some years as an advisor on pedigree matters for Nelson Bunker Hunt. Mr. and Mrs. He-witt imported the Bold Lad horse Sirlad, an Irish-bred which had been racing in Italy. Hewitt raced the horse, which was leased from Mrs. Hewitt, Catesby Clay, and Howard B. Noonan, and his trainer was Charlie Whittingham. In Hewitt's colors, Sirlad set a course record in winning the 1979 Sunset Handicap (gr. IT) at Hollywood Park and got to within a length of Affirmed the day he won the Hollywood Gold Cup (gr. I) and became racing's all-time leading earner. Hewitt was not an Englishman, but his life and style somehow befitted the image of the global Englishman as personified by Waugh, Noel Coward, Ian Fleming, and the like. Thus, it seemed fitting when the Hewitts moved to Jamaica—one more place on the earth to inhabit.

A few additional facts:

- *When Abe Hewitt graduated from Oxford in 1925, he did so with honors in philosophy, politics and economics*
- *As an attorney, he was appointed counsel in bankruptcy for the collapse of Kreuger and Toll, an international conglomerate involving 450 companies.*
- *During the Roosevelt administration he organized the Farm Credit Administration.During his time with the OSS in World War II, he negotiated with German bankers out of Sweden and England.Part of his professional career was spent as a technical advisor to banks and security houses.*
- *He described his wife, Dorothy, as "the bravest woman I've ever known". During World War II, she flew planes for the RAF from the factories in England to military bases.*
- *The reference in the obituary to Mr. Hewitt's book on breeders is "The Great Breeders and Their Methods", Thoroughbred Publishers, Inc., 1982, Lexington, Kentucky.*

The Myth of a Phalaris/Non-Phalaris "Mega-Nick"

(This is the text of an article originally written in 1995)

There has been considerable discussion in recent years about the so-called Phalaris/Non-Phalaris (P/NP) "mega-nick". The concept has troubled us from the outset because the evidence presented in support of the theory was static in nature, relying on data frozen in time. For example, when the theory was offered by Rommy Faversham in 1991, the question was asked, "Why is it, then, that the Phalaris line has never come to dominate broodmare sirelines?". The data showed that between 1964 and 1990, NP sires dominated the leading broodmare sire lists in terms of champion broodmare sire, AEI, and progeny earnings. We'd like to offer contradictory evidence suggesting that this is not really the case. Using North American graded stakes winners as the source, we note that for GSWs born prior to 1980, 35.4% represented the P broodmare sire line and 64.6% the NP broodmare sire line. However, for GSWs born between 1980 and 1987, the figures are 49.3% P and 50.7% NP. For GSWs born after 1987, they are 63.5% P and 36.5% NP. Clearly we are in a phase where P broodmare sires have expanded dramatically in the population of GSWs to the point where they far exceed the influence of the NP broodmare sires. And for all intents and purposes, GSWs are an indication of future breeding trends.

The original study also focused on the success of P/NP runners in the highest class races such as the Kentucky Derby, Belmont Stakes, Breeders' Cup Classic, and the Breeders' Cup turf races. There truly is a high percentage of P/NP horse that win these races. The question is whether this success symbolizes a true affinity of bloodlines or whether there are other factors at play. Two issues come to mind. First is distance, and second is the European influence. The Derby, Belmont, Breeders' Cup Classic, and Breeders' Cup Turf are run at 10-12f where stamina is a key ingredient. For the most part (and obviously there are exceptions), P sires represent speed in pedigrees (through sires like Raise a Native and Nasrullah) while NP sires represent endurance (through sires like Ribot and Princequillo). The blending of these aptitudes enhances the probability of a pedigree balanced in speed and stamina, historically a key component of classic race competitiveness. The Breeders' Cup Mile (as is the Breeders' Cup Turf) is populated with European horses. Our data show that the dams of European G1SWs since 1973 are only 33.1% P and 66.9% NP. Therefore, there is a higher probability of an NP dam among Breeders' Cup winners coming from Europe. Admittedly this is anecdotal evidence, but so is the evidence from the original study when it comes to these particular races because it suggests no cause and effect relationship. There could be many explanations apart from a "mega-nick" to explain the observations made. We have presented just a couple. we will later come back to the very large impact of NP mares on European racing and show that, despite this, there is no indication of P/NP supremacy even in an environment where NP mares are pervasive.

The original P/NP study also alluded to the success of P/NP sires relative to P/P sires. This allows us to introduce methodology to demonstrate the statistical basis for a nick. We will illustrate with hypothetical data. Let's say that among a population there are 80% P sires and 20% NP sires, as well as 60% P broodmare sires and 40% NP broodmare sires. That's essentially the raw distribution of bloodlines. If there is no advantage to any particular cross of bloodlines, the appearance of each cross should reflect the overall distribution. For the data cited, there should be 48% P/P; i.e., 60% (P broodmare sires) of 80% (P sires). Similarly, there should be 32% P/NP (40% of 80%), 12% NP/P (60% of 20%), and 8% NP/NP (40% of 20%). The total does indeed come out to 100% and is the predicted distribution of the particular crosses given the existing distribution of bloodlines in the population. Deviations from the prediction will suggest a true affinity or nick.

The real data, using North American GSWs, are as follows:

For **GSWs born before 1980** the distributions are 48.4% P sires, 51.6% NP sires, 35.4% P broodmare sires, and 64.6% NP broodmare sires. The distributions for the various crosses are shown as %ACTUAL and %PREDICTED, followed by the ratio of %ACTUAL to %PREDICTED.

BLOODLINE CROSS	%ACTUAL	%PREDICTED	RATIO
P/P	14.3	17.1	0.84
P/NP	34.1	31.3	1.09
NP/P	21.0	18.2	1.15
NP/NP	30.6	33.4	0.92

For **GSWs born between 1980 and 1987** the distributions are 67.9% P sires, 32.1% NP sires, 49.3% P broodmare sires, and 50.7% NP broodmare sires. The distributions for the various crosses are:

BLOODLINE CROSS	%ACTUAL	%PREDICTED	RATIO
P/P	32.0	33.5	0.96
P/NP	35.9	34.4	1.04
NP/P	17.3	15.8	1.09
NP/NP	14.8	16.3	0.91

For **GSWs born after 1987** the distributions are 79.8% P sires, 20.2% NP sires, 63.5% P broodmare sires, and 36.5% NP broodmare sires. The distributions for the various crosses are : P/P 50.1/50.7, 0.99; P/NP 29.7/29.1, 1.02; NP/P 13.4/12.8, 1.04; NP/NP 6.8/7.4, 0.92.

BLOODLINE CROSS	%ACTUAL	%PREDICTED	RATIO
P/P	50.1	50.7	0.99
P/NP	29.7	29.1	1.02
NP/P	13.4	12.8	1.04
NP/NP	6.8	7.4	0.92

The data tell us that before 1980 there was truly an advantage to P/NP and a disadvantage to P/P. We ascribe this to the speed on speed characteristics of the early P/P crosses, mainly through Nasrullah and Raise a Native. In succeeding time frames we see not only an explosive growth of P sires and P broodmare sires in the population of top class runners, but a dramatic narrowing of the gap in advantage for P/NP. At this point, there is little to support any difference at all unless one claims that ratios of 0.99 and 1.02 are measurable. Most important, however, is the trend. Shifts in bloodlines are dynamic, not static. The only way to get a handle on what's happening is over time. The trend is clearly in favor of P/P, probably because of the emergence of stamina-oriented P broodmare sires who bring balance into the P/P pedigrees. These include P broodmare sires such as Nijinsky II, Alydar, Roberto, and Buckpasser.

Our foreign racing data is only for **G1SWs in Europe since 1973**. Here, even though there are significantly more NP broodmare sires, the data show a true advantage for the P/P cross and, surprisingly, the NP/NP cross. The general distributions are 66.6% P sires, 33.4% NP sires, 33.1% P broodmare sires, and 66.9% NP broodmare sires. The distributions for the various crosses are (again, %ACTUAL/%PREDICTED and ratio of actual to predicted): P/P 23.6/22.1, 1.07; P/NP 43.0/44.5, 0.97; NP/P 9.5/11.1, 0.86; NP/NP 23.9/22.3, 1.07.

BLOODLINE CROSS	%ACTUAL	%PREDICTED	RATIO
P/P	23.6	22.1	1.07
P/NP	43.0	44.5	0.97
NP/P	9.5	11.1	0.86
NP/NP	23.9	22.3	1.07

North American sires of GSWs since 1973 follows.

The general distributions (i.e., of the sires themselves, not their graded stakes-winning progeny) are 65.4% P sires, 34.6% NP sires, 34.9% P broodmare sires, and 65.1% NP broodmare sires. The distributions for the various crosses suggest no real advantages, except perhaps for NP/P sires. A look at a more recent timeframe might be useful.

BLOODLINE CROSS	%ACTUAL	%PREDICTED	RATIO
P/P	22.1	22.8	0.97
P/NP	43.2	42.6	1.01
NP/P	12.8	12.1	1.06
NP/NP	21.9	22.5	0.97

Finally, we believe these studies provide good evidence that there is no statistical basis for the claim of a P/NP "mega-nick". If anything, the trends indicate a growing importance for P/P in North America. There already seems to be a P/P advantage in Europe. We can't really predict the future of bloodlines, but if the current scenario plays out, we wouldn't be surprised if someday we talk about Phalaris the way we now talk about Eclipse, and the hot topic of conversation will be the Nearco/Non-Nearco nick.

Rasmussen Factor (RF) Inbreeding in Stallions: The Effect on Their Racing and Breeding Career

The "Rasmussen Factor" (or RF) is a term used to describe inbreeding to superior female families through different individuals. As defined by the originators and developers of the idea, the late Daily Racing Form "Bloodlines" columnist Leon Rasmussen and his colleague, Rommy Faversham, the inbreeding must occur through the sire and the dam (i.e., be on both sides of the pedigree) and the duplication of the inbred female must be within five generations. Thus, inbreeding to full or half siblings within four generations would qualify, while inbreeding to the same son would not.

Rasmussen and Faversham claim an advantage for RF inbreeding based on a study of starters at the 1996 Del Mar and Oak Tree meets. They found 4.0% of the starters exhibited the RF in their pedigree while 6.0% of graded stakes winners in the 1990s did the same. Their conclusion was that RF inbreeding occurred 50% more often among the top class runners than it did in the general population. This would be equivalent to an Impact Value (IV) of 1.50.

In 2001, pedigree expert Roger Lyons questioned the significance of the Rasmussen/Faversham study by noting that inbreeding is not distributed evenly across the Thoroughbred population, with graded stakes winners having more fifth generation and beyond inbreeding of all types than less talented runners (http://www.werkhorse.com/Teamwerk2001.pdf). According to Lyons, this results from the fact that "ancestries that are swirled into the shallows of the breed have less in common with one another than ancestries that are swept along in the mainstream". In other words, higher-class runners descend from a narrower range of breeding stock than the population at large. His evidence comes from data on RF frequencies in yearling sales in 1998 and 1999. Lyons found that the percentage of RF yearlings at the Keeneland July, OBS August and Keeneland September sales exceeded the percentage of RF yearlings at the FTK July, Texas August, Louisiana August, Washington August and CTS August sales. He noted that the breeding of yearlings at the first three, higher quality sales was more typical of graded stakes winners than the breeding of the yearlings at the other sales, especially the California sale. It should not have been surprising then that Rasmussen and Faversham found the result they did. Unfortunately, they were comparing dissimilar populations that make their observed IV unreliable. At the same time, Lyons was also quick to point out that the superior performance of graded stakes winners is not necessarily related to their enhanced inbreeding.

Since the RF seems to be of general interest to the Thoroughbred community at large and breeders in particular, and because meaningful research on the RF is relatively limited, we have undertaken a study of our own that

examines the importance of the RF in the pedigree of stallions, both on their racing career and, to a lesser extent, their breeding career.

The population in question is all of the stallions found in the Register of Advertised Stallions in the The Blood-Horse Stallion Register for 2003. Although not a truly random population, it is certain that their inclusion is independent of any association with the RF. In all, there are 817 stallions included in the analysis. Of these, 49 display the RF pattern while 768 do not.

Furthermore, we will not compare separate and distinct populations as did Rasmussen and Faversham. Rather we will measure the distribution of effects within the single population of advertised stallions. In this manner, we hope to avoid any potential issues arising from the improper use of control groups.

For this exercise, racing class was divided into seven categories designating the highest level of racing success:

1 – Grade 1 winner
2 – Grade 2 winner
3 – Grade 3 winner
4 – Non-graded stakes winner
5 – Allowance winner
6 – Maiden winner
7 – Non-winner

A separate group comprised stallions that were unraced.

Table 1 summarizes the results for those stallions that did race and includes information on starts, earnings and racing ability.

Table 1. Racing Statistics for RF and Non-RF Stallions

	%RF	%NON-RF
NUMBER OF EXAMPLES	49	768
AVG NUMBER OF STARTS	20.1	20.0
AVERAGE EARNINGS	$901,377	$686,756
MEDIAN EARNINGS	$413,284	$413,719
AVERAGE EARNINGS/START	$49,928	$38,010
MEDIAN EARNINGS/START	$21,951	$21,592
AVERAGE RACING CLASS	2.7	2.8

The only apparent differences are in average earnings and average earnings per start, where it seems that RF stallions have a distinct advantage. However, the respective median figures are virtually identical. If we remove

the top two leading earners in each group, the averages shift dramatically to $620,554 for the RF stallions and $666,177 for the non-RF stallions. Clearly the averages are skewed by unusual earnings at the top end. The leading two in the RF category are Fantastic Light and Singspiel while those in the non-RF category are Skip Away and Silver Charm. The distortion in average earnings compared to median earnings may be attributed to the inflated purse structures of several key races in the US, Japan, Hong Kong and Dubai. Overall, however, the data indicate no difference in racing ability between the RF and non-RF stallions.

A more detailed examination of RF and racing class is presented in Table 2.

Table 2. RF Stallions by Racing Class

RACING CLASS	%RF
ALL	6.0
G1	6.0
G2	6.4
G3	6.8
SW	5.7
ALW	5.0
MDN	5.4
NON-WINNER	4.8
UNRACED	6.7

The variation in RF horses by racing class is minimal, although the 6.3% average for graded stakes winners is slightly larger than the 5.3% average for non-graded stakes winners. Nevertheless, a chi-square test involving the two populations (RF and non-RF) affords a P-value of 0.58, indicating that the groups are not different in a statistically significant sense. In addition, the increase in %RF from G1 to G2 to G3 winners is the opposite of what one expects from a RF effect favoring performance.

The last analysis of RF and racing performance for stallions involves the distribution of racing class within each group, as shown in Table 3.

Table 3. Distribution of Racing Class for RF and Non-RF Stallions

CATEGORY	%G1	%G2	%G3	%SW	%ALW	%MDN	%NON-WNR	%UNR
ALL	30.5	17.3	16.2	13.0	12.4	4.5	2.6	3.7
RF	30.6	18.4	18.4	12.2	10.2	4.1	2.0	4.1
NON-RF	30.5	17.2	16.0	13.0	12.5	4.6	2.6	3.6

Here again, the distributions are essentially indistinguishable and further suggest no effect on racing performance resulting from the presence or absence of the RF.

Finally, we will examine briefly the relationship between RF and stallion breeding performance. In this case, we isolate those stallions from within each subpopulation that have a Proficiency Index (PI) of 2.00 or more through 2001. PI is a measure of stallion performance including an earnings and a stakes production component. Fewer than 200 sires of North American runners normally qualify with a PI of at least 2.00. Table 4 summarizes the results.

Table 4. Leading Sires From Among RF and Non-RF Stallions

CATEGORY	%AMONG LEADING SIRES
ALL	8.3
RF	2.0
NON-RF	8.7

Among the 49 RF stallions, only one (2.0%), Quiet American, has a PI of 2.00 or more. This contrasts with 8.7% for the non-RF stallions. Although it may appear as if the RF in a sire's pedigree is detrimental to stud performance, we observe once more through the chi-square test that the difference is not statistically significant (P-value 0.12, which is greater than the P-value of 0.05 required for statistical significance).

Conclusion

This study confirms that the racing performance of stallions is unrelated to the appearance of a RF in their pedigree. Stud performance seems to be similarly unaffected. In general, the results support the arguments made earlier by Lyons and, more importantly, raise serious issues about the actual validity of the RF concept.

Thoughts on the Decline of the Modern Thoroughbred

The demise of the Thoroughbred is just around the corner. At least that's the claim of those who argue that owners, breeders and trainers are systematically destroying the very base upon which great racehorses are built. According to the critics, today's Thoroughbred has been selected mainly for speed at the expense of conformation, resulting in a more fragile animal less capable of withstanding the rigors of training and racing while, at the same time, less effective at classic distances. Presumably the owners, in the quest for quick returns on their investment, prefer speedy, precocious types likely to make an impact early and enhance their value in the shortest amount of time. The breeders, responding to the demands of their customers, the owners, gravitate towards breeding stock most likely to achieve those goals. The trainers, wishing to please their clients, push the horses beyond their physical limitations without establishing the proper foundation. Many critics suggest that a combination of short-term commercial interests, a failure to uphold the traditions of classic racing and inferior training methods is responsible for the perceived decline. On the other hand, there are those who refute the critics and claim that the Thoroughbred of today is as good or better than he ever was. They remind us that every generation has used the same arguments when comparing the "good old days" of racing to the present. To an extent they are correct. Many references to excessive speed in the Thoroughbred are a century or more old. Presumably, breakdowns have continually been a problem, and since the beginning of commerce, someone has always schemed to make a quick buck. Both sides have their points, but since there is no objective measure available, an assessment of the relative strengths and weaknesses of contemporary Thoroughbreds is a subjective exercise. Nevertheless, we can use the collective judgment of experts at least to appreciate how a few acknowledged authorities feel about the matter. And we can do it without biasing the answer because we don't have to ask them the direct question: "Is the Thoroughbred of today as good as the Thoroughbred of the past?" Rather, we do it by analyzing the results of a poll identifying the greatest racehorses of the 20th century. In late 1998, The Blood-Horse magazine asked seven well-known racing figures to judge the best Thoroughbreds of the 20th century based on their performances in North America. There were no nominees to choose from and no preconditions for selection. One hundred and ninety two horses received at least one vote, from which were identified the top 100. The seven experts included:

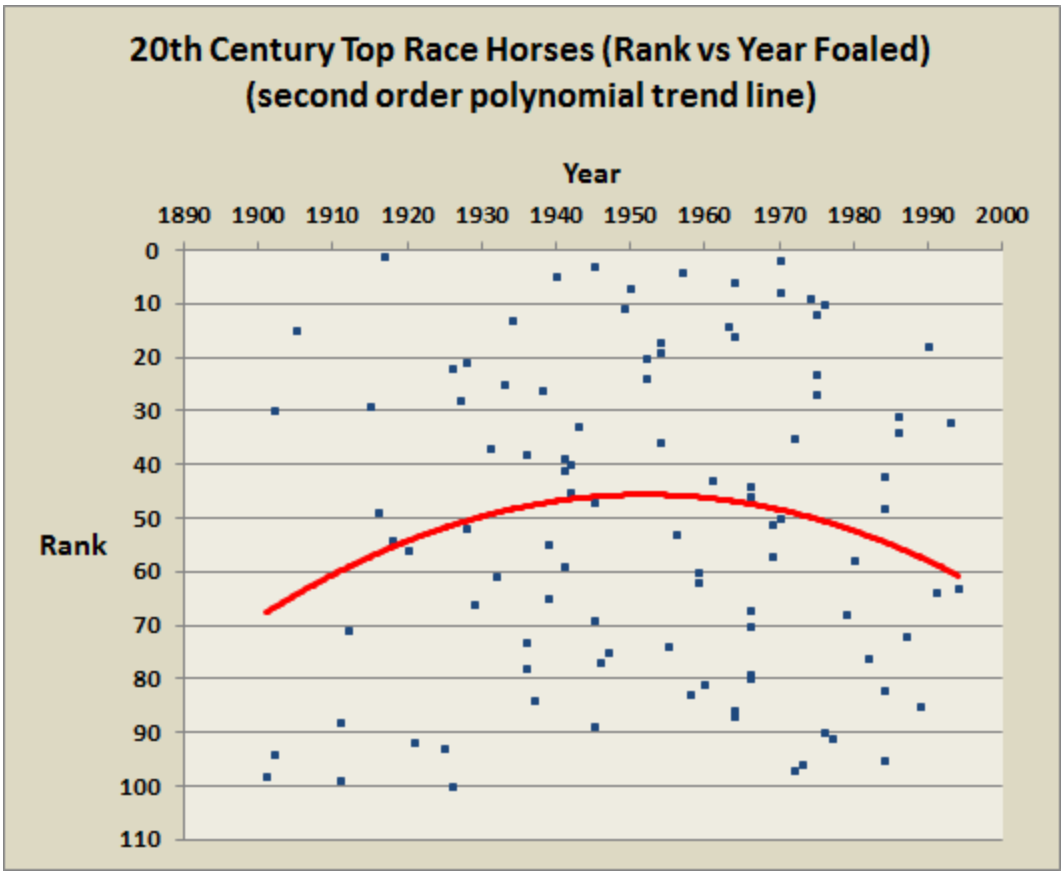
Howard Battle: Keeneland racing secretary
Lenny Hale: Vice president, Maryland Jockey Club
Jay Hovdey: Executive columnist with Daily Racing Form
Bill Nack: Senior writer, Sports Illustrated
Pete Pedersen: Senior steward in the state of California
Jennie Rees: Racing writer and columnist, the Louisville Courier-Journal
Tommy Trotter: Steward at Gulfstream Park (on leave)

The following table displays the results of the poll, listing the selected horses by rank, along with their year of birth, sex, sire, dam and owner.

RANK	HORSE	YEAR	SEX	SIRE	DAM	OWNER
1	MAN O' WAR	1917	C	FAIR PLAY	MAHUBAH	SAMUEL D. RIDDLE
2	SECRETARIAT	1970	C	BOLD RULER	SOMETHINGROYAL	MEADOW STABLE
3	CITATION	1945	C	BULL LEA	HYDROPLANE II	CALUMET FARM
4	KELSO	1957	G	YOUR HOST	MAID OF FLIGHT	BOHEMIA STABLE
5	COUNT FLEET	1940	C	REIGH COUNT	QUICKLY	MRS. JOHN D. HERTZ
6	DR. FAGER	1964	C	ROUGH N TUMBLE	ASPIDISTRA	TARTAN STABLE
7	NATIVE DANCER	1950	C	POLYNESIAN	GEISHA	ALFRED G. VANDERBILT
8	FOREGO	1970	G	FORLI	LADY GOLCONDA	LAZY F RANCH
9	SEATTLE SLEW	1974	C	BOLD REASONING	MY CHARMER	TAYHILL STABLE
10	SPECTACULAR BID	1976	C	BOLD BIDDER	SPECTACULAR	HAWKSWORTH FARM
11	TOM FOOL	1949	C	MENOW	GAGA	GREENTREE STABLE
12	AFFIRMED	1975	C	EXCLUSIVE NATIVE	WON'T TELL YOU	LOUIS WOLFSON
13	WAR ADMIRAL	1934	C	MAN O' WAR	BRUSHUP	GLEN RIDDLE FARM
14	BUCKPASSER	1963	C	TOM FOOL	BUSANDA	OGDEN PHIPPS
15	COLIN	1905	C	COMMANDO	PASTORELLA	JAMES R. KEENE
16	DAMASCUS	1964	C	SWORD DANCER	KERALA	MRS. THOMAS BANCROFT
17	ROUND TABLE	1954	C	PRINCEQUILLO	KNIGHT'S DAUGHTER	A.B. HANCOCK JR. AND TRAVIS M. KERR
18	CIGAR	1990	C	PALACE MUSIC	SOLAR SLEW	ALLEN E. PAULSON
19	BOLD RULER	1954	C	NASRULLAH	MISS DISCO	WHEATLEY STABLE
20	SWAPS	1952	C	KHALED	IRON REWARD	REX C. ELLSWORTH
21	EQUIPOISE	1928	C	PENNANT II	SWINGING	C.V. WHITNEY
22	PHAR LAP (NZ)	1926	G	NIGHT RAID	ENTREATY	DAVID J. DAVIS AND H.R. TELFORD
23	JOHN HENRY	1975	G	OLE BOB BOWERS	ONCE DOUBLE	DOTSAM STABLE
24	NASHUA	1952	C	NASRULLAH	SEGULA	BELAIR STUD AND LESLIE COMBS II SYNDICATE
25	SEABISCUIT	1933	C	HARD TACK	SWING ON	WHEATLEY STABLE AND CHARLES S. HOWARD
26	WHIRLAWAY	1938	C	BLENHEIM II	DUSTWHIRL	CALUMET FARM
27	ALYDAR	1975	C	RAISE A NATIVE	SWEET TOOTH	CALUMET FARM
28	GALLANT FOX	1927	C	SIR GALLAHAD III	MARGUERITE	BELAIR STUD
29	EXTERMINATOR	1915	G	MCGEE	FAIR EMPRESS	J. CAL MILAM AND WILLIS SHARPE KILMER
30	SYSONBY	1902	C	MELTON	OPTIME	JAMES R. KEENE
31	SUNDAY SILENCE	1986	C	HALO	WISHING WELL	DR. E. GAILLARD-A. HANCOCK AND C. WHITTINGHAM
32	SKIP AWAY	1993	C	SKIP TRIAL	INGOT WAY	CAROLYN HINE
33	ASSAULT	1943	C	BOLD VENTURE	IGUAL	ROBERT J. KLEBERG JR.
34	EASY GOER	1986	C	ALYDAR	RELAXING	OGDEN PHIPPS
35	RUFFIAN	1972	F	REVIEWER	SHENANIGANS	LOCUST HILL FARM
36	GALLANT MAN	1954	C	MIGOLI	MAJIDEH	RALPH LOWE
37	DISCOVERY	1931	C	DISPLAY	ARIADNE	ADOLPHE PONS AND ALFRED G. VANDERBILT
38	CHALLEDON	1936	C	CHALLENGER II	LAURA GAL	WILLIAM L. BRANN
39	ARMED	1941	G	BULL LEA	ARMFUL	CALUMET FARM
40	BUSHER	1942	F	WAR ADMIRAL	BABY LEAGUE	COL. E.R. BRADLEY AND L.B. MAYER
41	STYMIE	1941	C	EQUESTRIAN	STOP WATCH	KING RANCH AND ETHEL D. JACOBS
42	ALYSHEBA	1984	C	ALYDAR	BEL SHEBA	DOROTHY AND PAMELA SCHARBAUER
43	NORTHERN DANCER	1961	C	NEARCTIC	NATALMA	E.P. TAYLOR
44	ACK ACK	1966	C	BATTLE JOINED	FAST TURN	FORKED LIGHTENING RANCH
45	GALLORETTE	1942	F	CHALLENGER II	GALLETTE	WILLIAM L. BRANN
46	MAJESTIC PRINCE	1966	C	RAISE A NATIVE	GAY HOSTESS	FRANK M. MCMAHON
47	COALTOWN	1945	C	BULL LEA	EASY LASS	CALUMET FARM
48	PERSONAL ENSIGN	1984	F	PRIVATE ACCOUNT	GRECIAN BANNER	OGDEN PHIPPS
49	SIR BARTON	1916	C	STAR SHOOT	LADY STERLING	JOHN E. MADDEN AND CMDR. J.K.L. ROSS
50	DAHLIA	1970	F	VAGUELY NOBLE	CHARMING ALIBI	NELSON BUNKER HUNT
51	SUSAN'S GIRL	1969	F	QUADRANGLE	QUAZE	FRED W. HOOPER JR
52	TWENTY GRAND	1928	C	ST. GERMANS	BONUS	GREENTREE STABLE
53	SWORD DANCER	1956	C	SUNGLOW	HIGHLAND FLING	BROOKEMEADE STABLE
54	GREY LAG	1918	C	STAR SHOOT	MISS MINNIE	MAX HIRSCH AND HARRY F. SINCLAIR
55	DEVIL DIVER	1939	C	ST. GERMANS	DABCHICK	GREENTREE STABLE
56	ZEV	1920	C	THE FINN	MISS KEARNEY	RANCOCAS STABLE
57	RIVA RIDGE	1969	C	FIRST LANDING	IBERIA	MEADOW STABLE

RANK	HORSE	YEAR	SEX	SIRE	DAM	OWNER
58	SLEW O' GOLD	1980	C	SEATTLE SLEW	ALLUVIAL	EQUUSEQUITY STABLE
59	TWILIGHT TEAR	1941	F	BULL LEA	LADY LARK	CALUMET FARM
60	NATIVE DIVER	1959	G	IMBROS	FLEET DIVER	MR. AND MRS. L.K. SHAPIRO
61	OMAHA	1932	C	GALLANT FOX	FLAMBINO	BELAIR STUD
62	CICADA	1959	F	BRYAN G.	SATSUMA	CHRISTOPHER T. CHENERY
63	SILVER CHARM	1994	C	SILVER BUCK	BONNIE'S POKER	ROBERT AND BEVERLY LEWIS
64	HOLY BULL	1991	C	GREAT ABOVE	SHARON BROWN	WARREN A. CROLL JR.
65	ALSAB	1939	C	GOOD GOODS	WINDS CHANT	MRS. ALBERT SABATH
66	TOP FLIGHT	1929	F	DIS DONC	FLYATIT	C.V. WHITNEY
67	ARTS AND LETTERS	1966	C	RIBOT	ALL BEAUTIFUL	PAUL MELLON
68	ALL ALONG (FR)	1979	F	TARGOWICE	AGUJITA	DANIEL WILDENSTEIN
69	NOOR	1945	C	NASRULLAH	QUEEN OF BAGHDAD	CHARLES S. HOWARD (ESTATE)
70	SHUVEE	1966	F	NASHUA	LEVEE	MRS. WHITNEY STONE
71	REGRET	1912	F	BROOMSTICK	JERSEY LIGHTNING	HARRY PAYNE WHITNEY
72	GO FOR WAND	1987	F	DEPUTY MINISTER	OBEAH	CHRISTIANA STABLES
73	JOHNSTOWN	1936	C	JAMESTOWN	LA FRANCE	BELAIR STABLE
74	BALD EAGLE	1955	C	NASRULLAH	SIAMA	HARRY F. GUGGENHEIM
75	HILL PRINCE	1947	C	PRINCEQUILLO	HILDENE	CHRISTOPHER T. CHENERY
76	LADY'S SECRET	1982	F	SECRETARIAT	GREAT LADY M.	MR. AND MRS. EUGENE V. KLEIN
77	TWO LEA	1946	F	BULL LEA	TWO BOB	CALUMET FARM
78	EIGHT THIRTY	1936	C	PILATE	DINNER TIME	GEORGE D. WIDENER
79	GALLANT BLOOM	1966	F	GALLANT MAN	MULTIFLORA	ROBERT J. KLEBERG JR.
80	TA WEE	1966	F	INTENTIONALLY	ASPIDISTRA	TARTAN STABLE
81	AFFECTIONATELY	1960	F	SWAPS	SEARCHING	ETHEL D. JACOBS
82	MIESQUE	1984	F	NUREYEV	PASADOBLE	FLAXMAN HOLDINGS
83	CARRY BACK	1958	C	SAGGY	JOPPY	MRS. JACK PRICE
84	BIMELECH	1937	C	BLACK TONEY	LA TROIENNE	COL. E.R. BRADLEY
85	LURE	1989	C	DANZIG	ENDEAR	CLAIBORNE FARM AND NICOLE P. GORMAN
86	FORT MARCY	1964	G	AMERIGO	KEY BRIDGE	ROKEBY STABLE
87	GAMELY	1964	F	BOLD RULER	GAMBETTA	WILLIAM HAGGIN PERRY
88	OLD ROSEBUD	1911	G	UNCLE	IVORY BELLS	COL. HAMILTON-C. APPLEGATE AND FRANK D. WEIR
89	BEWITCH	1945	F	BULL LEA	POTHEEN	CALUMET FARM
90	DAVONA DALE	1976	F	BEST TURN	ROYAL ENTRANCE	CALUMET FARM
91	GENUINE RISK	1977	F	EXCLUSIVE NATIVE	VIRTUOUS	DIANA FIRESTONE
92	SARAZEN	1921	G	HIGH TIME	RUSH BOX	COL. PHIL T. CHINN AND FAIR STABLE
93	SUN BEAU	1925	C	SUN BRIAR	BEAUTIFUL LADY	W.S. KILMER
94	ARTFUL	1902	F	HAMBURG	MARTHA II	HARRY PAYNE WHITNEY
95	BAYAKOA (ARG)	1984	F	CONSULTANT'S BID	ARLUCEA	MR. AND MRS. FRANK WHITHAM
96	EXCELLER	1973	C	VAGUELY NOBLE	TOO BALD	BELAIR STUD AND NELSON BUNKER HUNT
97	FOOLISH PLEASURE	1972	C	WHAT A PLEASURE	FOOL-ME-NOT	JOHN L. GREER
98	BELDAME	1901	F	OCTAGON	BELLA DONNA	AUGUST BELMONT II (LESSEE)-NEWTON BENNINGTON
99	ROAMER	1911	G	KNIGHT ERRANT	ROSE TREE II	WOODFORD CLAY AND ANDREW MILLER
100	BLUE LARKSPUR	1926	C	BLACK SERVANT	BLOSSOM TIME	COL. E.R. BRADLEY

There may be some discussion about the relative ranking of a few horses, and there are probably a few others that could be named to replace some already on the list. Nevertheless, we will take this result at face value and use it to examine how the experts, although unknowingly at the time, revealed their attitudes about the changing quality of the Thoroughbred. Chart 1 uses the raw data in the table to plot the ranking of the horses against the year in which they were foaled. In the chart, the horizontal axis represents the year while the vertical axis represents the rank. The result shows, not unexpectedly, a great degree of scatter, with data points spread across the chart in what appears to be random fashion. However, if we apply trend line analysis to the data points, we may be able to observe patterns over time.



The trend line (red curve) shows a peak between about 1940 and 1960. This means that a larger number of higher ranked horses are clustered in that time frame. The downward trend since then reinforces the position of the critics in that the horses on the list selected since mid-century are, as a group, not as highly regarded as those that came immediately before them. The overall pattern seems to have been continual improvement through the first half of the 20th century followed by a gradual decline since then. This study is far from definitive because the rankings are not purely objective; humans have applied their best judgment. On the other hand, since there is no purely objective standard to use, the opinions of the seven experts are as a good as any and better than most. The result of their judgment is that changes have occurred and that the best of recent years are not quite up to the level of the best that preceded them.

Timeform All-Time Highweights

Each year, Timeform rates the quality of every horse that ran on the flat in Britain, plus many foreign-trained horses that raced outside of Britain. Recently, they have included horses that raced in North America. According to the publishers, Timeform Ratings are "simply the merit of the horse expressed in pounds and is arrived by careful examination of its running against other horses using a scale of weight for distance beaten which ranges from around 3 lb a length at five furlongs and 2 lb a length at a mile and a quarter to 1 lb at two miles". At the end of each racing year, the final weight assignments for all the horses in training are determined at weight-for-age. Therefore, equal ratings mean horses of equal merit. Additionally, adjustments are made to the general level of the handicap so that all the ratings are kept at the same standard level from year to year. Listed below, with pedigree and career highlights, are all of the runners ever weighted by Timeform at 135 pounds or more. The highest rating in Timeform history belongs to Frankel who displaced the great Sea-Bird in 2012. The charts at the end of the list show the relationship between the Timeform Ratings and the foaling year of the horses assigned weights of 135 pounds or more and, separately, 140 pounds of more. The trend lines indicate no bias over time. In fact, the assignment of horses at 140 pounds or more has slowed with time. Of the fourteen horses weighted at 140 pounds or more, ten were foaled prior to 1985. Only four were foaled since.

We thank Mr. Neil O'Connor of Timeform for supplying the names of the initial list of the horses and their ratings.

147: ***Frankel***, b.c., 2008 (Galileo-Kind, by Danehill); In England: 2010 Dubai Dewhurst S (7f), 2011 QIPCO 2000 Guineas (8f), 2011 St. James's Palace S (8f), 2011 QIPCO Sussex S (8f), 2011 Queen Elizabeth II S (8f), 2012 Lockinge S (8f), 2012 Queen Anne S (8f), 2012 QIPCO Sussex S (8f), 2012 Juddmonte International S (10½f), 2012 QIPCO Champion S (10f)

145: ***Sea-Bird***, ch.c., 1962 (Dan Cupid-Sicalade, by Sicambre); In France: 1965 Prix Lupin (10½f), 1965 Grand Prix de Saint-Cloud (12½f), 1965 Prix de l'Arc de Triomphe (12f); In England: 1965 The Derby (12f)

144: ***Brigadier Gerard***, b.c., 1968 (Queen's Hussar-La Paiva, by Prince Chevalier); In England: 1970 Middle Park S (6f), 1971 The 2000 Guineas (8f), 1971 Sussex S (8f), 1971 Champion S (10f), 1972 Eclipse S (10f), 1972 King George VI & Queen Elizabeth S (12f), 1972 Champion S (10f)

144: ***Tudor Minstrel***, br.c., 1944 (Owen Tudor-Sansonnet, by Sansovino); In England: 1947 The 2000 Guineas (8f), 1947 St. James's Palace S (8f)

142: ***Abernant***, gr.c., 1946 (Owen Tudor-Rustom Mahal, by Rustom Pasha); In England: 1948 Middle Park S (6f)

142: ***Ribot***, b.c., 1952 (Tenerani-Romanella, by El Greco); In Italy: 1954 Gran Criterium (7½f), 1955 Gran Premio del Jockey Club (12f), 1956 Gran Premio di Milano (15f); In France: 1955 Prix de l'Arc de Triomphe (12f), 1956 Prix de l'Arc de Triomphe (12f); In England: 1956 King George VI & Queen Elizabeth S (12f)

142: ***Windy City***, ch.c., 1949 (Wyndham-Staunton, by The Satrap); In England: 1951 Gimcrack S (6f), 1951 Phoenix Plate (5f)

141: ***Mill Reef***, b.c., 1968 (Never Bend-Milan Mill, by Princequillo); In England: 1970 Dewhurst S (7f), 1971 The Derby (12f), 1971 Eclipse S (10f), 1971 King George VI & Queen Elizabeth S (12f), 1972 Coronation Cup (12f); In France: 1971 Prix de l'Arc de Triomphe (12f), 1972 Prix Ganay (10½f)

140: ***Dancing Brave***, b.c., 1983 (Lyphard-Navajo Princess, by Drone); In England: 1986 Eclipse S (10f), 1986 King George VI & Queen Elizabeth S (12f), 1986 The 2000 Guineas (8f); In France: 1986 Prix de l'Arc de Triomphe (12f)

140: ***Dubai Millennium***, b.c., 1996 (Seeking the Gold-Colorado Dancer, by Shareef Dancer); In England: 1999 Queen Elizabeth II S (8f), 2000 Prince of Wales's S (10f); In France: 1999 Prix du Haras de Fresnay-Le-Buffard Jacques Le Marois (8f); In United Arab Emirates: 2000 Dubai World Cup (10f)

140: ***Harbinger***, b.c., 2006 (Dansili-Penang Pearl, by Bering); In England: 2010 King George VI & Queen Elizabeth S (12f)

140: ***Sea The Stars***, b.c., 2006 (Cape Cross-Urban Sea, by Miswaki); In England: 2009 The 2000 Guineas S (8f), 2009 Investec Derby (12f), 2009 Coral-Eclipse (10f), 2009 Juddmonte International S (10f); In Ireland: 2009 Tattersalls Millions Irish Champion S (10f); In France: 2009 Qatar Prix de l'Arc de Triomphe

140: ***Shergar***, b.c., 1978 (Great Nephew-Sharmeen, by Val de Loir); In England: 1981 The Derby (12f), 1981 King George VI & Queen Elizabeth Diamond S (12f); In Ireland: 1981 Irish Sweeps Derby (12f)

140: ***Vaguely Noble***, ch.c., 1965 (Vienna-Noble Lassie, by Nearco); In England: 1967 Observor Gold Cup (8f); In France: 1968 Prix de l'Arc de Triomphe (12f)

139: ***Generous***, ch.c., 1988 (Caerleon-Doff the Derby, by Master Derby); In England: 1990 Three Chimneys Dewhurst S (8f), 1991 The Derby (12f), 1991 King George VI & Queen Elizabeth S (12f); In Ireland: 1991 Budweiser Irish Derby (12f)

139: ***Pappa Fourway***, b/br.c., 1952 (Pappageno-Oola Hills, by Denturius); In England: 1955 King's Stand S (5f)

139: ***Reference Point***, b.c., 1984 (Mill Reef-Home On The Range, by Habitat); In England: 1986 William Hill Futurity S (8f), 1987 The Derby (12f), 1987 King George VI & Queen Elizabeth Diamond S (12f), 1987 The St. Leger (14f)

138: ***Alleged***, b.c., 1974 (Hoist the Flag-Princess Pout, by Prince John); In France: 1977 Prix de l'Arc de Triomphe (12f), 1978 Prix de l'Arc de Triomphe (12f)

138: ***Alycidon,*** ch.c., 1945 (Donatello II-Aurora, by Hyperion); In England: 1949 Ascot Gold Cup (20f)

138: ***American Pharoah***, b.c., 2012 (Pioneerof the Nile-Littleprincessemma, by Yankee Gentleman); In North America: 2014 Del Mar Futurity (7f), 2014 FrontRunner S (8½f), 2015 Arkansas Derby (9f), 2015 Kentucky Derby (10f), Preakness S (9½f), Belmont S (12f), Haskell Invitational S (9f), Breeders' Cup Classic (10f)

138: ***Celtic Swing***, br.c., 1992 (Damister-Celtic Ring, by Welsh Pageant); In England: 1994 Racing Post Trophy S (8f); In France: 1995 Les Emirates Arabes Unis Prix du Jockey Club (12f)

138: ***Cigar***, b.c., 1990 (Palace Music-Solar Slew, by Seattle Slew); In North America: 1994 NYRA Mile H (8f), 1995 Donn H (9f), 1995 Gulfstream Park H (10f), 1995 Oaklawn H (9f), 1995 Pimlico Special H (9½f), 1995 Hollywood Gold Cup H (10f), 1995 The Woodward (9f), 1995 Jockey Club Gold Cup (10f), 1995 Breeders' Cup Classic (10f), 1996 Donn H (9f), 1996 The Woodward (10f); In Dubai: 1996 Dubai World Cup S (10f)

138: ***Daylami***, gr.c., 1994 (Doyoun-Daltawa, by Miswaki); In France: 1997 Dubai Poule d'Essai des Poulains (8f); In England: 1998 Coral-Eclipse S (10f), 1999 Vodafone Coronation Cup (12f), 1999 King George VI & Queen Elizabeth Diamond S (12f), 1999 ESAT Digifone Champion S (10f); In North America: 1999 Breeders' Cup Turf S (12f)

138: ***Exbury***, ch.c., 1959 (Le Haar-Greensward, by Mossborough); In England: 1963 Coronation Cup (12f); In France: 1963 Prix Ganay (10f), 1963 Grand Prix de Saint-Cloud (12½f), 1963 Prix de l'Arc de Triomphe (12f)

138: ***Nijinsky II***, b.c., 1967 (Northern Dancer-Flaming Page, by Bull Page); In England: 1969 Dewhurst S (7f), 1970 The 2000 Guineas (8f), 1970 The Derby (12f), 1970 King George VI & Queen Elizabeth S (12f), 1970 The St. Leger (14½f); In Ireland: 1970 Irish Sweeps Derby (12f)

138: ***Star of India***, ch.f., 1953 (Court Martial-Eastern Grandeur, by Gold Bridge); In England: 1955 Moulton S (5f), 1955 Newmarket Foal S (5f), 1955 Prendergast S (5f), 1955 Prince of Wales's S (5f)

137: ***Apalachee,*** **b.c.,** 1971 (Round Table-Moccasin, by Nantallah); In England: 1973 Observor Gold Cup (8f)

137: ***Dayjur***, dkb/br.c., 1987 (Danzig-Gold Beauty, by Mr. Prospector); In England: 1990 Keeneland Nunthorpe S (5f), 1990 Ladbroke Sprint Cup (6f); In France: Ciga Prix de l'Abbaye de Longchamp (5f)

137: ***Ghostzapper***, b.c., 2000 (Awesome Again-Baby Zip, by Relaunch); In North America: 2003 Vosburgh S (6½f), 2004 Breeders' Cup Classic (10f), 2004 Woodward S (9f), 2005 Metropolitan H (8f)

137: ***Grundy***, ch.c., 1972 (Great Nephew-Word From Lundy, by Worden); In England: 1974 Dewhurst S (7f), 1975 The Derby (12f), 1975 King George VI & Queen Elizabeth S (12f); In Ireland: 1975 The 2000 Guineas (8f), 1975 Irish Sweeps Derby (12f)

137: ***Mark of Esteem***, b.c., 1993 (Darshaan-Homage, by Ajdal); In England: 1996 Pertemps 2000 Guineas (8f), 1996 Queen Elizabeth II S (8f)

137: ***Molvedo,*** **br.c.,** 1958 (Ribot-Maggiolina, by Nakamuro); In Italy: 1960 Gran Criterium (7½f), 1961 Gran Premio del Jockey Club (12f); In France: 1961 Prix de l'Arc de Triomphe (12f)

137: ***Montjeu***, b.c., 1996 (Sadler's Wells-Floripedes, by Top Ville); In France: 1999 Prix du Jockey Club (12f), 1999 Prix de l'Arc de Triomphe (12f), 2000 Grand Prix de Saint-Cloud (12f); In Ireland: 1999 Budweiser Irish Derby (12f), 2000 Tattersalls Gold Cup (10½f); In England: 2000 King George VI and Queen Elizabeth Diamond S (12f)

137: ***Moorestyle***, b.c., 1977 (Manacle-Guiding Star, by Reliance); In England: 1980 July Cup (6f); In France: 1980 Prix de l'Abbaye de Longchamp (5f), 1980 Prix de la Foret (7f), 1981 Prix de la Foret (7f)

137: ***Never Say Die***, ch.c., 1951 (Nasrullah-Singing Grass, by War Admiral); In England: 1954 The Derby (12f), 1954 The St. Leger (14½f)

137: ***Peintre Celebre***, ch.c., 1994 (Nureyev-Peinture Bleue, by Alydar); In France: 1997 Prix de l'Arc de Triomphe (12f), 1997 Prix du Jockey-Club (12f), 1997 Grand Prix de Paris (10f)

137: ***Pinza,*** b.c., 1950 (Chanteur-Pasqua, by Donatello II); In England: 1953 The Derby (12f), 1953 King George VI & Queen Elizabeth S (12f)

137: ***Princely Gift,*** b.c., 1951 (Nasrullah-Blue Gem, by Blue Peter); In England: 1955 Hungerford S (7f)

137: ***Ragusa***, b.c., 1960 (Ribot-Fantan, by Ambiorix); In England: 1963 King George VI & Queen Elizabeth S (12f), 1963 The St. Leger (14½f), 1964 Eclipse S (10f); In Ireland: 1963 Irish Sweeps Derby (12f)

137: ***Reliance***, b.c., 1962 (Tantieme-Relance, by Relic); In France: 1965 Prix du Jockey-Club (12f), 1965 Grand Prix de Paris (15½f), 1965 Prix Royal-Oak (15½f)

137: ***Rheingold***, b.c., 1969 (Faberge-Athene, by Supreme Court); In France: 1972 Grand Prix de Saint-Cloud (12½f), 1973 Prix Ganay (10½f), 1973 Grand Prix de Saint-Cloud (12½f), 1973 Prix de l'Arc de Triomphe (12f)

137: ***Right Boy***, gr.c., 1954 (Impeccable-Happy Ogan, by Ballyogan); In England: 1957 King's Stand S (5f)

137: ***Troy***, b.c., 1976 (Petingo-La Milo, by Hornbeam); In England: 1979 The Derby (12f), 1979 King George VI & Queen Elizabeth S (12f), 1979 Benson & Hedges Gold Cup (10½f); In Ireland: 1979 Irish Sweeps Derby (12f)

137: ***Zilzal,*** ch.c., 1986 (Nureyev-French Charmer, by Le Fabuleux); In England: 1989 Queen Elizabeth II S (8f), 1989 Sussex S (8f)

136: ***Alcide***, b.c., 1955 (Alycidon-Chenille, by King Salmon); In England: 1958 The St. Leger (14½f), 1959 King George VI & Queen Elizabeth S (12f)

136: ***Allez France***, b.f., 1970 (Sea-Bird- Priceless Gem, by Hail to Reason); In France: 1972 Criterium des Pouliches (8f), 1973 Poule d'Essai des Pouliches (8f), 1973 Prix de Diane (10½f), 1973 Prix Vermeille (12f), 1974 Prix Ganay (10½f), 1974 Prix d'Ispahan (9¼f), 1974 Prix de l'Arc de Triomphe (12f), 1975 Prix Ganay (10½f)

136: ***Ballymoss,*** ch.c., 1954 (Mossborough-Indian Call, by Singapore); In Ireland: 1957 The Irish Derby (12f): In England: 1957 The St. Leger (14½f), 1958 Coronation Cup (12f), 1958 Eclipse S (10f), 1958 King George & Queen Elizabeth S (12f); In France: 1958 Prix de 'l'Arc de Triomphe (12f)

136: ***Bering***, ch.c., 1983 (Arctic Tern-Beaune, by Lyphard); In France: 1986 Prix du Jockey-Club (12f)

136: ***Black Caviar***, br.f., 2006 (Bel Esprit-Helsinge, by Desert Sun); In Australia: 2010 Patinack Farm Classic (6f), 2011 Lightning S (5f), 2011 William Reid S (6f), 2011 T. J. Smith S (6f), 2011 BTC Cup (6f), 2011 Patinack Farm Classic (6f), 2011 William Reid S (6f), 2012 Goodwood S (6f), 2012 Sportingbet Classic (6f), 2012 C. F. Orr S (7f), 2012 Lightning S (5f), 2013 Black Caviar Lightning S (5f), 2013 William Reid S (6f); In England: 2012 Diamond Jubilee S (6f)

136: ***Black Tarquin***, br.c., 1945 (Rhodes Scholar-Vagrancy, by Sir Gallahad); In England: 1948 The St. Leger (14½f)

136: ***Bustino***, b.c., 1971 (Busted-Ship Yard, by Doutelle); In England: 1974 The St. Leger (14½f), 1975 Coronation Cup (12f)

136: ***Crepello,*** ch.c., 1954 (Donatello II-Crepuscule, by Mieuxce); In England: 1957 The 2000 Guineas (8f), 1957 The Derby (12f)

136: ***El Condor Pasa***, b.c., 1995 (Kingmambo-Saddlers Gal, by Sadler's Wells); In Japan: 1998 Japan Cup (12f); In France: 1999 Grand Prix de Saint-Cloud (12f)

136: ***El Gran Senor,*** b.c., 1981 (Northern Dancer-Sex Appeal, by Buckpasser); In England: 1983 Dewhurst S (8f), 1984 The 2000 Guineas (8f); In Ireland: 1984 Irish Sweeps Derby (12f)

136: ***Floribunda***, b.c., 1958 (Princely Gift-Astrentia, by Denturius)

136: ***Gentlemen***, ch.c., 1992 (Robin des Bois-Elegant Glance, by Loose Canon); In Argentina: 1995 Polla de Potrillos (8f), Gran Premio Nacional (12.4f), Dos Mil Guineas (8f); In North America: 1997 Pacific Classic S (10f), Hollywood Gold Cup S (10f), Pimlico Special Handicap (9½f)

136: ***Habibti***, br.f., 1980 (Habitat-Klairessa, by Klairon); In England: 1983 July Cup (6f), 1984 King's Stand S (5f); In France: 1983 Prix de l'Abbaye de Longchamp (5f)

136: ***Hafiz,*** ch.c., 1952 (Nearco-Double Rose, by Macaron); In England: 1955 Champion S (10f)

136: ***Hawk Wing***, b.c., 1999 (Woodman-La Lorgnette, by Val de l'Orne); In England: 2002 Coral Eorobet Eclipse S (10f), 2003 Juddmonte Lockinge S (8f); In Ireland: 2001 Aga Khan Studs National S (7f)

136: ***Helissio***, b.c., 1993 (Fairy King-Helice, by Slewpy); In France: 1996 Prix de l'Arc de Triomphe (12f), 1996 Prix Lupin (10½f), 1996 Grand Prix de Saint-Cloud (12f), 1997 Grand Prix de Saint-Cloud (12f), 1997 Prix Ganay (10½f)

136: ***Herbager***, b.c., 1956 (Vandale-Flagette, by Escamillo); In France: 1959 Prix du Jockey-Club (12f), 1959 Grand Prix de Saint-Cloud (12½f)

136: ***My Babu***, b.c., 1945 (Djebel-Perfume, by Badruddin); In England: 1948 The 2000 Guineas (8f)

136: ***Northjet,*** ch.c., 1977 (Northfields-Jellatina, by Fortino II); In France: 1981 Prix du Moulin de Longchamp (8f), 1981 Prix Jacques le Marois (8f)

136: ***Old Vic***, b.c., 1986 (Sadler's Wells-Cockade, by Derring-Do); In France: 1989 Prix du Jockey-Club (12f); In Ireland: 1989 Budweiser Irish Derby (12f)

136: ***Relko***, b.c., 1960 (Tanerko-Relance, by Relic); In France: 1963 Poule d'Essai des Pouliches (8f), 1963 Prix Royal-Oak (15f), 1964 Prix Ganay (10f), 1964 Grand Prix de Saint-Cloud (12½f); In England: 1963 The Derby (12f), 1964 Coronation Cup (12f)

136: ***Slip Anchor***, b.c., 1982 (Shirley Heights-Sayonara, by Birkhan); In England: 1985 The Derby (12f)

136: ***Suave Dancer***, b.c., 1988 (Green Dancer-Suavite, by Alleged); In France: 1991 CIGA Prix de l'Arc de Triomphe (12f), 1991 Prix du Jockey-Club Lancia (12f); In Ireland: 1991 Meadow Meats Irish Champion S (10f)

136: ***Sakhee***, b.c., 1997 (Bahri-Thawakib, by Sadler's Wells); In France: 2001 Prix de l'Arc de Triomphe Lucien Barriere (12f); In England: 2001 Juddmonte International S (10½f)

136: ***Tantieme,*** b.c., 1947 (Deux Pour Cent-Terka, by Indus); In France: 1949 Grand Criterium (8f), 1950 Poule d'Essai des Poulains (8f), 1950 Prix Lupin (10½f), 1950 Prix de l'Arc de Triomphe (12f), 1951 Prix Ganay (10f), 1951 Prix de l'Arc de Triomphe (12f); In England: 1951 Coronation Cup (12f)

136: ***Texana***, ch.f., 1955 (Relic-Tosca, by Tourbillon); In France: 1957 Prix l'Abbaye de Longchamp (5f)

136: ***Thatch***, b.c., 1970 (Forli-Thong, by Nantallah); In England: 1973 Sussex S (8f)

136: ***Warning***, b.c., 1985 (Known Fact-Slightly Dangerous, by Roberto); In England: 1988 Queen Elizabeth II S (8f), 1988 Swettenham Stud Sussex S (8f)

135: ***All Along***, b.f., 1979 (Targowice-Agujita,by Vieux Manoir); In France: 1982 Prix Vermeille (12f), 1983 Prix de l'Arc de Triomphe (12f); In North America: 1983 Rothmans International S (13f), 1983 Turf Classic S (12f), 1983 Washington D. C. International H (12f)

135: ***Arazi***, ch.c., 1989 (Blushing Groom-Danseur Fabuleux, by Northern Dancer); In France: 1991 CIGA Grand Criterium (8f), 1991 Prix Morny Agence Francaise (6f), 1991 Prix de la Salamandre (7f); In North America: 1991 Breeders' Cup Juvenile (8½f)

135: ***Arbar***, b.c., 1944 (Djebel-Astronomie, by Asterus); In England: 1948 Ascot Gold Cup (20f)

135: ***Arctic Prince***, br.c., 1948 (Prince Chevalier-Arctic Sun, by Nearco); In England: 1951 The Derby (12f)

135: ***Chanteur***, b.c., 1942 (Chateau Bouscaut-La Diva, by Blue Skies); In England: 1947 Coronation Cup (12f)

135: ***Charlottesville***, b.c., 1957 (Prince Chevalier-Noorani, by Nearco); In France: 1960 Prix Lupin (10½f)

135: ***Cirrus Des Aigles,*** b.g., 2006 (Even Top-Taille de Guepe, by Septieme Ciel); In England: 2011 QIPCO Champion S (10f), 2014 Coronation Cup (12f); In France: 2012 Prix Ganay (10½f), 2014 Prix Ganay (10½f), 2014 Prix d'Ispahan (9½f), 2015 Prix Ganay (10½f); In Dubai: 2012 Dubai Sheema Classic (12f)

135: ***Coronation***, b.f., 1946 (Djebel-Esmeralda, by Tourbillon); In France: 1948 Prix Robert Papin (5½f), 1949 Prix de l'Arc de Triomphe (12f), 1949 Poule d'Essai des Pouliche (8f); In England: 1948 Queen Mary S (5f)

135: ***Dahlia,*** **ch.f.,** 1970 (Vaguely Noble-Charming Alibi, by Honeys Alibi); In France: 1973 Prix Saint-Alary (10f), 1974 Grand Prix de Saint-Cloud (12½f); In Ireland: 1973 Irish Guinness Oaks (12f); In England: 1973 King George VI & Queen Elizabeth S (12f), 1974 King George VI & Queen Elizabeth S (12f), 1974 Benson & Hedges Gold Cup (10½f), 1975 Benson & Hedges Gold Cup (10½f); In North America: 1973 Washington D. C. International H (12f), 1974 Man o' War S (12f), 1976 Hollywood Invitational H (12f); In Canada: 1974 Canadian International Championship S (13f)

135: ***Intikhab,*** b.c., 1994 (Red Ransom-Crafty Example, by Crafty Prospector); In England: 1998 Vodafone Diomed S (8f), 1998 Queen Anne S (8f)

135: ***Known Fact***, dkb/br.c., 1977 (In Reality-Tamerett, by Tentam); In England : 1979 Middle Park S (6f), 1980 The 2000 Guineas (8f)

135: *Kris*, ch.c., 1976 (Sharpen Up-Doubly Sure, by Reliance); In England: 1979 Sussex S (8f)

135: *La Tendresse*, b.f., 1959 (Grey Sovereign-Isetta, by Morland); In England: 1961 Lowther S (5f), 1961 Molecomb S (5f), 1961 Seaton Delaval S (5f)

135: *Le Moss*, ch.c., 1975 (Le Levanstell-Feemoss, by Ballymoss); In England: 1979 Ascot Gold Cup (20f), 1980 Ascot Gold Cup (20f)

135: *Manduro*, b.c., 2002 (Monsun-Mandellicht, by Be My Guest); In France: 2007 Prix d'Ispahan (9¼f), 2007 Prix Jacques Le Marois (8f); In England: 2007 Prince of Wales's S (10f)

135: *Match*, br.c., 1958 (Tantieme-Relance, by Relic); In France: 1961 Prix Royal-Oak (15f), 1962 Grand Prix de Saint-Cloud (12½f); In England: 1962 King George VI & Queen Elizabeth S (12f); In North America: 1962 Washington D. C. International S (12f)

135: *Nashwan*, ch.c., 1986 (Blushing Groom-Height of Fashion, by Bustino); In England: 1989 The Derby (12f), 1989 Eclipse S (10f), 1989 King George VI & Queen Elizabeth S (12f), 1989 The 2000 Guineas (8f)

135: *Never So Bold*, b.c., 1980 (Bold Lad-Never Never Land, by Habitat); In England: 1985 July Cup (6f), 1985 King's Stand S (5f), 1985 William Hill Sprint Championship (5f)

135: *Pebbles*, ch.f., 1981 (Sharpen Up-La Dolce, by Connaught); In England: 1984 The 1000 Guineas (8f), 1985 Champion S (10f), 1985 Eclipse S (10f); In North America: 1985 Breeders' Cup Turf

135: *Petingo*, b.c., 1965 (Petition-Alcazar, by Alycidon); In England: 1967 Middle Park S (6f), 1968 Sussex S (8f)

135: *Petoski*, b.c., 1982 (Niniski-Sushila, by Petingo); In England: 1985 King George VI & Queen Elizabeth S (12f)

135: *Right Royal*, br.c., 1958 (Owen Tudor-Bastia, by Tornado); In France: 1960 Prix de la Salamandre (7f), 1960 Grand Criterium (8f), 1961 Poule d'Essai des Poulains (8f), 1961 Prix Lupin (10½f), 1961 Prix du Jockey-Club (12f); In England: King George VI & Queen Elizabeth S (12f)

135: *Royal Anthem*, b.c., 1995 (Theatrical-In Neon, by Ack Ack); In North America: 1998 Canadian International S (12f); In England: 1999 Vodafone Coronation Cup (12f), 1999 Juddmonte International S (10f)

135: *Sagace*, b.c., 1980 (Luthier-Seneca, by Chaparral); In France: 1984 Prix de l'Arc de Triomphe (12f), 1985 Prix d'Ispahan (9¼f), 1985 Prix Ganay (10½f)

135: *Sassafras*, b.c., 1967 (Sheshoon-Ruta, by Ratification); In France: 1970 Prix du Jockey-Club (12f), 1970 Prix de l'Arc de Triomphe (12f), 1970 Prix Royal-Oak (15½f)

135: *Shadeed*, b.c., 1982 (Nijinsky II-Continual, by Damascus); In England: 1985 The 2000 Guineas (8f), 1985 Queen Elizabeth II S (8f)

135: *Shahrastani*, ch.c., 1983 (Nijinsky II-Shademah, by Thatch); In England: 1986 The Derby (12f); In Ireland: 1986 Irish Sweeps Derby (12f)

135: ***Shareef Dancer***, b.c., 1980 (Northern Dancer-Sweet Alliance, by Sir Ivor); In Ireland: 1983 Irish Sweeps Derby (12f)

135: ***Sicambre*****, br.c.,** 1948 (Prince Bio-Sif, by Rialto); In France: 1950 Grand Criterium (8f), 1951 Prix du Jockey-Club (12f), 1951 Grand Prix de Paris (15f)

135: ***Sir Ivor*****, b.c.,** 1965 (Sir Gaylord-Attica, by Mr. Trouble); In France: 1967 Grand Criterium (8f); In England: 1968 The 2000 Guineas (8f), 1968 The Derby (12f), 1968 Champion S (10f); In North America: 1968 Washington D. C. International S (12f)

135: ***Souverain*****, b.c.,** 1943 (Maravedis-Jolie Reine, by Palais Royal); In France: 1946 Grand Prix de Paris (15f), 1947 Ascot Gold Cup (20f)

135: ***St. Jovite***, dkb/br.c., 1989 (Pleasant Colony-Northern Sunset, by Northfields); In England: 1992 King George VI & Queen Elizabeth S (12f); In Ireland: 1992 Budweiser Irish Derby (12f)

135: ***Supreme Court***, br.c., 1948 (Precipitation or Persian Gulf-Forecourt, by Fair Trial); In England: 1951 King George VI & Queen Elizabeth Festival of Britain S (12f)

135: ***Teenoso***, br.c., 1980 (Youth-Furioso, by Ballymoss); In England: 1983 The Derby (12f), 1984 King George VI & Queen Elizabeth Diamond S (12f); In France: Grand Prix de Saint-Cloud (12½f)

135: ***Tenerani***, b.c., 1944 (Bellini-Tofanella, by Apelle); In Italy: 1947 Derby Italiano (12f), 1947 Gran Premio di Milano (15f)

135: ***The Bug*****,** ch.c., 1943 (Signal Light-Flying Meteor, by Flying Orb); In England: 1946 July Cup (6f), 1946 Nunthorpe S (5f)

135: ***The Minstrel***, ch.c., 1974 (Northern Dancer-Fleur, by Victoria Park); In England; 1976 Dewhurst S (7f), 1977 The Derby (12f), 1977 King George VI & Queen Elizabeth Diamond S (12f); In Ireland: 1977 Irish Sweeps Derby (12f)

135: ***Trempolino***, ch.c., 1984 (Sharpen Up-Trephine, by Viceregal); In France: 1987 Prix de l'Arc de Triomphe (12f)

135: ***Wise Dan***, ch.g., 2007 (Wiseman's Ferry-Lisa Danielle, by Wolf Power); In North America: 2011 Clark H (9f), 2012 Shadwell Mile S (8f), 2012 Breeders' Cup Mile (8f), 2013 Maker's 46 Mile S (8f), 2013 Woodford Reserve Turf Classic S (9f); In Canada: 2012 Woodbine Mile (8f), 2013 Woodbine Mile (8f)

135: ***Youth***, b.c., 1973 (Ack Ack-Gazala, by Dark Star); In France: 1976 Prix Lupin (10½f), 1976 Prix du Jockey-Club (12f); In Canada: 1976 Canadian International Championship (13f); In North America: 1976 Washington D. C. International S (12f)

Variants: The Achilles' Heel of Speed Figures

This article makes reference to Performance Figures (PFs), our proprietary methodology for evaluating the performance quality of a race. These figures are based on a combination of fractional and final times converted into a single number. They represent performance integrated over the entire race. In that sense, they differ from conventional speed figures which rely only on the final time. For this methodology, the entire pace line of a race is converted to a performance number which is compared to the number for the appropriate class-par pace line or, occasionally, a projected pace line. All pars are adjusted for age, distance, sex, and time of year. Variants are then calculated in the normal way. The lower the number (i.e., the more negative), the higher is the level of performance. Beaten lengths calculations are as follows: 7 points per length at five furlongs; 6 points per length between five and one-half and six and one-half furlongs; 5 points per length between seven furlongs and a mile; 4 points per length between a mile and forty yards and nine and one-half furlongs; 3 1/2 points per length at ten furlongs; and 3 points per length at greater than ten furlongs.

Many racing fans understand that the recorded time of a race may not be the same thing as how fast it was.

To the uninitiated, such a statement might seem illogical because we usually equate time over a distance with speed. In other words, we tend to focus on how "fast" - or the rate of speed.

On closer inspection, we can appreciate that many things affect the final time of a race, not the least of which are the condition of the track surface and how environmental influences may be impacting it. The traditional way of resolving "raw speed" versus "how fast" usually is through the use of speed figures.

Speed figures and related performance ratings come in various forms and have been around for many years. Developed by such individuals as Bill Quirin, Andrew Beyer, Len Ragozin and by organizations such as Equibase and Bloodstock Research, they add significantly to our understanding of the difference between the final time of a race and how fast it actually was.

Their value lies in allowing us to make adjustments to the raw time based on the degree to which the track itself and environmental conditions affect the ability of the racing surface to carry speed.

On a given day, the effects of temperature, humidity, wet weather, wind, track maintenance and even the angle of the sun can have a dramatic effect on race times. We have all seen, for example, the huge difference in final times at a particular distance on turf between a course labeled firm versus another labeled yielding. The same horse, expressing an identical level of effort, may cover a mile in 1:34 flat on firm turf and 1:39 flat on yielding turf yet earn the same speed figure because of variations in the speed-carrying characteristics of the surface on the day.

A specific example of this can be seen in the past performances of the multiple Grade 1-winning middle distance turf horse Get Stormy which retired after the 2012 season with earnings in excess of $1.6 million.

On May 20, 2009 in a $46,000 allowance race for three-year-olds and up, he was beaten a half length going a mile on Belmont Park's outer turf course which was listed as firm, to earn a Beyer Speed Figure of 90 for his 1:34.4 clocking. A month later, on June 27, in an identical allowance event on the same course and at the same distance - except on a surface listed as soft - he was beaten a neck, earning the same 90 Beyer speed figure but for a much slower clocking of 1:38.3.

A sensible question to ask at this point is how one possibly can arrive at identical speed figures of 90 for two races with final times almost four seconds apart?

The answer lies in accurately determining the true speed-carrying characteristics of the track when the races were run.

We make this determination by invoking what is called a track variant, a measurement of the difference in time between an individual performance and some standard. We do this to see how much faster or slower the time of the race was relative to our expectations.

Variants also come in many different forms depending on the speed figure methodology. For many years, Daily Racing Form has calculated a speed rating and a daily track variant. Their original speed rating was based on a scale where the track record was assigned a value of 100.

The speed rating for a particular performance was determined by adding to or subtracting from 100 one point for each fifth of a second faster or slower than the track record. Accordingly, a race that was two seconds slower than the record was given a speed rating of 90 (100 minus 10 where the 10 corresponds to 10 fifths or two seconds slower than the record).

Similarly, if the track record was broken by one second (five fifths), the speed rating was 105 (100 plus 5). The daily variant also was based on fifths of a second and was calculated first by noting the difference between the time of a race and the track record for the race's distance and then averaging all of the differences that day - or their individual variants.

Separate determinations were made for turf and for dirt or synthetic surfaces, and in recent years separate daily variants have been calculated for sprints and for routes.

In addition, Daily Racing Form no longer uses the track record as the basic yardstick. DRF now uses the track's best time at each given distance over the previous three years. That best time for each distance now is the speed rating standard of 100.

To illustrate, let's look at a fictitious day's racing involving five dirt sprints at, consecutively, 5, 6, 6, 7 and 7 furlongs. The table shows the distance, time of the race, three-year best time and resulting race variant.

RACE	DIST.	TIME	3-YR BEST TIME	VARIANT
1	5.00F	:59.1	:57.0	11 SLOW
2	6.00F	1:10.3	1:09.0	8 SLOW
3	6.00F	1:11.4	1:09.0	14 SLOW
4	7.00F	1:23.4	1:22.0	9 SLOW
5	7.00F	1:24.3	1:22.0	13 SLOW
			AVERAGE =	11 SLOW

Here the daily variant is 11 slow, computed by averaging the five individual race variants. The conventional speed rating/daily variant (SR/DV) combination is displayed below where the figure before the dash under SR/DV is equal to 100 minus the number of fifths of a second slower than the three-year best time. The figure after the dash is the average variant.

So Race 3 was two and four-fifths seconds slower than the three-year best time, or 14 fifths. One hundred minus 14 affords the speed rating of 86 and the SR/DV is represented as 86 – 11.

RACE	SR/DV
1	89 - 11
2	92 - 11
3	86 - 11
4	91 - 11
5	87 - 11

By the same logic, if the winner of Race 1 had set a new three-year best time of :56.1, its speed rating would be 104, not 89, because its time was four-fifths faster than the three-year best time. Also, the daily variant would now be 8 slow instead of 11 slow and the first table would look like this:

RACE	DIST.	TIME	3-YR BEST TIME	VARIANT
1	5.00F	:56.1	:57.0	4 FAST
2	6.00F	1:10.3	1:09.0	8 SLOW
3	6.00F	1:11.4	1:09.0	14 SLOW
4	7.00F	1:23.4	1:22.0	9 SLOW
5	7.00F	1:24.3	1:22.0	13 SLOW
			AVERAGE =	8 SLOW

Similarly, the SR/DV numbers would be:

RACE	SR/DV
1	104 – 8
2	92 – 8
3	86 – 8
4	91 – 8
5	87 – 8

Some handicappers use the sum of the speed rating and daily variant (SR + DV) as a final speed figure indicating the true race speed, although more esoteric and sophisticated methods have gained favor in recent years. Whether these alternative techniques are more accurate is a constant source of debate. In any case, the surfaces in the two examples expressed a different track speed for the day as demonstrated by the daily variants. The respective SR + DV figures for the two situations are:

	SR + DV	
RACE	VARIANT 11 SLOW	VARIANT 8 SLOW
1	100	112
2	103	100
3	97	94
4	102	99
5	98	95

Immediately we can see that, because the track was playing faster in the second case, the SR + DV figures for the horses in Races 2 through 5 are lower. What this means is that even though the horses in Races 2 through 5 ran identical times in both cases, they were actually slower in the second case because the track was inherently faster.

Remember, these examples are solely to illustrate the point. If a horse really were to break an existing record by four-fifths of a second on a day when the other races were averaging two and one-fifth seconds slower than the record, you'd have quite a special animal on your hands. Normally, individual race variants will cluster around the average and differ from one another by just a few ticks, although extraordinary performances can occasionally

generate very large variants. At times these individual anomalies are discarded when calculating the daily variant, a practice that is also debatable.

The next reasonable question to ask is why we have spent so much time on these basic and generally well understood principles. Quite simply, it was to demonstrate how important the daily variant truly is. In fact, the variant is as important as the time itself because an inaccurate variant will dramatically affect the final calculated speed figure.

Inaccurate variants are not an issue with the Daily Racing Form methodology because the variant is measured against an absolute time standard. However, there are other issues with the Daily Racing Form variant that many handicappers find troublesome.

It is possible that on a given day, a high level allowance horse and a $5,000 claimer will win six-furlong races with identical clockings and generate the same race variant. Let's say 1:10 flat compared to a three-year best time of 1:08 flat.

Both will have earned speed ratings of 90 and respective race variants of 10 slow. It may well be that the allowance horses at the track generate average speed ratings of 90, while the $5,000 claimers' average speed ratings may be only 80. In the example, both may earn race variants of 10 slow, but in reality the allowance horse met the expectations of a 90 speed rating while the claimer exceeded expectations by two seconds earning a speed rating of 90 versus an anticipated speed rating of 80.

Now it should be obvious that Daily Racing Form variants do not consider the class level of the horses and this is of concern to quite a few players. Therefore, one alternative to the Daily Racing Form variant methodology is the establishment of performance standards other than record times against which performances are measured. This brings us to the concept of par times.

Par times are simply the average winning times for races at a specific distance and a specific class level at a specific track, taking into account the sex of the runner, its age and the time of year. They are generally derived from empirical observations and can be broadened to include average fractional times as well as final times.

Using class/distance par times instead of track distance records should increase the accuracy of the individual variants because it measures the speed of the track based on the actual expectation of how fast the race should be run. This avoids a lot of the noise created by using, for example, three-year best times where you encounter situations like the one described earlier with our allowance horse and claimer both stopping the clock in identical

times. In that example, the allowance horse was essentially meeting expectations while the claimer was far exceeding them.

Let’s assume that the six-furlong "par time", or the expected winning time for the allowance horse is 1:10 flat and the six-furlong par time for the claimer is 1:12 flat.

If the allowance horse wins in 1:10 he essentially has matched "par" and we can assign a variant of 0.

If the claimer also wins in 1:10 he has run two seconds, or ten fifths, faster than par and we can assign his race a variant of 10 fast. The average is five fast and we can adjust each horse’s final time by that amount, making both races 1:11 flat. If we say that five ticks fast represents the speed of the track on the day, then the allowance horse actually failed to match par by a full second while the claimer exceeded par by the same. Now we have a firmer understanding of each horse’s performance, something we wouldn’t have with the SR + DV method that doesn’t differentiate their efforts.

Again, whichever methodology one prefers, the importance of an accurate daily variant cannot be overemphasized. In the par time approach, it is critical to know whether a horse’s performance met, exceeded or failed to match expectations. An error of just a few fifths of a second can change a first-rate effort into a flop and vice versa. In reality we see this quite often where the speed figures of one purveyor will totally contradict those of another. More often than not, the differences lie in how the respective variants were determined.

To repeat, when calculating speed figures other than those of Daily Racing Form, each race is associated with a projected finishing time (the par time) depending on conditions of venue, class, distance, surface, age, sex and time of year. The degree to which the actual race time deviates from the par time is the previously-mentioned race variant. So, for example, if the par time for a six furlong event on dirt for older male $25,000 claimers at Churchill Downs is 1:10.0 and the winner’s time is 1:10.2, the race variant would be “2 slow”, meaning 2 ticks or two-fifths of a second slower than the anticipated time. If, on the other hand, the winner’s time is 1:09.2, the race variant would be “3 fast”.

On a given day, the individual race variants are averaged, usually separately for sprints and routes. That average, called the daily variant, is then applied to the individual races to adjust the final time.

The following data display the results for sprints at Gulfstream Park on May 24, 2014, of which there were four one-turn races on dirt on a track listed as fast.

The par times are taken from the 2014 edition of Par Times published by HorseStreet Products. If we assign a "fast" variant a negative number and a "slow" variant a positive number, then 1 fast would be -1 and 4 slow would be +4. Accordingly, the average variant for the four races is 2 slow (-1+0+4+4 = +7 which, when divided by 4 (the number of races), equals +1.75, rounded to +2). The adjusted final times are displayed in the last column.

RACE NO.	DIST.	CONDITIONS	TIME	PAR	VARIANT	ADJ. TIME
4	6.00F	3YO&UP, CL $6.25K	1:11.2	1:11.3	1 FAST	1:11.0
5	6.00F	3YO&UP, F&M, CL $12.5K	1:11.3	1:11.3	0	1:11.1
7	7.00F	3YO&UP, MSW	1:24.0	1:23.1	4 SLOW	1:23.3
8	6.00F	3YO&UP, F&M, OCL $62.5	1:10.4	1:10.0	4 SLOW	1:10.2

Following the adjustments, i.e., by decreasing each race time by two-fifths of a second, all of the final times are now within 2 or 3 ticks of the par, or expected times.

Once such adjustments are made, the revised final time is usually associated with a number (the speed figure) that represents the actual level of performance. That number is based on the particular scale employed by the individual or group making the figures and the scales can vary widely depending on the methodology.

Most important, for any given methodology, the assigned number generally is transferable from track to track. This enables us to compare performances across all venues and surfaces regardless of each track's inherent speed-carrying characteristics. This is significant because for tracks of equal quality the par times can be different at each class level. So if we say that Santa Anita and Belmont Park represent the same class of racing, we can equate the figures for both at a given class level despite differences in par times. Thus, $10,000 older male claimers at the two venues should have the same par speed figure even though the respective par times at six furlongs are 1:10.2 at Santa Anita and 1:10.4 at Belmont Park.

For the purposes of illustration we'll construct a scale in which an older male $10,000 claiming horse correlates with a par figure of 80 and where higher class performers correlate with a higher figure while lower class performers correlate with a lower figure. On our hypothetical scale, the highest level graded stakes performers might be expected to attain figures in excess of 110 while low-end maiden claimers could earn figures below 60. In the above example then, 1:10.2 at Santa Anita and 1:10.4 at Belmont Park are both equivalent to a speed figure of 80, somewhere in between figures achieved by the highest class and the lowest class performers.

What we have described is an oversimplification of the techniques applied because the various purveyors of speed figures may include additional factors such as ground lost, pace, weight, wind, etc. in their calculations. But what we have described does capture the essence of what a speed figure is and how it is created.

In the May 24 Gulfstream Park example, the reader will note a quantitative difference between the variants in Races 1 and 2 and those in Races 3 and 4. The observed difference might be random; nevertheless, some figure makers will decide that something may have happened between Races 5 and 7 that affected the characteristics of the racing surface. That "something" could actually be nothing or it could be the result of a change in wind speed or direction, temperature, moisture content of the surface or even some type of track maintenance. In those instances the speed figure maker may create what is called a "split variant" where races on one part of the card are assigned a different variant from races on another part.

In the example below, Races 4 and 5 might be assigned an average variant of 1 fast. Similarly, Races 7 and 8 would be assigned a variant of 4 slow.

The following table displays the results of the May 24 races using split variants.

RACE NO.	DIST.	CONDITIONS	TIME	PAR	VARIANT	ADJ. TIME
4	6.00F	3YO&UP, CL $6.25K	1:11.2	1:11.3	1 FAST	1:11.3
5	6.00F	3YO&UP, F&M, CL $12.5K	1:11.3	1:11.3		1:11.4
7	7.00F	3YO&UP, MSW	1:24.0	1:23.1	4 SLOW	1:23.1
8	6.00F	3YO&UP, F&M, OCL $62.5	1:10.4	1:10.0		1:10.0

Here we see that the new adjusted times are all equal to or within 1 tick of the par times while in the original example using a single daily variant the adjusted times vary between 2 and 3 ticks away from the par times.

Which is correct, a single variant for all the races, or split variants for the first two and last two races?

It's hard to know for sure, but what is clear is that depending on which option is chosen, the results are not the same. And even if they are not, do we care? Well, we do care if the adjusted times are converted to a speed figure.

The following data are taken from the book "Beyer on Speed" by Andrew Beyer, published by Houghton Mifflin Company in 1993. In the Appendix to his book, Beyer includes a listing of one-turn speed ratings where the time of race is equated with a Beyer Speed Figure (BSF). The next table shows the BSFs that would be assigned to the May 24 sprints depending on whether one has used the single variant method or the split variant method.

RACE NO.	SINGLE VARIANT ADJ. TIME	BSF	SPLIT VARIANT ADJ. TIME	BSF
4	1:11.0	92	1:11.3	83
5	1:11.1	89	1:11.4	81
7	1:23.2	96	1:23.1	101
8	1:10.2	100	1:10.0	106

What clearly is evident is that the single and split variant techniques provide dramatically contrasting results.

Now let's say that the winners of Races 4 and 8 come back in the same six-furlong event and we want to use these figures to separate them for handicapping purposes.

The single variant method tells us that the winner of Race 8 is 8 Beyer points faster than the winner of Race 4 (100 minus 92) while the split variant method tell us that the winner of Race 8 is 23 Beyer points faster (106 minus 83).

According to Beyer's 'beaten length adjustments' in his book, 8 Beyer points at six furlongs is equivalent to 3 1/4 lengths while 23 Beyer points is equivalent to 9 1/4 lengths. That is a six-length spread.

For handicapping purposes, we certainly would like to know if the winner of Race 8 is about 9 lengths superior or about 3 lengths superior. If we review the par times for the two races we see 1:11.3 for race 4 and 1:10.0 for Race 8, a difference of 1 3/5 seconds or, using the traditional (but not totally accurate) one-fifth of a second equals one length, 8 lengths. Therefore, based on the established par time, the nine-length difference between the two horses is more reasonable, which argues in favor of the split variant technique, at least on May 24.

Regardless of which variant method is used, it should be fairly obvious at this point that speed figures are critically dependent on how variants are calculated. Said another way, **variants may be the weakest link in all speed figure calculations**. The biggest issue with variants is that they generally are thought of as relatively static, meaning either the variant is the same for an entire card or the variant is split into still static clusters. The reality may be that variants are not necessarily static at all. They are dynamic and can change even from race to race depending on environmental conditions.

Imagine, if you will, a day in which, following a race on a track labeled fast, there is a huge downpour that drenches the surface between races. Or imagine that the wind increases substantially between races, accelerating the drying out process of the racing surface. Under those circumstances should we assume the speed-carrying characteristics of the track would remain the same? I don't think so. Thus, if one accepts the possibility that variants may, but not necessarily change throughout the day, we are still faced with the problem of determining how to identify the changes and how to take those changes into account in our variant calculations.

One approach to identifying a possibly continually changing variant is not to average the individual race variants or clusters of variants but to subject all of the race variants to "regression analysis."

Regression analysis is a process used in statistics to estimate the relationships among variables where variables are functions that have values associated with them.

Variables can be dependent or independent.

An independent variable is a variable intentionally changed to observe its effect on the dependent variable. The dependent variable may be expected to change whenever an independent variable is changed.

One familiar example of how regression analysis might be used is to define the relationship, if any, between life expectancy and cigarette consumption.

From real world data, we may know that non-smokers have a life expectancy of, say, 75 years. Those who smoke one pack a day may have a life expectancy of 70 years. Similarly, those who smoke two packs a day may have a life expectancy of 65 years while those who smoke three packs a day may have a life expectancy of only 60 years.

Here, the number of packs smoked each day is the independent variable while life expectancy is the dependent variable.

Life expectancy is the dependent variable because we anticipate that it may change 'depending' on how much one smokes.

Linear regression analysis of the data will generate a straight line that offers the best fit of the data to the line, meaning that the individual data points collectively fall closest to line. Since every straight line has an equation associated with it, we can use the equation to predict the life expectancy of a smoker regardless of how many packs a day he or she smokes.

In this study we may consider the race number or even the actual starting time of the race as the independent variable. The variant, then, would be the dependent variable because we expect that it may change depending on the number of the race or its starting time, the independent variable.

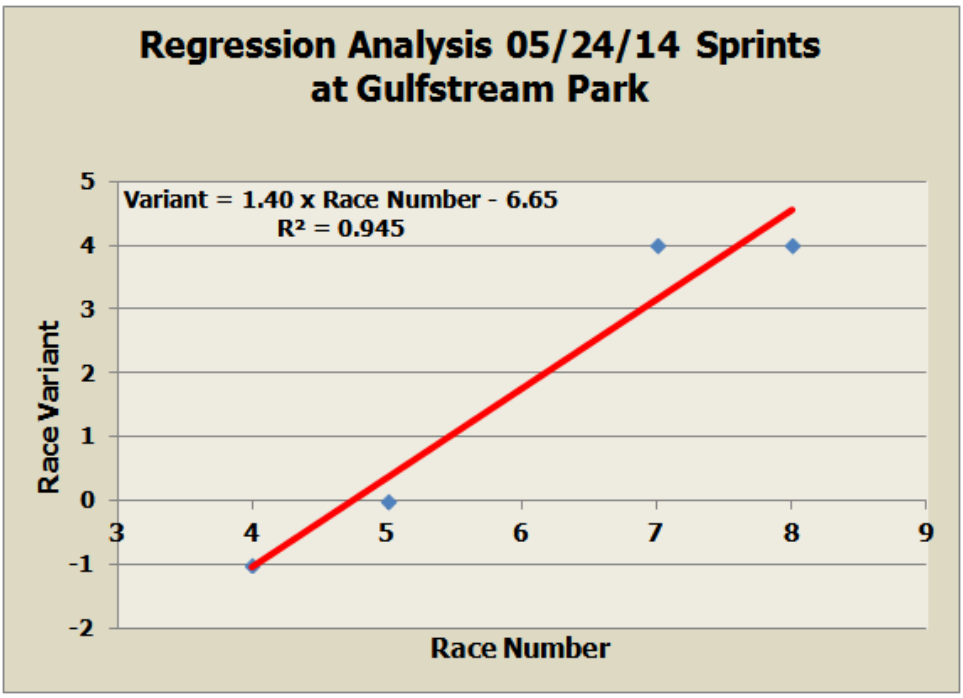
Races on a card are run in sequential order and are scheduled to start at specific times. There is nothing that happens during a race that will change its number or starting time. On the other hand, the variant for each race is unknown until after the race is completed, and each variant is associated with that particular race. Said another way, the race number or starting time determines the variant. The variant never determines the race number or starting time. That is the difference between an independent and a dependent variable.

In the cigarette consumption versus life expectancy example, life expectancy (the dependent variable) does not affect cigarette consumption (the independent variable). Cigarette consumption, however, does affect life expectancy.

Back to racing, neither the starting time nor the race number has a direct physical impact on the variant. However, they both correlate with environmental conditions that may or may not be changing significantly over time. It is those conditions that impact the variant. Theoretically, we could track and analyze all of the environmental factors (temperature, wind, track moisture, etc.) throughout the day and develop a correlation with the variant. In a practical sense, that would be virtually impossible to do. The race number and starting time already have the environmental factors at the time associated with them because the effects of environment are being expressed at ALL times, with a specific set of conditions existing when each race is run. In other words, race number and starting time are proxies for environmental conditions, which may or may not be changing.

Now, we will apply regression analysis to the May 24 sprints at Gulfstream Park. In this case we will use 'linear regression', the simplest of many regression analysis methods. Regression analysis is accessible and straightforward for anyone using an advanced spreadsheet program with a good statistics tool, such as Microsoft Excel.

Linear regression tries to model the relationship between two variables by fitting a linear equation to the data. The variables, as noted earlier, are the race variant and the race number. The red line on the following chart is the resultant linear trend line showing the best fit of the data.



One thing to note immediately is the value of the term R^2 (R squared), 0.945. R squared indicates how well the data points fit the statistical model. If every data point fell exactly on the red trend line the value of R squared would be exactly 1.000. The closer the data points are to the line, the closer R squared is to 1.000.

Our value of 0.945 indicates (and displays visually) that these four data points do, indeed, fall close to the calculated line. If there were no correlation, i.e., if the data points were scattered randomly, then R squared would be closer to 0.000 and most of the data points would be farther from the red trend line. Our result confirms a very strong correlation between race number and race variant. The square root of R squared is called the 'correlation coefficient', a separate and more commonly known measure of the strength and direction of the linear relationship between two variables.

In the above example, an R squared of 0.945 affords a correlation coefficient of 0.972. Here, too, the closer the correlation coefficient is to 1.000, the closer the data points are to the trend line.

The graphical display also reinforces the notion of possibly using split variants as the two clusters (Races 4 and 5 versus Races 7 and 8) are clearly differentiated.

On the other hand, had Race 6 been a sprint and included in this data set, the trend line predicts its variant should be about 2 slow and if it actually was in that range, any attempt to cluster races to generate split variants would be less obvious. Therein lies the essence of using regression analysis to generate individual race variants consistent

with environmental changes observed throughout the day. It obviates the need to generate an average variant or split variants, a choice not always apparent or easily made.

At this point we can compare the three methods of variant calculation, the results of which are compiled in the next table.

RACE NO.	SINGLE VARIANT	SPLIT VARIANT	REGRESSION VARIANT
4	+2	−1	−1
5			0
7		+4	+3
8			+5

Consequently, these are the adjusted times based on the technique applied.

RACE NO.	TIME	SINGLE VARIANT	SPLIT VARIANT	REGRESSION VARIANT
4	1:11.2	1:11.0	1:11.3	1:11.3
5	1:11.3	1:11.1	1:11.4	1:11.3
7	1:24.0	1:23.3	1:23.1	1:23.2
8	1:10.4	1:10.2	1:10.0	1:09.4

Please observe that the results found by applying variants derived from linear regression and those generated by splitting the race variants, are quite close to each other. They also are significantly different from those obtained by using a single daily variant. One could argue that in the absence of regression analysis, the split variant seems a better choice than a single variant for this particular card and is preferred. Nevertheless, regression analysis allows us not to have to make that choice at all, a choice made on assumptions, correct or not, about environmental changes from race to race.

Thus far we've shown how regression analysis can be used when working with traditional final time conversions. In our work, however, we generate Performance Figures (PFs) which are based not solely on the final time of a race but which incorporate internal fractions, or pace, into the final number.

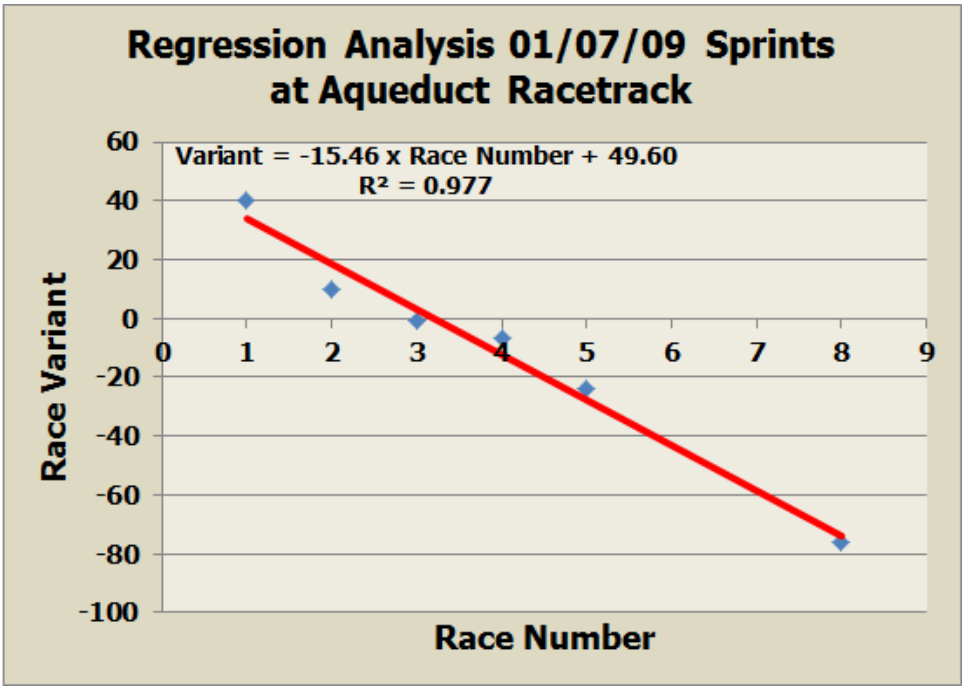
We will demonstrate the regression analysis approach for generating variants using more complex real-life examples.

The track condition on dirt throughout the entire card at Aqueduct Racetrack on January 7, 2009 was listed as sloppy (sealed) with the weather shown as rainy throughout the day. There were six six-furlong sprint races on the

day. The following table presents the pertinent data associated with each race – the race number, the conditions, the time, the actual PF, the par PF and the raw PF variant.

RACE NO.	CONDITIONS	TIME	PF	PAR	VARIANT
1	4YO&UP, F&M, OCL $75K	1:11.3	+4	-36	+40
2	4YO&UP, F&M, MSW	1:12.2	+10	0	+10
3	4YO&UP, OCL $35K	1:10.2	-31	-30	-1
4	3YO, MSW (NY-BRED)	1:13.0	+17	+24	-7
5	4YO&UP, F&M, CL $10K	1:12.0	-12	+12	-24
8	3YO, ALW (NW1 X) (NY-BRED)	1:10.0	-62	+14	-76

Linear regression analysis affords the result displayed on the next chart.



This is a dramatic demonstration of how the speed-carrying characteristics of a racing surface can change throughout the day in response to shifting environmental factors. Clearly, the steady rain was continuously making the surface faster and at an almost constant rate, confirmed by the very high R squared value of 0.977 (correlation coefficient = 0.988).

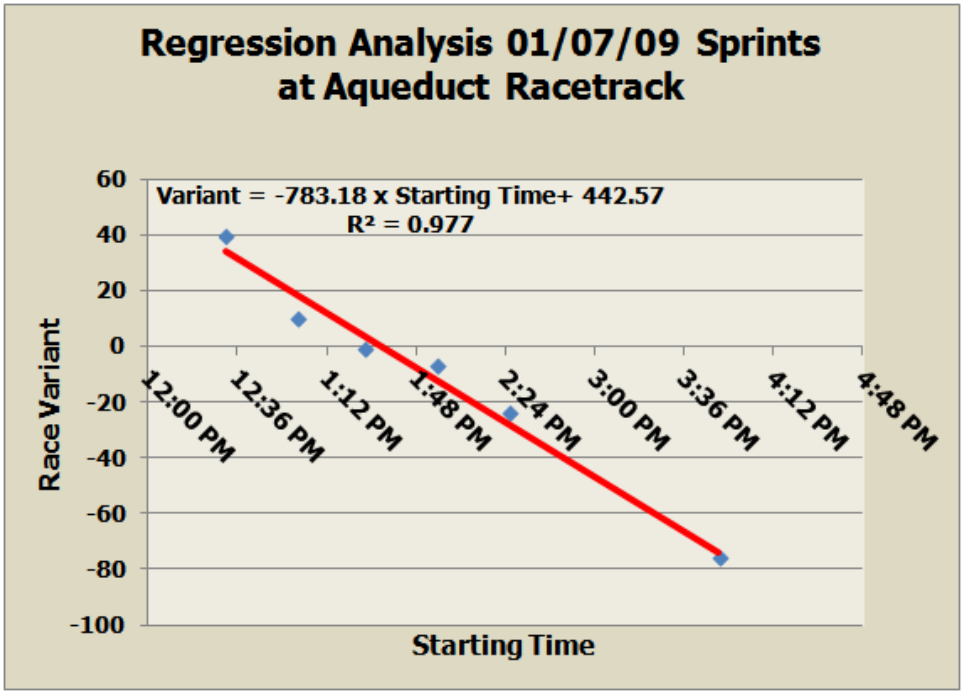
The traditional average variant for the day was 10 PF units fast. The revised PFs using both the average variant (gray area) and regression analysis (yellow area) are shown in the following table. The above chart also suggests

that a split variant option is not viable for these data. There is no obvious disconnect between groups of races, only a smooth transition from race to race.

RACE NO.	PF	PAR	AVG. VARIANT	ADJ. PF	REGRESSION VARIANT	ADJ. PF
1	+4	-36	-10	+14	+34	-30
2	+10	0	-10	+20	+19	-9
3	-31	-30	-10	-21	+3	-34
4	+17	+24	-10	+27	-12	+29
5	-12	+12	-10	-2	-28	+16
8	-62	+14	-10	-52	-74	+12

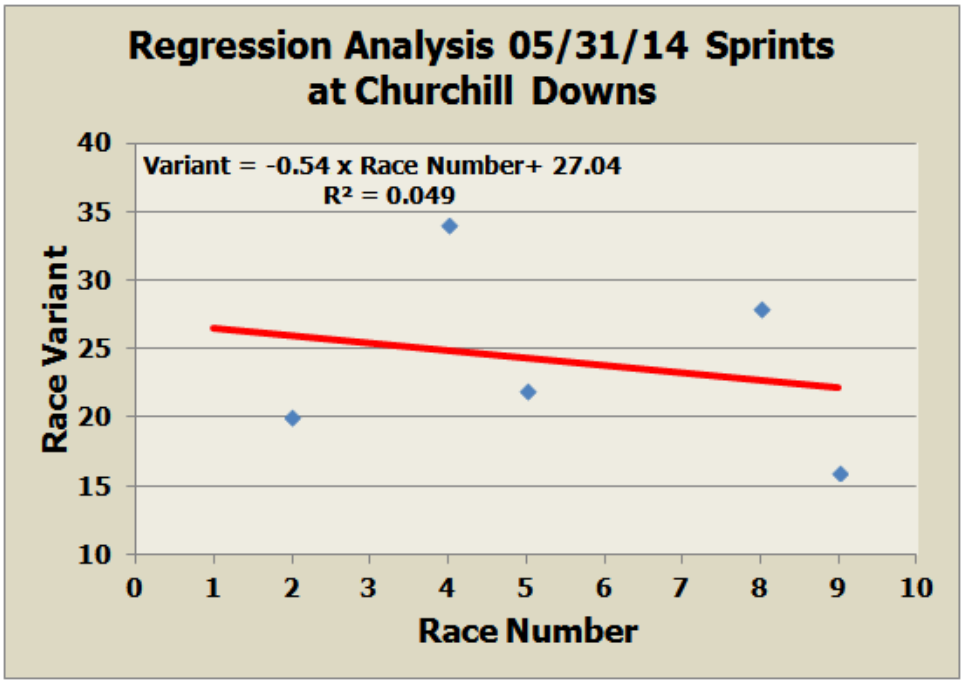
Comparing the par PFs with the adjusted PFs derived from the average variant technique or the regression variant technique reveals a much more realistic and likely result when using regression analysis.

In addition, instead of the race number as the independent variable we can use the actual starting time of each race and observe the same result.



It is important to recognize that every race card will generate a trend line. But not all trend lines are created equal. The key lies in the R squared value and the correlation coefficient. The nearer R squared or the correlation coefficient is to 1.000 the more likely it is that the trend line reflects real changes over time. Trend lines that generate a low R squared value or low correlation coefficient may still reveal what appears to be a pattern; however, the lower their values the closer the distribution of data points is to random scatter and the nearer the

trend line is to horizontal. Therefore, we generally will revert to an average variant when the correlation coefficient is less than 0.50 (R squared = 0.25). Here is such an example for the five dirt sprints contested at Churchill Down on May 31, 2014 on a track listed as fast.



The R squared value of 0.049 (correlation coefficient = 0.22) indicates substantial scatter among the data points. The trend line shows a change of just four PF units between races 2 and 9. At sprint distances that is about a half length difference, suggesting that the track was playing similarly throughout the day. The average variant is 24 PF units slow.

RACE NO.	PF	PAR	AVG. VARIANT	AVG. VARIANT PF	REGRESSION VARIANT	REGRESSION VARIANT PF
2	+20	0	+24	-4	+26	-6
4	+46	+12	+24	+22	+24	+21
5	+50	+28	+24	+26	+25	+26
8	+19	-9	+24	-5	+23	-4
9	-46	-62	+24	-70	+22	-68

If we adjust the raw PFs using either the average variant or the regression variants (the gray columns), we obtain essentially the same final numbers, confirming that the surface was relatively unaffected by environmental changes during the day.

The beauty of regression analysis as applied to race variants is that you don't have to know when or even how the changes in the racing surface occurred. Regression fuses all of the factors affecting change and incorporates them

into the analysis. Bear in mind that there are other, more complex forms of regression analysis besides simple linear regression, such as 'polynomial regression.'

Polynomial regression - also an option in most high-end spreadsheets - may be useful when observed changes are not ideally linear. This could occur, for example, when a race card starts out under fair skies followed by a period of drenching rain followed by returning fair skies with increased winds.

There are virtually an infinite number of scenarios that might benefit from using polynomial regression, especially when there is reason to believe that modifications to the track surface may not be happening in a strictly linear fashion. Of course, the user can determine which regression method is more appropriate by monitoring the R squared value or the correlation coefficient of the trend line generated by each and opting for the technique providing the better fit of the data.

In any case, the reader should now appreciate the sensitivity of speed figures to the methodology applied in calculating variants. There is more than one way to do it. Some are better than others. In the end, the goal is to best identify how environmental changes are affecting the ability of the racing surface to carry speed at any point in time.

Historical Review of Kentucky Derby Pace Parameters

Pace parameters are a series of performance-related numbers based on the pace characteristics of a horse in a race. Below is presented an historical review and summary of pace parameters for Kentucky Derby starters in prep races at a mile or more on the main track since 1998.

Using linear regression (involving fractional times and lengths behind) we generate the slope and intercept of the best straight line that models the individual performance where slope is a measure of fatigue and intercept is a measure of early speed inversely related to the slope. We use the slope and the intercept for a race to calculate a projected time at any distance. These times include a projected ten-furlong time (10f), a projected turn time in a ten-furlong race (10f TT, the time to negotiate the distance between the six furlong and eight furlong markers) and a projected last quarter-mile time in a ten-furlong race (10f LQ). Next, we calculate unadjusted Sartin Methodology-based Brohamer pace numbers ("Modern Pace Handicapping", by Tom Brohamer, William Morrow and Company, Inc,. New York, 1991) for the same races. For our purposes these are limited to a 3Fr (Final Fraction) number which is the speed in feet-per-second from the six furlong call to the finish, a %E (Percent Early) number which is a relative measure of energy used through the six-furlong call and a TE (Total Energy) number which is a measure of the total available energy based on conditions of distance, surface, track and inherent ability. Speed types display %E figures significantly higher than off-the-pace types, although the absolute numbers are greatly affected by the distance of a race. We emphasize 3Fr, %E and TE from among the various available Brohamer figures because these are directly related to a horse's ability to save and to utilize energy and to finish its races with something left in reserve.

The following analysis is for demonstration purposes and is not the only way the data can be used. For each year since 1998, the starters are rank ordered according to the six pace parameters derived from Derby prep races at a mile or more on dirt plus the PF (Performance Figure; see Introduction to article "Variants: The Achilles' Heel of Speed Figures", p. 300) earned in those races. The pace parameters are 1) the fastest 10f; 2) the fastest 10f LQ 3) the fastest 10f TT; 4) the highest 3Fr; 5) the lowest %E and 6) the highest TE. For the PF category, the more negative the number the better the performance. Only those horses ranked among the top five (or occasionally more because of ties) in any of the seven categories and with at least one PF of -55 or better are considered. To test the usefulness of this analysis, all qualifiers are bet to win, across-the-board and in exotic wagering combinations, although these approaches should not be considered a recommendation of a betting strategy. The results for the individual races are displayed on the right side of the table and a summary is presented at the bottom of the table. Since 1998, this specific methodology has identified eleven of eighteen winners as well as five exactas, three trifectas and two superfectas. Overall since 1998, the Derby winner has been among the top

five twelve times in 10f, eleven times in 10f TT and TE, ten times in 3Fr, nine time in 10f LQ, eight times in PF and six times in %E. The winner also earned a PF of -55 or better eleven times. Again, limiting the wagers to those horses with PF -55 or better is arbitrary and is applied here only for the sake of consistency. For example, the Derby winner may have a PF below the top five or not as good as -55 but his pedigree might suggest he will better at a classic distance. Conversely, a contender with a top five PF or a PF better than -55 may have a pedigree suggesting he would be better in shorter races. This is where judgment plays a key role.

In the following tables, the horses shown in red finished among the top three with the winners also shown in **bold** type:

1998

10F	10F LQ	10F TT	3FR	%E	TE	PF
INDIAN CHARLIE	HALORY HUNTER	HALORY HUNTER	HALORY HUNTER	HALORY HUNTER	INDIAN CHARLIE	CAPE TOWN
REAL QUIET	**REAL QUIET**	**REAL QUIET**	NATIONALORE	NATIONALORE	OLD TRIESTE	HALORY HUNTER
OLD TRIESTE	NATIONALORE	CAPE TOWN	**REAL QUIET**	PARADE GROUND	**REAL QUIET**	INDIAN CHARLIE
HALORY HUNTER	CAPE TOWN	INDIAN CHARLIE	INDIAN CHARLIE	VICTORY GALLOP	HALORY HUNTER	ARTAX
ARTAX	INDIAN CHARLIE	NATIONALORE	PARADE GROUND	CAPE TOWN	ARTAX	FAVORITE TRICK

HORSE	# OF APPEARANCES	BEST PREP PF	DERBY FINISH			W	P	S	WPS WAGER
REAL QUIET	5	-59	**1**			18.80	8.80	5.80	6.00
VICTORY GALLOP	1	-56	**2**				13.00	7.60	6.00
INDIAN CHARLIE	6	-62	**3**					4.20	6.00
HALORY HUNTER	7	-65	**4**						6.00
CAPE TOWN	4	-75	**5**						6.00
FAVORITE TRICK	1	-60	8						6.00
ARTAX	3	-60	13						6.00
PARADE GROUND	2	-51				18.80	21.80	17.60	42.00
OLD TRIESTE	2	-31		EXACTA:	291.80				
NATIONALORE	4			TRIFECTA:	1,221.00				
				SUPERFECTA:	3,007.40				

1999

10F	10F LQ	10F TT	3FR	%E	TE	PF
CHARISMATIC	STEPHEN GOT EVEN	**CHARISMATIC**	ECTON PARK	ECTON PARK	**CHARISMATIC**	MENIFEE
ADONIS	**CHARISMATIC**	STEPHEN GOT EVEN	STEPHEN GOT EVEN	STEPHEN GOT EVEN	ADONIS	ADONIS
PRIME TIMBER	EXCELLENT MEETING	EXCELLENT MEETING	**CHARISMATIC**	KIMBERLITE PIPE	PRIME TIMBER	CAT THIEF
EXCELLENT MEETING	K ONE KING	PRIME TIMBER	KIMBERLITE PIPE	K ONE KING	ECTON PARK	VICAR
MENIFEE	ECTON PARK	K ONE KING	EXCELLENT MEETING	ANSWER LIVELY	STEPHEN GOT EVEN	EXCELLENT MEETING
		ECTON PARK				

HORSE	# OF APPEARANCES	BEST PREP PF	DERBY FINISH			W	P	S	WPS WAGER
CHARISMATIC	5	-64	**1**			64.60	27.80	14.40	6.00
MENIFEE	2	-75	**2**				8.40	5.80	6.00
CAT THIEF	1	-70	**3**					5.80	6.00
PRIME TIMBER	2	-59	**4**						6.00
EXCELLENT MEETING	5	-67	**5**						6.00
ADONIS	3	-72	17						6.00
VICAR	1	-68	18						6.00
ECTON PARK	4	-50				64.60	36.20	26.00	42.00
KIMBERLITE PIPE	2	-50		EXACTA:	727.80				
ANSWER LIVELY	1	-50		TRIFECTA:	5,886.20				
STEPHEN GOT EVEN	5	-44		SUPERFECTA:	24,015.50				
K ONE KING	3	-34							

2000

10F	10F LQ	10F TT	3FR	%E	TE	PF
APTITUDE	IMPEACHMENT	IMPEACHMENT	IMPEACHMENT	IMPEACHMENT	APTITUDE	HAL'S HOPE
FUSAICHI PEGASUS	DEPUTY WARLOCK	DEPUTY WARLOCK	APTITUDE	RONTON	**FUSAICHI PEGASUS**	HIGH YIELD
WAR CHANT	APTITUDE	APTITUDE	WAR CHANT	ANEES	WAR CHANT	**FUSAICHI PEGASUS**
DEPUTY WARLOCK	ANEES	ANEES	DEPUTY WARLOCK	WHEELAWAY	DEPUTY WARLOCK	MORE THAN READY
MORE THAN READY	WHEELAWAY	WHEELAWAY	**FUSAICHI PEGASUS**	APTITUDE	THE DEPUTY	THE DEPUTY
		FUSAICHI PEGASUS				
		WAR CHANT				

HORSE	# OF APPEARANCES	BEST PREP PF	DERBY FINISH			W	P	S	WPS WAGER
FUSAICHI PEGASUS	5	-80	**1**			6.60	5.60	4.00	6.00
APTITUDE	6	-57	**2**				9.80	5.80	6.00
MORE THAN READY	2	-69	4						6.00
WHEELAWAY	2	-57	5						6.00
WAR CHANT	4	-63	9						6.00
THE DEPUTY	1	-67	10						6.00
HIGH YIELD	1	-82	17						6.00
ANEES	3	-52				6.60	15.40	9.80	42.00
DEPUTY WARLOCK	5	-24		EXACTA:	66.00				
IMPEACHMENT	4	-23		TRIFECTA:					
RONTON	1			SUPERFECTA:					

2001

10F	10F LQ	10F TT	3FR	%E	TE	PF
STARTAC	STARTAC	STARTAC	STARTAC	FIFTY STARS	BALTO STAR	CONGAREE
POINT GIVEN	JAMAICAN RUM	JAMAICAN RUM	FIFTY STARS	STARTAC	STARTAC	THUNDER BLITZ
THUNDER BLITZ	THUNDER BLITZ	THUNDER BLITZ	BALTO STAR	**MONARCHOS**	POINT GIVEN	**MONARCHOS**
JAMAICAN RUM	FIFTY STARS	POINT GIVEN	POINT GIVEN	DOLLAR BILL	CONGAREE	BALTO STAR
CONGAREE	**MONARCHOS**	**MONARCHOS**	**MONARCHOS**	BALTO STAR	**MONARCHOS**	MILLENNIUM WIND
	POINT GIVEN	FIFTY STARS			THUNDER BLITZ	POINT GIVEN
	TALK IS MONEY	TALK IS MONEY				

HORSE	# OF APPEARANCES	BEST PREP PF	DERBY FINISH			W	P	S	WPS WAGER
MONARCHOS	6	-70	**1**			23.00	11.80	8.80	6.00
CONGAREE	3	-76	**3**					7.20	6.00
THUNDER BLITZ	5	-76	4						6.00
POINT GIVEN	6	-65	5						6.00
MILLENNIUM WIND	4	-69	14						6.00
BALTO STAR	4	-69	14						6.00
JAMAICAN RUM	3	-51				23.00	11.80	16.00	36.00
STARTAC	6	-49		EXACTA:					
TALK IS MONEY	2	-34		TRIFECTA:					
FIFTY STARS	4	-5		SUPERFECTA:					

2002

10F	10F LQ	10F TT	3FR	%E	TE	PF
MEDAGLIA D'ORO	LUSTY LATIN	LUSTY LATIN	LUSTY LATIN	LUSTY LATIN	LUSTY LATIN	MEDAGLIA D'ORO
LUSTY LATIN	CAME HOME	CAME HOME	IT'SALLINTHECHASE	IT'SALLINTHECHASE	MEDAGLIA D'ORO	**WAR EMBLEM**
CAME HOME	IT'SALLINTHECHASE	MEDAGLIA D'ORO	**WAR EMBLEM**	**WAR EMBLEM**	CAME HOME	SAARLAND
HARLAN'S HOLIDAY	MEDAGLIA D'ORO	SAARLAND	CAME HOME	CAME HOME	PERFECT DRIFT	HARLAN'S HOLIDAY
SAARLAND	SAARLAND	BLUE BURNER	MEDAGLIA D'ORO	PERFECT DRIFT	SAARLAND	JOHANNESBURG

HORSE	# OF APPEARANCES	BEST PREP PF	DERBY FINISH			W	P	S	WPS WAGER
WAR EMBLEM	3	-62	**1**			43.00	22.80	13.60	6.00
MEDAGLIA D'ORO	5	-75	4						6.00
SAARLAND	3	-61	10						6.00
HARLAN'S HOLIDAY	2	-54				43.00	22.80	13.60	18.00
JOHANNESBURG	1	-53		EXACTA:					
CAME HOME	4	-48		TRIFECTA:					
LUSTY LATIN	6	-36							
IT'SALLINTHECHASE	3	-31							
PERFECT DRIFT	2	-32	**3**						

2003

10F	10F LQ	10F TT	3FR	%E	TE	PF
ATSWHATIMTALKNBOUT	ATSWHATIMTALKNBOUT	ATSWHATIMTALKNBOUT	EMPIRE MAKER	LONE STAR SKY	ATSWHATIMTALKNBOUT	TEN MOST WANTED
DOMESTIC DISPUTE	EMPIRE MAKER	EMPIRE MAKER	LONE STAR SKY	TEN CENTS A SHINE	EMPIRE MAKER	BUDDY GIL
EMPIRE MAKER	**FUNNY CIDE**	DOMESTIC DISPUTE	**FUNNY CIDE**	EMPIRE MAKER	DOMESTIC DISPUTE	PEACE RULES
FUNNY CIDE	DOMESTIC DISPUTE	**FUNNY CIDE**	ATSWHATIMTALKNBOUT	**FUNNY CIDE**	**FUNNY CIDE**	INDIAN EXPRESS
PEACE RULES	SUPAH BLITZ	SUPAH BLITZ	DOMESTIC DISPUTE	OFFLEE WILD	LONE STAR SKY	EMPIRE MAKER

HORSE	# OF APPEARANCES	BEST PREP PF	DERBY FINISH			W	P	S	WPS WAGER
FUNNY CIDE	6	-56	**1**			27.60	12.40	8.20	6.00
EMPIRE MAKER	7	-58	**2**				5.80	4.40	6.00
PEACE RULES	2	-66	**3**					6.00	6.00
BUDDY GIL	1	-66	6						6.00
TEN MOST WANTED	1	-69	9						6.00
INDIAN EXPRESS	1	-66	14						6.00
ATSWHATIMTALKNBOUT	5	-48				27.60	18.20	18.60	36.00
LONE STAR SKY	3	-39		EXACTA:	97.00				
DOMESTIC DISPUTE	5	-38		TRIFECTA:	664.80				
SUPAH BLITZ	2	-33		SUPERFECTA:					
OFFLEE WILD	1	-26							

2004

10F	10F LQ	10F TT	3FR	%E	TE	PF
IMPERIALISM	THE CLIFF'S EDGE	THE CLIFF'S EDGE	**SMARTY JONES**	**SMARTY JONES**	**SMARTY JONES**	**SMARTY JONES**
SMARTY JONES	TAPIT	**SMARTY JONES**	POLLARD'S VISION	PRO PRADO	POLLARD'S VISION	BORREGO
READ THE FOOTNOTES	**SMARTY JONES**	IMPERIALISM	PRO PRADO	POLLARD'S VISION	IMPERIALISM	POLLARD'S VISION
THE CLIFF'S EDGE	IMPERIALISM	TAPIT	THE CLIFF'S EDGE	THE CLIFF'S EDGE	BORREGO	THE CLIFF'S EDGE
TAPIT	ACTION THIS DAY	ACTION THIS DAY	BORREGO	BORREGO	READ THE FOOTNOTES	LION HEART

HORSE	# OF APPEARANCES	BEST PREP PF	DERBY FINISH			W	P	S	WPS WAGER
SMARTY JONES	7	-74	**1**			10.20	6.20	4.80	6.00
LION HEART	1	-62	**2**				8.20	5.80	6.00
THE CLIFF'S EDGE	5	-64	5						6.00
READ THE FOOTNOTES	2	-55	7						6.00
TAPIT	3	-58	9						6.00
BORREGO	4	-68	10						6.00
PRO PRADO	3	-62	13						6.00
POLLARD'S VISION	4	-67	17						6.00
IMPERIALISM	4	-49	**3**			10.20	14.40	10.60	48.00
ACTION THIS DAY	2	-36		EXACTA:	65.20				
				TRIFECTA:					
				SUPERFECTA:					

2005

10F	10F LQ	10F TT	3FR	%E	TE	PF
DON'T GET MAD	DON'T GET MAD	DON'T GET MAD	AFLEET ALEX	SUN KING	BELLAMY ROAD	BELLAMY ROAD
GIACOMO	AFLEET ALEX	AFLEET ALEX	SUN KING	AFLEET ALEX	DON'T GET MAD	HIGH FLY
BELLAMY ROAD	WILKO	WILKO	GREELEY'S GALAXY	GREELEY'S GALAXY	AFLEET ALEX	AFLEET ALEX
WILKO	**GIACOMO**	**GIACOMO**	HIGH LIMIT	GREATER GOOD	**GIACOMO**	NOBLE CAUSEWAY
BUZZARDS BAY	SORT IT OUT	SORT IT OUT	DON'T GET MAD	HIGH FLY	WILKO	FLOWER ALLEY

HORSE	# OF APPEARANCES	BEST PREP PF	DERBY FINISH			W	P	S	WPS WAGER
AFLEET ALEX	6	-63	**3**					4.60	6.00
BELLAMY ROAD	3	-103	7						6.00
FLOWER ALLEY	1	-58	9						6.00
HIGH FLY	2	-68	10						6.00
NOBLE CAUSEWAY	1	-62	14						6.00
HIGH LIMIT	1	-57	20						6.00
BUZZARDS BAY	1	-42						4.60	36.00
DON'T GET MAD	5	-21		EXACTA:					
GIACOMO	4	-23	**1**	TRIFECTA:					
GREATER GOOD	1	-49		SUPERFECTA:					
GREELEY'S GALAXY	2	-42							
SUN KING	2	-50							
WILKO	4	-40							

2006

10F	10F LQ	10F TT	3FR	%E	TE	PF
SHOWING UP	BOB AND JOHN	BOB AND JOHN	SHOWING UP	SWEETNORTHERNSAINT	SHOWING UP	SINISTER MINISTER
CAUSE TO BELIEVE	POINT DETERMINED	POINT DETERMINED	SWEETNORTHERNSAINT	JAZIL	CAUSE TO BELIEVE	BROTHER DEREK
STORM TREASURE	DEPUTY GLITTERS	SHOWING UP	DEPUTY GLITTERS	DEPUTY GLITTERS	BROTHER DEREK	LAWYER RON
BROTHER DEREK	CAUSE TO BELIEVE	CAUSE TO BELIEVE	POINT DETERMINED	STEPPENWOLFER	POINT DETERMINED	JAZIL
POINT DETERMINED	JAZIL	BROTHER DEREK	KEYED ENTRY	BLUEGRASS CAT	BOB AND JOHN	SWEETNORTHERNSAINT
					KEYED ENTRY	

HORSE	# OF APPEARANCES	BEST PREP PF	DERBY FINISH			W	P	S	WPS WAGER
BROTHER DEREK	4	-74	4-DH						6.00
JAZIL	3	-55	4-DH						6.00
SWEETNORTHERNSAINT	3	-55	7						6.00
LAWYER RON	1	-70	12						6.00
SINISTER MINISTER	1	-84	16						6.00
BOB AND JOHN	4	-60	17						6.00
BLUEGRASS CAT	1	-32	**2**						36.00
CAUSE TO BELIEVE	4	-29		EXACTA:					
DEPUTY GLITTERS	3	-40		TRIFECTA:					
KEYED ENTRY	2	-52		SUPERFECTA:					
POINT DETERMINED	5	-40							
SHOWING UP	4	-51							
STEPPENWOLFER	1	-49	**3**						
STORM TREASURE	1	-33							

2007

10F	10F LQ	10F TT	3FR	%E	TE	PF
NOBIZ LIKE SHOBIZ	CIRCULAR QUAY	CIRCULAR QUAY	**STREET SENSE**	**STREET SENSE**	DOMINICAN	CIRCULAR QUAY
SCAT DADDY	TIAGO	TIAGO	LIQUIDITY	ZANJERO	NOBIZ LIKE SHOBIZ	ANY GIVEN SATURDAY
CIRCULAR QUAY	**STREET SENSE**	**STREET SENSE**	ZANJERO	LIQUIDITY	**STREET SENSE**	**STREET SENSE**
STREET SENSE	ZANJERO	NOBIZ LIKE SHOBIZ	TIAGO	COWTOWN CAT	ZANJERO	NOBIZ LIKE SHOBIZ
TIAGO	COWTOWN CAT	ZANJERO	ANY GIVEN SATURDAY	TIAGO	LIQUIDITY	DOMINICAN
					TEUFLESBERG	ZANJERO

HORSE	# OF APPEARANCES	BEST PREP PF	DERBY FINISH		W	P	S	WPS WAGER
STREET SENSE	5	-60	**1**		11.80	6.40	4.60	6.00
CIRCULAR QUAY	3	-65	6					6.00
ANY GIVEN SATURDAY	1	-60	8					6.00
NOBIZ LIKE SHOBIZ	2	-55	10					6.00
DOMINICAN	1	-55	11					6.00
COWTOWN CAT	2	-34						24.00
LIQUIDITY	2	-45		EXACTA:				
SCAT DADDY	1	-46		TRIFECTA:				
TEUFLESBERG	1	-53		SUPERFECTA:				
TIAGO	5	-45						
ZANJERO	5	-54						

2008

10F	10F LQ	10F TT	3FR	%E	TE	PF
BOB BLACK JACK	VISIONAIRE	GAYEGO	PYRO	PYRO	COLONEL JOHN	**BIG BROWN**
COLONEL JOHN	GAYEGO	VISIONAIRE	GAYEGO	VISIONAIRE	GAYEGO	SMOOTH AIR
GAYEGO	COLONEL JOHN	COLONEL JOHN	COLONEL JOHN	GAYEGO	BOB BLACK JACK	DENIS OF CORK
BIG BROWN	PYRO	BOB BLACK JACK	BOB BLACK JACK	COLONEL JOHN	PYRO	PYRO
EIGHT BELLES	BOB BLACK JACK	MONBA	VISIONAIRE	Z FORTUNE	RECAPTURETHEGLORY	TALE OF EKATI

HORSE	# OF APPEARANCES	BEST PREP PF	DERBY FINISH		W	P	S	WPS WAGER
BIG BROWN	2	-89	**1**		6.80	5.00	4.80	6.00
DENIS OF CORK	1	-67	**3**				11.60	6.00
RECAPTURETHEGLORY	1	-57	5					6.00
Z FORTUNE	1	-59	10					6.00
SMOOTH AIR	1	-69	11					6.00
GAYEGO	6	-62	17					6.00
BOB BLACK JACK	5	-43			6.80	5.00	16.40	36.00
COLONEL JOHN	6	-45		EXACTA:				
EIGHT BELLES	1	-39	**2**	TRIFECTA:				
MONBA	1	-42		SUPERFECTA:				
PYRO	5	-43						
VISIONAIRE	4	-52						

2009

10F	10F LQ	10F TT	3FR	%E	TE	PF
MR. HOT STUFF	HOLD ME BACK	MR. HOT STUFF	PIONEEROF THE NILE	PIONEEROF THE NILE	PIONEEROF THE NILE	PIONEEROF THE NILE
DUNKIRK	MR. HOT STUFF	HOLD ME BACK	MR. HOT STUFF	ADVICE	MR. HOT STUFF	CHOCOLATE CANDY
PIONEEROF THE NILE	PIONEEROF THE NILE	PIONEEROF THE NILE	ADVICE	FRIESAN FIRE	PAPA CLEM	WEST SIDE BERNIE
PAPA CLEM	CHOCOLATE CANDY	CHOCOLATE CANDY	PAPA CLEM	MR. HOT STUFF	ADVICE	GENERAL QUARTERS
HOLD ME BACK	GENERAL QUARTERS	DUNKIRK	FRIESAN FIRE	GENERAL QUARTERS	DUNKIRK	MR. HOT STUFF

HORSE	# OF APPEARANCES	BEST PREP PF	DERBY FINISH		W	P	S	WPS WAGER
PIONEEROF THE NILE	7	-59	**2**			8.40	6.40	6.00
CHOCOLATE CANDY	3	-55	5					6.00
FRIESAN FIRE	2	-59	18					6.00
ADVICE	3	-40				8.40	6.40	18.00
DUNKIRK	3	-45		EXACTA:				
GENERAL QUARTERS	3	-51		TRIFECTA:				
HOLD ME BACK	2	-42						
MR. HOT STUFF	7	-51						
PAPA CLEM	3	-48						

2010

10F	10F LQ	10F TT	3FR	%E	TE	PF
DEVIL MAY CARE	HOMEBOYKRIS	HOMEBOYKRIS	HOMEBOYKRIS	HOMEBOYKRIS	SIDNEY'S CANDY	AMERICAN LION
HOMEBOYKRIS	LOOKIN AT LUCKY	LOOKIN AT LUCKY	SIDNEY'S CANDY	SIDNEY'S CANDY	CONVEYANCE	**SUPER SAVER**
ICE BOX	ICE BOX	ICE BOX	LOOKIN AT LUCKY	AMERICAN LION	HOMEBOYKRIS	SIDNEY'S CANDY
CONVEYANCE	STATELY VICTOR	STATELY VICTOR	AMERICAN LION	LOOKIN AT LUCKY	AMERICAN LION	MISSION IMPAZIBLE
SIDNEY'S CANDY	NOBLE'S PROMISE	NOBLE'S PROMISE	STATELY VICTOR	STATELY VICTOR	STATELY VICTOR	PADDY O'PRADO

HORSE	# OF APPEARANCES	BEST PREP PF	DERBY FINISH		W	P	S	WPS WAGER
SUPER SAVER	1	-60	**1**		18.00	8.80	6.00	6.00
MISSION IMPAZIBLE	1	-56	9					6.00
AMERICAN LION	4	-64	11					6.00
SIDNEY'S CANDY	5	-58	17					6.00
CONVEYANCE	2	-41			18.00	8.80	6.00	24.00
DEVIL MAY CARE	1	-51		EXACTA:				
HOMEBOYKRIS	6	-31		TRIFECTA:				
ICE BOX	3	-50	**3**	SUPERFECTA:				
LOOKIN AT LUCKY	4	-37						
NOBLE'S PROMISE	2	-37						
PADDY O'PRADO	1	-53	**2**					
STATELY VICTOR	5	-49						

2011

10F	10F LQ	10F TT	3FR	%E	TE	PF
DERBY KITTEN	BRILLIANT SPEED	BRILLIANT SPEED	BRILLIANT SPEED	BRILLIANT SPEED	DERBY KITTEN	MUCHO MACHO MAN
DIALED IN	TWINSPIRED	DERBY KITTEN	DERBY KITTEN	TWINSPIRED	DIALED IN	PANTS ON FIRE
MIDNIGHT INTERLUDE	DERBY KITTEN	TWINSPIRED	TWINSPIRED	DERBY KITTEN	TWICE THE APPEAL	NEHRO
TWICE THE APPEAL	DIALED IN	DIALED IN	DIALED IN	MUCHO MACHO MAN	MIDNIGHT INTERLUDE	BRILLIANT SPEED
BRILLIANT SPEED	MUCHO MACHO MAN	MUCHO MACHO MAN	MUCHO MACHO MAN	DIALED IN	BRILLIANT SPEED	DIALED IN
						SHACKLEFORD

HORSE	# OF APPEARANCES	BEST PREP PF	DERBY FINISH		W	P	S	WPS WAGER
NEHRO	1	-56	**2**			8.80	6.40	6.00
MUCHO MACHO MAN	5	-63	**3**				7.00	6.00
BRILLIANT SPEED	7	-55	7					6.00
PANTS ON FIRE	1	-57	9					6.00
DERBY KITTEN	6	-51				8.80	13.40	24.00
DIALED IN	7	-54		EXACTA:				
MIDNIGHT INTERLUDE	2	-36		TRIFECTA:				
TWICE THE APPEAL	2	-18						
TWINSPIRED	4	-45						

2012

10F	10F LQ	10F TT	3FR	%E	TE	PF
BODEMEISTER	EL PADRINO	EL PADRINO	EL PADRINO	EL PADRINO	BODEMEISTER	HANSEN
I'LL HAVE ANOTHER	BODEMEISTER	BODEMEISTER	DULLAHAN	DADDY LONG LEGS	DULLAHAN	UNION RAGS
CREATIVE CAUSE	CREATIVE CAUSE	CREATIVE CAUSE	BODEMEISTER	DULLAHAN	**I'LL HAVE ANOTHER**	CREATIVE CAUSE
GEMOLOGIST	**I'LL HAVE ANOTHER**	**I'LL HAVE ANOTHER**	CREATIVE CAUSE	WENT THE DAY WELL	EL PADRINO	BODEMEISTER
DULLAHAN	UNION RAGS	DULLAHAN	UNION RAGS	OPTIMIZER	CREATIVE CAUSE	DULLAHAN
						GEMOLOGIST

HORSE	# OF APPEARANCES	BEST PREP PF	DERBY FINISH		W	P	S	WPS WAGER
BODEMEISTER	6	-59	**2**			6.20	5.60	6.00
DULLAHAN	6	-57	**3**				7.20	6.00
CREATIVE CAUSE	6	-61	5					6.00
UNION RAGS	4	-65	7					6.00
GEMOLOGIST	2	-57	16					6.00
DADDY LONG LEGS	1	117				6.20	12.80	30.00
EL PADRINO	5	-53		EXACTA:				
I'LL HAVE ANOTHER	4	-45	**1**	TRIFECTA:				
OPTIMIZER	1	-34		SUPERFECTA:				
WENT THE DAY WELL	1	-34						

2013

10F	10F LQ	10F TT	3FR	%E	TE	PF
ITSMYLUCKYDAY	VYJACK	VYJACK	JAVA'S WAR	JAVA'S WAR	ITSMYLUCKYDAY	GOLDENCENTS
ORB	VERRAZANO	VERRAZANO	NORMANDY INVASION	NORMANDY INVASION	VERRAZANO	NORMANDY INVASION
VERRAZANO	NORMANDY INVASION	NORMANDY INVASION	VYJACK	VYJACK	VYJACK	OVERANALYZE
GOLDENCENTS	JAVA'S WAR	JAVA'S WAR	CHARMING KITTEN	LINES OF BATTLE	JAVA'S WAR	OXBOW
VYJACK	GOLDEN SOUL	**ORB**	VERRAZANO	CHARMING KITTEN	NORMANDY INVASION	PALACE MALICE

HORSE	# OF APPEARANCES	BEST PREP PF	DERBY FINISH		W	P	S	WPS WAGER
NORMANDY INVASION	6	-59	4					6.00
OXBOW	1	-57	6					6.00
OVERANALYZE	1	-59	11					6.00
PALACE MALICE	1	-57	12					6.00
VERRAZANO	5	-56	14					6.00
GOLDENCENTS	3	-68	17					6.00
CHARMING KITTEN	2	-27						36.00
GOLDEN SOUL	1	-48	**2**	EXACTA:				
ITSMYLUCKYDAY	2	-50		TRIFECTA:				
JAVA'S WAR	5	-44		SUPERFECTA:				
LINES OF BATTLE	1	-50						
ORB	2	-54	**1**					
VYJACK	6	-46						

2014

10F	10F LQ	10F TT	3FR	%E	TE	PF
CALIFORNIA CHROME	WICKED STRONG	WICKED STRONG	DANCE WITH FATE	DANCE WITH FATE	**CALIFORNIA CHROME**	MEDAL COUNT
CHITU	INTENSE HOLIDAY	**CALIFORNIA CHROME**	INTENSE HOLIDAY	INTENSE HOLIDAY	CANDY BOY	**CALIFORNIA CHROME**
CANDY BOY	**CALIFORNIA CHROME**	INTENSE HOLIDAY	**CALIFORNIA CHROME**	MEDAL COUNT	CHITU	DANCE WITH FATE
WILDCAT RED	DANCE WITH FATE	CANDY BOY	MEDAL COUNT	DANZA	WILDCAT RED	CHITU
GENERAL A ROD	CANDY BOY	GENERAL A ROD	CANDY BOY	COMMANDING CURVE	GENERAL A ROD	WICKED STRONG
		WILDCAT RED				WILDCAT RED

HORSE	# OF APPEARANCES	BEST PREP PF	DERBY FINISH		W	P	S	WPS WAGER
CALIFORNIA CHROME	7	-64	**1**		7.00	5.60	4.20	6.00
DANCE WITH FATE	5	-56	6					6.00
MEDAL COUNT	4	-68	8					6.00
CANDY BOY	5	-36						18.00
CHITU	4	-52		EXACTA:				
COMMANDING CURVE	1	-10	**2**	TRIFECTA:				
DANZA	1	-47	**3**					
GENERAL A ROD	3	-49						
INTENSE HOLIDAY	4	-38						
WICKED STRONG	4	-51						
WILDCAT RED	5	-51						

2015

10F	10F LQ	10F TT	3FR	%E	TE	PF
FIRING LINE	FRAMMENTO	FRAMMENTO	MUBTAAHIJ	**AMERICAN PHAROAH**	DORTMUND	MUBTAAHIJ
DORTMUND	FROSTED	FROSTED	FROSTED	MUBTAAHIJ	BOLO	MATERIALITY
BOLO	UPSTART	UPSTART	**AMERICAN PHAROAH**	FROSTED	FIRING LINE	FROSTED
ITSAKNOCKOUT	TENCENDUR	TENCENDUR	DORTMUND	TENCENDUR	MUBTAAHIJ	CARPE DIEM
AMERICAN PHAROAH	MUBTAAHIJ	MUBTAAHIJ	BOLO	KEEN ICE	**AMERICAN PHAROAH**	UPSTART

HORSE	# OF APPEARANCES	BEST PREP PF	DERBY FINISH		W	P	S	WPS WAGER
FROSTED	5	-63	4					6.00
MATERIALITY	1	-66	6					6.00
CARPE DIEM	1	-62	10					6.00
TENCENDUR	3	-55	17					6.00
UPSTART	3	-61	18					6.00
AMERICAN PHAROAH	4	-49	**1**					30.00
BOLO	3	-39		EXACTA:				
DORTMUND	3	-54	**3**	TRIFECTA:				
FIRING LINE	2	-50	**2**					
FRAMMENTO	2	-33						
ITSAKNOCKOUT	1	-36						
KEEN ICE	1	-37						
MUBTAAHIJ	6	118 RPR						

2016

10F	10FLQ	10FTT	3FR	%E	TE	PF
MOHAYMEN	MOHAYMEN	MOHAYMEN	MOHAYMEN	CREATOR	MOHAYMEN	DANZING CANDY
DESTIN	MY MAN SAM	CREATOR	TROJAN NATION	MOHAYMEN	MOR SPIRIT	CREATOR
OUTWORK	CREATOR	MY MAN SAM	DESTIN	TROJAN NATION	DESTIN	SUDDENBREAKINGNEWS
EXAGGERATOR	MO TOM	EXAGGERATOR	MOR SPIRIT	DESTIN	**NYQUIST**	MOR SPIRIT
NYQUIST	EXAGGERATOR	MO TOM	CREATOR	OSCAR NOMINATED	TROJAN NATION	EXAGGERATOR

HORSE	# OF APPEARANCES	BEST PREP PF	DERBY FINISH			W	P	S	WPS WAGER
CREATOR	5	-57	13						6.00
DANZING CANDY	1	-59	15						6.00
NYQUIST	2	-41	**1**						12.00
DESTIN	4	-40		EXACTA:					
EXAGGERATOR	4	-48	**2**	TRIFECTA:					
MO TOM	2	-38							
MOHAYMEN	6	-44							
MOR SPIRIT	3	-51							
MY MAN SAM	2	-44							
OSCAR NOMINATED	1	-33							
OUTWORK	1	-36							
SUDDENBREAKINGNEWS	1	-52							
TROJAN NATION	3	-32							

TOTALS					W	P	S	WPS WAGER
WINNERS IN TOP FIVE:				TOTALS =	218.60	177.80	171.80	540.00
10F								
13			$2 WIN ONLY:	WIN:	218.60			
68.4%				BET:	180.00			
10F LQ				PROFIT:	38.60			
9				ROI:	21.4%			
47.4%								
10F TT			$2 ACROSS-THE-BOARD:	WIN:	568.20			
11				BET:	540.00			
57.9%				PROFIT:	28.20			
3FR				ROI:	5.2%			
10								
52.6%			$2 EXACTAS:	WIN:	1,247.80			
%E				BET:	888.00			
6				PROFIT:	359.80			
31.6%				ROI:	40.5%			
TE								
12			$2 TRIFECTAS:	WIN:	7,772.00			
63.2%				BET:	3,744.00			
PF				PROFIT:	4,028.00			
8				ROI:	107.6%			
42.1%								
PF BETTER THAN OR = -55								
11			$2 SUPERFECTAS:	WIN:	27,022.90			
57.9%				BET:	13,296.00			
				PROFIT:	13,726.90			
				ROI:	103.2%			

A Brief Review of DOSAGE: A PRACTICAL APPROACH

Dosage, a technique for classifying Thoroughbred pedigrees by type, originated in the early part of the 20th century from the research of the Frenchman Lt. Col. J. J. Vuillier. In his classic study of the extended pedigrees of the best runners in England and France, Vuillier (in LES CROISEMENTS RATIONNELS DANS LA RACE PURE) observed that very few stallions appeared with any great frequency. He called these stallions *chefs-de-race*. He also noted that the degree of inheritance attributed to these *chefs-de-race* was essentially constant in all pedigrees, the absolute value (or Dosage figure) varying from sire to sire. Furthermore, he demonstrated that in successive 15 to 20 year time frames, new series of *chefs-de-race* emerged which eventually established their own fixed degree of influence. This process, in which new series of *chefs-de-race* periodically become dominant, provides a rational model for the evolution of the Thoroughbred race horse. Vuillier believed that the objective in breeding should be to attain Dosage figures in the foal as close as possible to the established Dosage figures for the breed. For some time he practiced his theories successfully in the employ of H. H. The Aga Khan, breeder of such notables as Bahram, Majideh, Mahmoud, and Nasrullah, among many others.

Some years later, the Italian Dr. Franco Varola (in TYPOLOGY OF THE RACE HORSE and THE FUNCTIONAL DEVELOPMENT OF THE THOROUGHBRED) developed a modified version of Dosage that retained the principle that Thoroughbred evolution proceeds through the influence of a very small number of the stallions at stud in any era. Varola did, however, shift the emphasis from quantity (i.e., the degree of inheritance associated with individual sires) to quality (i.e., the pattern of aptitudinal traits inherited from key ancestors). Discounting the generation in which his expanded list of *chefs-de-race* appeared, he arrived at a distribution of aptitudinal traits in a given pedigree that described the "type" of the horse being analyzed. The most significant point made by Varola was that the characteristics transmitted by his *chefs-de-race* were not necessarily those they possessed as runners. The focus, instead, was entirely on the qualities passed on as breeding animals. Thus, in contrast to conventional pedigree analysis based on an historical perspective of ancestral performance, Dosage relies on the dynamics of inheritance. As an alternative and complementary method of pedigree interpretation, it may help avoid potential problems associated with the traditional concept of "breeding the best to the best".

Our approach, which first appeared publicly as a series of articles in Leon Rasmussen's Bloodlines column in Daily Racing Form just prior to the 1981 Kentucky Derby, has been to fuse the basic ideas of Vuillier and Varola, incorporating both quantitative and qualitative components in the hope of providing additional insights. In order to establish greater utility, we chose to use more accessible four-generation pedigrees instead of the extended pedigrees used previously. We also re-introduced Vuillier's approximation of a genetic effect by halving the

influence of any *chef-de-race* in each successive earlier generation. Finally, we established a statistical method for evaluating the results of our analysis. In this framework, Dosage in its latest configuration was developed.

Each *chef-de-race* is assigned to one or two of five aptitudinal groups (Brilliant, Intermediate, Classic, Solid, and Professional) covering the spectrum (from left to right) of speed to endurance. The assignments are made to best reflect the traits that these stallions predictably and consistently transmit to their offspring. For bookkeeping purposes we assign a total potential value of 16 points to each generation. Since there are, progressively, one, two, four, and eight sires in the first four generations, *chefs-de-race* that appear among these sires will contribute 16, 8, 4, and 2 points each as we work back. The points for all *chefs-de-race* present are then tallied in the appropriate aptitude columns. *Chefs-de-race* that confer two aptitudinal characteristics have their points split between the two aptitudes. In the end, the total points in each column produce the Dosage Profile (DP), a series of five numbers that reflect the relative proportions of each of the five aptitudes and is expressed in the order:

Brilliant-Intermediate-Classic-Solid-Professional

For example, the DP of the leading classic sire Halo, dk.b. or br. c., 1969 (Hail to Reason-Cosmah, by Cosmic Bomb), himself a *chef-de-race*, is calculated as follows:

GENERATION (PTS)	SIRES (APTITUDINAL GROUP(S))	B	I	C	S	P
1ST GENERATION (16):	HAIL TO REASON (CLASSIC)			16		
2ND GENERATION (8):	TURN-TO (BRILLIANT/INTERMEDIATE)	4	4			
	COSMIC BOMB (N/A)					
3RD GENERATION (4):	ROYAL CHARGER (BRILLIANT)	4				
	BLUE SWORDS (N/A)					
	PHARAMOND II (N/A)					
	MAHMOUD (INTERMEDIATE/CLASSIC)		2	2		
4TH GENERATION (2):	NEARCO (BRILLIANT/CLASSIC)	1		1		
	ADMIRAL DRAKE (PROFESSIONAL)					2
	BLUE LARKSPUR (CLASSIC)			2		
	SIR GALLAHAD III (CLASSIC)			2		
	PHALARIS (BRILLIANT)	2				
	BLUE LARKSPUR (CLASSIC)			2		
	BLENHEIM II (CLASSIC /SOLID)			1	1	
	PEACE CHANCE (N/A)					
	DP:	**11**	**6**	**26**	**1**	**2**

The ratio of points in the speed wing (Brilliant points + Intermediate points + one-half the Classic points) to points in the stamina wing (one-half the Classic points + Solid points + Professional points) is the Dosage Index (DI). This number is directly proportional to the inherited prepotent speed in a pedigree and inversely proportional to the stamina. A DI of 1.00 indicates a balance of the two. The DI of Halo is 1.88 ((11 + 6 + 13) divided by (13 + 1 + 2)).

If we consider the five aptitude groups as points spaced equally along a linear scale where Brilliant is assigned a value of +2.00, Intermediate is +1.00, Classic is 0.00, Solid is -1.00, and Professional is -2.00, the DP allows for the calculation of the Center of Distribution (CD), that point along the scale corresponding to the total combined influences of all *chefs-de-race* in the pedigree. In that sense, it is a balance point (analogous to a center of gravity) of all weighted aptitudes supplied by *chefs-de-race* in the four generations. Calculation of the CD is done by taking the sum of twice the Brilliant points plus Intermediate points minus Solid points minus twice the Professional points and dividing that number by the total points in the DP. An exact balance of speed and stamina yields a CD of 0.00. The CD for Halo is 0.50 (((2 x 11) + 6 - 1 - (2 x 2)) divided by (11 + 6 + 26 + 1 + 2)), which places the combined effect of all *chefs-de-race* in his four generation pedigree equidistant between the Classic and Intermediate aptitudes.

For reference, a current list of *chefs-de-race* is located at this site. The *chefs-de-race* are shown in alphabetical order along with their aptitudinal assignments where B=Brilliant, I=Intermediate, C=Classic, S=Solid, and P=Professional.

Research using the described methodology as a tool for pedigree classification has resulted in many revealing observations including the following:

1. There is a direct correlation between the DI or CD and performance at varying distances as determined from separate populations of stakes winning sprinters, middle distance runners, and routers. As expected, the sprinters have the highest values (reflecting the importance of speed in short races), the routers have the lowest (confirming the need for endurance in long races), and the middle distance runners fall in between. In general, the Dosage figures correlate with the average distance of the races in each category. The precision of the technique is highlighted in the table below where average Dosage figures are displayed for specific distances between 5 1/2 and 12 furlongs for open stakes between 1983 and 2015. The correlation is virtually linear, confirming the direct relationship between distance and the speed/stamina characteristics of pedigrees as expressed by Dosage figures.

DISTANCE	AVG DI	AVG CD
5 1/2 f	3.93	0.81
6 f	4.14	0.86
6 1/2 f	3.59	0.80
7 f	3.65	0.81
8 f	2.92	0.68
8f & 70 yds	3.21	0.72
8 1/2 f	3.01	0.69
9 f	2.83	0.65
9 1/2 f	2.52	0.58
10 f	2.49	0.57
11 f	2.11	0.48
12 f	2.01	0.43

Elite Thoroughbreds as a group (e.g., champions, classic winners, leading sires) have significantly lower DIs and CDs than the general population of stakes winners, suggesting that outstanding performance on the track or at stud benefits from a large component of inherited stamina. There is no evidence, however, of an inherent superiority associated with lower Dosage figures. In other words, a lower DI is not better than a higher DI. Rather, the lower Dosage figures merely reflect the fact that our most prestigious races are run at longer distances and that successful competitors are aptitudinally suited to those races. Elite Thoroughbreds also have a higher point total in their DP than do typical stakes winners, acknowledging the fact that they tend to be somewhat better bred, at least to the extent that more *chefs-de-race* in a pedigree correlate with superior breeding stock.

3. Seven winners of the Kentucky Derby since 1940 (Strike the Gold, Real Quiet, Charismatic, Giacomo, Mine That Bird, American Pharoah and Nyquist), and six winners of the Belmont Stakes over the same time frame (Damascus, Conquistador Cielo, Creme Fraiche, Commendable, Sarava and American Pharoah) have had a DI above 4.00. This is in direct contrast to dirt stakes winners in general, of which almost one-fourth have a DI greater than 4.00 and for which the average DI is about 3.5. The combination of Dosage and our observation that 26 winners of the Kentucky Derby since 1972 were ranked as a juvenile within 10 pounds of the high weight on the Experimental Free Handicap or were named juvenile champion in another country has become an especially powerful tool in isolating the true classic contenders. In the 21 Derbies where a "dual qualifier" (i.e., DI and two-year-old form) failed to win, 16 finished second, and in 10 of those races, a qualifier subsequently won either the Preakness or Belmont Stakes. The implications of this result are that a pedigree suited to distance, along with a demonstration of high-class, early maturity are more important for classic performance than other factors such as form in the pre-Derby preps at distances less than ten furlongs. Over the past four-plus decades, an average of only about three and a half starters per Derby have met both criteria, including longshot winners Genuine Risk, Gato del Sol, Ferdinand, Alysheba, Unbridled, Sea Hero, Go for Gin, and Thunder Gulch. In addition, the "dual

qualifiers" have accounted for 9 exactas and 5 trifectas. Twenty-six percent of all "dual qualifiers" won at least one classic race.

4. The average DI of juvenile stakes winners steadily decreases throughout the season, indicating a larger speed component in the pedigree of winners early in the year relative to winners later on. This phenomenon parallels the need for greater stamina as the distances of races for two-year-olds increase through the year.

5. The DI of many steeplechase champions since 1972 exceeds the classic guideline figure of 4.00 despite the long distances associated with steeplechase racing. This result suggests that the pace of these races is well within the ability of speed-bred runners and that their quickness over the jumps can be a more important factor for success. The remainder of steeplechase champions have had a DI close to 1.00 or less, more typical of expectations for competitors at very long distances. Surprisingly, there are few steeplechase champions with a DI in the range of middle distance flat racers.

6. The average DI of stakes winners at tracks favoring speed is higher than the average DI of stakes winners at tracks where speed is less favored. This result is consistent with the observation that brilliantly bred runners often carry their speed further on the speed-oriented surface.

7. Turf stakes winners have, on average, a lower DI than stakes winners on dirt. Furthermore, the turf runners have a significantly greater representation of Solid and Professional chefs-de-race in their pedigree. This result is consistent with the observation that turf races are run at a longer average distance than are races on dirt.

The studies described here are based on large populations that reflect statistically significant trends. The Dosage user must recognize, however, that within these populations there is great variation. Accordingly, Dosage figures for an individual may not conform to those of the whole population. Greater accuracy and increased predictability depends in large part on a continual modification and refinement of the chef-de-race list, guided by the principle of a better description of reality.

Why I Left the Game: Departing Words

With the conclusion of this year's Triple Crown I am ending my association with Thoroughbred racing.

The web site, chef-de-race.com, will no longer be updated. The content will remain available until the current contract with my web host lapses sometime in 1Q 2017, after which the site will go dark. Until then, any and all of the information at the site will be freely available.

My interest in American racing has been waning for quite some time and I had hinted at my departure to friends as far back as three years ago. After 60 years, initially as a youthful racing fan, then as a hands-on owner, breeder and caretaker of pleasure horses and finally as an active participant on the racing side, the rewards of the sport that once were motivational and inspiring are mostly gone. Suffice it to say that my perception of a decline in the quality and diversity of American Thoroughbred racing along with the industry's continual (and, I believe, intentional) inability to deal effectively with the abusive nature of the game has taken its toll. American racing's ongoing decline is real and I am not alone in this view. A simple Google search will return many links to web pages suggesting the same.

I'm not retiring because “retiring” implies an end to a job or career, neither of which applies. For me Thoroughbred racing always has been an avocation. I've never been directly involved in the industry and I personally know only a handful of people who are, all of whom are better described as associates rather than friends since I know virtually nothing about their lives outside of racing. For decades I was content to enjoy the thrills and excitement of the sport while remaining an outside observer. Now it's coming to an end quite simply because I would prefer to spend my time doing other things, including a return to a more interactive involvement with horses and greater participation in another "avocation", photography.

I've never relied on racing to make a living. If I had, perhaps my views would be more mainstream and similar to those of people actively working in the industry and whose income depends on maintaining or at best tweaking the *status quo*. That's not who I am as you will see.

By training and inclination I am a physical scientist with advanced degrees in chemistry, and as the author of over 60 U.S. patents and peer-reviewed journal publications I know a bit about scientific method. I trained with a Nobel Prize winner and for many years I managed a world-class exploratory chemistry research group, was involved in university technology acquisition and participated in strategic planning for an international chemical company. I have extensive research and development experience in agricultural, animal health and industrial

chemistry. It is this expertise, training and academic discipline that I have continuously applied to my research into the relationship between Thoroughbred pedigrees and on-track performance.

I was a hands-on owner, breeder and early-stage trainer of Morgan and half-Morgan show and pleasure horses long before I became actively involved in Thoroughbred racing. I fed them, groomed them, played with them, tended to their ailments and pretty much hung out with them on a daily basis for 35 years until leaving the U.S. in 2004. I cared for a few retired race horses as well. So I also know something about the mind and body of the horse.

These were some of my "babies":

Our opinions and values are shaped and developed largely by our life experiences. Since those experiences are unique to the individual I have no expectation the opinions and values of others will necessarily agree with mine. And that's fine. It's how it should be. Our differences are what make life interesting. In other words, what follows is the result of my 70+ years living on planet Earth and it is irrelevant that others may disagree. Our experiences entitle us to our own understanding of the truth.

Native Dancer was the first Thoroughbred I ever saw race. I was just a boy of ten when the "Gray Ghost of Sagamore" became TV's first Thoroughbred superstar. Watching him finish second in the 1953 Kentucky Derby in his only career loss was devastating to an impressionable youngster. Despite the disappointment, I was hooked. My love affair with the horse had begun. Looking back, I am fortunate to have seen many of the great Thoroughbreds that followed. I recall the excitement of watching Swaps, Nashua, Round Table and Ribot in the 1950s; Kelso, Dr. Fager, Damascus, Buckpasser and Sea Bird II in the 1960s; and, of course, Secretariat, Forego, Ruffian, Seattle Slew, Affirmed, Spectacular Bid and Brigadier Gerard in the 1970s. Then I sensed a change. Good American horses still came along on a regular basis but none, at least for me, generated the magic of those earlier years until Ghostzapper appeared in the first decade of the new century. There really haven’t been any since, although I have enjoyed a few such as Rachel Alexandra and California Chrome. Lest the reader think that I'm blinded by nostalgia, consider that the best colt and the best filly I have ever seen over seven decades both raced within the last half dozen years. However, neither one was American-bred and neither one was American-raced. Some latter day American horses have been prematurely proclaimed as racing's next saviors, the horses that will rekindle fan interest and return the game to its glory days. It has never happened and it never will. The slow decline of racing in the U.S. has been ongoing for years and if Secretariat couldn't reverse the trend I doubt any individual horse ever can.

I think there are parallels between the trajectories of Thoroughbred racing and professional boxing. From the 1940s and into the 1960s boxing reached its zenith of popularity when the Gillette Cavalcade of Sports was one TV's most successful series, bringing the best of boxing into millions of homes every Friday night. A short time later Muhammad Ali came along and his skills transcended those of all who came before. One could even argue that Secretariat was racing's Muhammad Ali. Then boxing changed. People's tastes changed. Why the public began to view boxing as excessively violent and corrupt is worthy of discussion but is not the point. What is the point is that our perceptions of the sport did change and that over time it lost favor with the general public even if retaining a hardcore base of followers. The American public seemingly has developed a similar attitude toward Thoroughbred racing. A growing number believe it is cruel and dishonest. This belief is continually reinforced when a prominent horse dies on the track or a well-known trainer or jockey is accused of cheating. I would argue that boxing's and racing's decline is the direct result of the respective industry's policies and internal activities.

True latter day giants of the turf are becoming rarer as Thoroughbred racing has moved in a direction that has failed to sustain public interest. Today we are feeling the effects of Thoroughbred racing's persistent shift toward breeding for speed and early maturity in the hope of quick returns on investment. Since the 1980s the annual percentage of major North American stakes races contested beyond a mile-and-an-eighth on dirt has fallen dramatically. In 1987 there were over 50 major stakes races on dirt beyond nine furlongs. The leading horses among the winners were Alysheba, Bet Twice, Broad Brush, Creme Fraiche, Ferdinand, Java Gold, Personal Ensign and Snow Chief. In 2015 there were about half as many such races. The best horses included American Pharoah, Beholder, Shared Belief and Tonalist, hardly a comparable group in my opinion. For me, racing today is less diverse and less interesting. The emphasis on speed is reflected in the evaluations of classic races produced by many of the organizations that generate such ratings. For example, when Daily Racing Form's Beyer Speed Figures for American classic races are plotted by year, the trend line shows that the typical figure for the winners of those races has fallen from 111 in 1990 to 103 in 2015. Similarly, Equibase speed figures have fallen from 115 to 109 over the same time frame. My own Performance Figures (PFs) reflect an identical pattern, falling from -65 in 1997 to -56 in 2015. Even the Racing Post in the UK has noted a decline in their trend figures for the Kentucky Derby from about 123 in 1997 to about 120 in 2015. Horses, with some exceptions, apparently are winning the American classics at lower levels of quality than expressed two, three and four decades ago. It shouldn't be a surprise considering how excessive speed in a pedigree limits ability over a classic distance. This seems like the wrong direction for a sport that promotes classic racing as the ideal. It is not a coincidence that no major American record on dirt beyond a sprint distance has been broken in almost 30 years while records at 5 1/2, 6 and 6 1/2 furlongs all have been set since 2009.

As only an occasional recreational horseplayer (I haven't visited a race track in almost 20 years) I don't really know how the trend toward ever-increasing speed affects the side of the game that supports and sustains it -

betting. And as a casual and infrequent horseplayer the wagering part of the game isn't nearly enough to keep me involved. However, there is another component of the sport that does impact the wagering side and that is the seemingly indiscriminate use of medication, both legal and illegal. The industry, clearly driven by short-term motives, has failed to properly address this serious issue even though many racing venues outside the United States seem to thrive while exercising strict control over the use of drugs. There is no convincing explanation as to why horses in the United States routinely race on Lasix and/or Bute while horses in other parts of the world do not. Apart from the potentially damaging long-term physiological effects of any pharmaceutical, their application could be considered abusive to the extent such drugs mask physical deficiencies that in their absence would preclude the horse from being able to race effectively if at all. Yet we still hear the argument that such drugs are not performance enhancing. That may be strictly true in that they don't allow a horse to run faster than it is physically capable of running. However, they undeniably enable physically compromised horses to run that probably shouldn't be running in the first place. I would consider that performance-enhancing in the broadest sense. It's a virtual certainty that the overuse of race day medication contributes to injuries and fatalities on the track. Yet it appears that the quest for short-term profitability inhibits any serious attempt to find a meaningful solution. Because of this economically-driven, self-induced paralysis we are continually subjected to the infuriating and obscene meme following any on-track fatality that "it's sad but it's part of the game." We've all heard this reprehensible comment even from the most successful trainers, riders and owners. In my opinion such comments are a disgrace and reflect poorly on those who make them. I doubt they would make similar statements about high school football. I guess in the end most people either don't really care or are in denial. It's also likely they are unaware of the Associated Press study conducted almost a decade ago that identified at least 5,000 track-related horse fatalities in the U.S. between 2003 and 2008, an average of about three per day. I'm as guilty as anyone who tolerates these activities without protest.

Solutions cannot be achieved without difficulty because of the overriding economic interests of those within the industry, but there are things that can be done. The objective, short of eliminating the sport, is to minimize the likelihood of injury and death, accepting that riders have a choice but the horses do not. As an industry outsider I have no say in implementing change, but I can have an opinion.

An obvious step is the complete elimination of race day medication with severe penalties for violators, up to and including criminal prosecution or a lifetime ban depending on the severity of the infraction. This protects not only the athletes but the interests of the horseplayers as well. I've never understood why any transgressions by trainers, owners, riders or veterinarians that could affect the outcome of a race and, consequently, the bankrolls of horseplayers are tolerated at all. Which other gambling outlet permits similar behavior? What would the penalty be if the ownership or staff of a Las Vegas casino was caught cheating? Would it be a slap on the wrist? I doubt it.

Another even less likely approach is a switch to racing exclusively on grass, a surface well documented to reduce (but unfortunately not eliminate) fatalities and which is the standard racing surface for most of the world. The industry did experiment, generating mixed results, with all-weather synthetic surfaces as a substitute for dirt. In reality, synthetic surfaces are not the same as or even a close approximation to dirt. If safety truly was the primary concern a safer surface, turf, already exists. A. F. Carke in *Am Assoc Equine Pract 55:183-186, 2009* noted that although it appears synthetic surfaces are safer than dirt, when synthetic surfaces replaced turf courses the Fatal Musculoskeletal Injury (FMSI) rates increased, confirming turf as the safest type of surface. I personally believe the real motivation behind the introduction of synthetic surfaces was purely economic with increased safety a secondary consideration and good for public relations. The drainage characteristics of synthetic surfaces are supposed to keep them viable under virtually all weather conditions. The desired result? No revenue loss from cancellations due to weather-related problems. And, presumably, although debatable, maintenance costs can be lower as well. There may have been marginal improvements in safety with synthetic surfaces, but that may be because they are inherently slower compared to dirt. However, as a trained scientist I found it disturbing that these surfaces were installed and used without any prior long-term studies of their health effects on the horses or the riders. Synthetic surfaces are formulated in different ways but generally consist of sand and polymeric materials in fiber form usually modified by the addition of rubber and wax. As the surface particles erode under continual exposure to mechanical effects (e.g., the pounding of horses' hooves, harrowing, etc.) and environmental effects (e.g., heat, sunlight, wind, moisture, etc.) the dust and vapors created are inhaled by horse and rider. It's bad enough when the athletes' lungs are exposed to the dust from the breakdown of dirt particles. It's far worse when they are exposed to dust and vapors from eroding synthetic materials and even natural materials that are potentially carcinogenic or may physically damage the respiratory system. Not knowing the long-term effects should be completely unacceptable - but not, apparently, to those who control the game.

In a changing world Thoroughbred racing faces other problems affecting its long-term viability. From the wagering side, which is the foundation of the game, the number of competitive threats continues to grow. There are many more options today to throw away one's money. Most of them are a lot easier as well. It doesn't take much knowledge to pull the lever on a slot machine in a casino or buy a lottery ticket. Thoroughbred handicapping, on the other hand, is hard, very hard. The intellectual challenge is enormous and may be its most attractive feature. It's more like chess than checkers, and realistically most are not up to the task. The amount of time, knowledge and discipline required for success is well beyond that which the vast majority is willing to invest or develop. When racing was virtually "the only game in town", decades ago, there was limited competition for the wagering and entertainment dollar. Today it's different. A couple of years ago an article by sports columnist Henry D. Fetter in the May 20, 2014 edition of The Atlantic magazine about California Chrome's impending attempt at a Triple Crown noted that "anyone who goes out even to so fabled a racing venue as Santa

Anita can readily see how dire the situation has become. Weekday attendance of 15,000 and weekend tallies of 30,000 or even 40,000 that were once routine have dwindled into "crowds" of 2,000 on weekdays and fewer than 10,000 most Saturdays or Sundays, in a facility that was built to host 80,000 or more." Years ago almost everyone who was a contemporary had heard of Seabiscuit, Citation or Secretariat. Not long ago I conducted an informal survey of a dozen or so well-educated American friends with no direct involvement or particular interest in racing but who were current on national and world events. I asked them who Secretariat, Curlin and Zenyatta were. All but one knew who Secretariat was. None knew who Curlin was and only one had even heard of Zenyatta and he thought she was a Derby winner. It supported my suspicion that the future of Thoroughbred racing in the United States may be in jeopardy because fewer and fewer people care. Apparently Americans increasingly prefer to watch cars rather than horses race around ovals.

Then there is the Breeders' Cup, purposely mislabeled as the World Championship of Thoroughbred racing. I recall a conversation with John Gaines, the main driving force behind the Breeders' Cup, in 1983, a year before the event's inauguration. I don't know if he was being forthright or telling me what I wanted to hear, but he said the primary intent of the Breeders' Cup series was to increase interest in Thoroughbred racing and, consequently, grow the fan base. If that was truly the intent then by every measure it has been a dismal failure. That's not to say it isn't a great day for wagering and watching high class Thoroughbreds do their thing. It is certainly that. On the downside, it has done absolutely nothing to broaden racing’s appeal while the focus on the Breeders' Cup as a singular year-end goal has diminished the significance of many historically important races not the least of which is the former New York Fall Championship series comprised of the Jockey Club Gold Cup (once contested at 2 miles, then a mile and a half and now at a mile and a quarter), the Woodward Stakes (previously at a mile and a quarter and now at a mile and an eighth) and the Suburban Handicap (also previously at a mile and a quarter and now at a mile and an eighth, as well as being demoted to Grade 2 status). Today, if a horse doesn't win a Breeders' Cup race its prospects for an Eclipse award are severely compromised unless its prior dominance within its division is absolute. When so much influence is placed on one divisional race it reduces the significance of all the others within it. I consider that an unfortunate development.

So there you have it. My fading interest in and frustration with American Thoroughbred racing have gotten to the point where the emotional, intellectual and financial rewards are not enough. If I were strictly a handicapper with less emotional investment in the horses themselves I might think differently. Unfortunately, my day-to-day involvement has become more work than pleasure. As expressed earlier, my perception (and I reiterate, my perception, not yours) of decreasing quality coupled with less diversity and an industry unable or unwilling to effectively address its most serious issues tells me it's time to go. Sadly, I see no prospect of a trend reversal. Perhaps these issues have always existed and I just wasn't paying attention or perhaps they have always existed but they were never exposed to the extent they are today. Advances in communication have made access to

information so much easier. That said, I am reminded of the line from Bob Seger's classic song "Against the Wind": "Wish I didn't know now what I didn't know then."

I can summarize my feelings about how much racing has changed with a few of examples of what racing once was and is no longer. On September 28, 1974 at Belmont Park, the great Forego won the mile-and-a-half Woodward Stakes-G1 rallying from 17 lengths behind after the first half mile in a driving finish. Just three weeks later at Aqueduct on October 19 he made an improbable drop back to seven furlongs in the Vosburgh Stakes-G2 and won ridden out under 131 pounds in a time of 1:21.3 giving 13 pounds to runner-up Stop the Music, a very good horse that held the 5 1/2 furlong and one mile dirt records at Belmont Park. And only three weeks after that on November 9, also at Aqueduct, he won ridden out again making an incredible jump to two miles in the Jockey Club Gold Cup-G1. That year he raced 13 times between February and November including a two-month hiatus. Two years later he won the Marlboro Cup-G1 in one tick over the Belmont mile-and-a-quarter track record defeating that year's Kentucky Derby-G1 winner and eventual three-year-old champion Honest Pleasure while toting 137 pounds and giving 18 pounds to his younger rival. In 1956 the equally great Swaps, which had won the Kentucky Derby the year before, raced nine times. In those nine races he set six track records by two, five, five, seven, eight and 12 ticks and matched another. The distances were a flat mile, a mile-and-seventy yards, a mile-and-a-sixteenth, a mile-and-and-eighth, a mile-and-a-quarter and a mile-and-five sixteenths. The new records were established across the country at Gulfstream Park in Florida, Washington Park in Illinois and Hollywood Park in California. On seven occasions that year he carried 130 pounds. Finally, there was Round Table which, in a four-year career during the late 1950s, won 43 of 66 starts with eight seconds and five thirds at 15 different tracks from coast to coast, set 15 track and course records and won 17 times under 130 to 136 pounds. These are the kinds of horses and performances I miss, haven't seen in years and almost certainly never will see again.

I've always felt it is a difficult thing to love both horses and horse racing. It's something I've struggled with for a very long time and it's a position I have expressed to friends and on various racing forums through the years. A very recent event will help clarify my feelings. On May 21 of this year at Pimlico, on Preakness day, the winner of the first race, a mile-and-a-sixteenth starter allowance race on the dirt, was a nine-year-old gelding named Homeboykris. In 2009, Homeboykris won the Champagne Stakes (G1) as a two-year-old. He was subsequently ranked at 117 pounds on the Experimental Free Handicap, the 11th highest rated juvenile colt or gelding of his year. On the way back to the barn after the Pimlico race he collapsed and died. As recently as last December, in his 60th lifetime start, he was claimed for $5,000, his eighth claim in four years. I fully understand that racing is a business, but to me this unnecessary situation (and many others like it) are unacceptable. Homeboykris won over a half million dollars and was among the best of his generation as a youngster. How is it possible that a horse like this was allowed to keep racing for so long while continually descending the class ladder to such an extent? Some of you will understand the point I am trying to make. Others may not. This tragedy has special meaning to me

because I had recommended Homeboykris as a potential purchase for a client following his maiden win at Calder. Having spent so many earlier years connected to horses at a personal level, and independently of their exploitation for profit I have belatedly come down on the side of the horse.

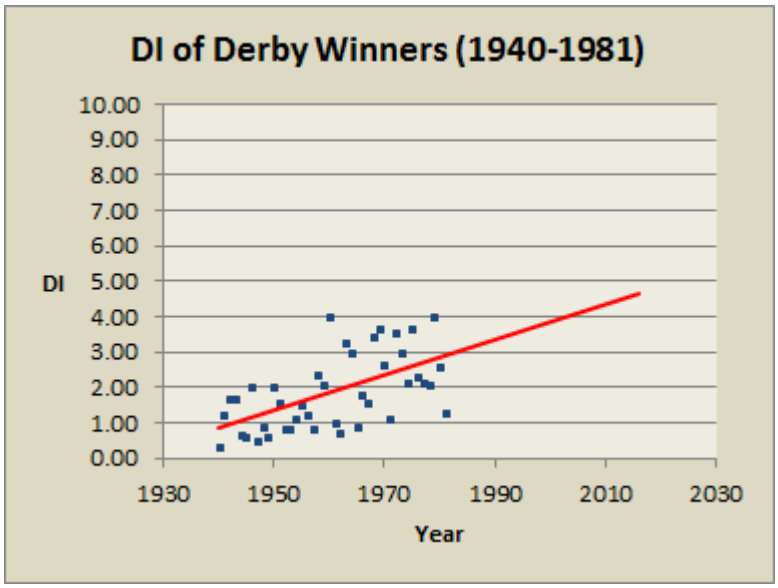
Dosage followers can rest assured that the subject has been left in the more than capable hands of Mr. Steve Miller, my long-standing UK associate whose expertise extends well beyond pedigree evaluation. He has been instrumental in the development of Dosage theory and its application and has been involved in the *chef-de-race* selection process for almost 20 years. He will assume the responsibility for future *chef-de-race* assignments. Steve is an author, correspondent, columnist and analyst. He has also been a Thoroughbred owner – having had horses in training with Mark Johnston (Flat) and the late Toby Balding (National Hunt). He has written on horse racing and breeding issues for Raceform Update and writes a regular column of big-race previews, based on the Dosage system, for the Racing Post Weekender. His observations on the Thoroughbred racehorse have appeared over the years in the Sporting Life, Racing Post, Pacemaker & Thoroughbred Breeder, the Blood-Horse and Raceform and Timeform publications. His academic interests are in Art, Theology and Science. He studied for his MA at King's College London (in collaboration with the National Gallery, London) and has written a book on Italian Renaissance painting – The Word Made Visible in the Painted Image (Cambridge Scholars' Publishing). Formerly a research editor in the City of London, he is a freelance writer and columnist and lives in North London with his wife and two children.

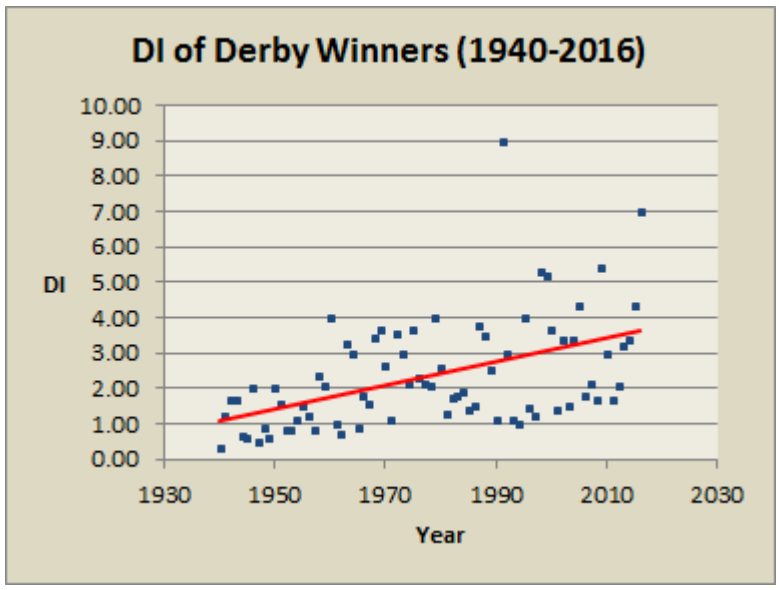
As for Performance Figures, without a national network to expand their utility they will fade away.

In retrospect I believe we have made some valuable contributions to our understanding of Thoroughbred pedigrees. We have confirmed Vuillier's original hypothesis that the aptitudinal evolution of the Thoroughbred can be adequately expressed through the influence of a very small number of the stallions at stud in any era. We have developed statistical tools that allow us to monitor the evolution of Thoroughbred speed over time, clearly confirming the continuous shift away from stamina. And we have shown that the patterns of inherited prepotent speed found in pedigrees correlate in a statistically significant way with performance characteristics on the track for large populations. We have also tried to broaden our understanding of speed figure methodology by shifting the emphasis away from final time to the notion of total energy expenditure while intimately incorporating pace into the figure calculation. And at all times we have tried to present original and current data that the owner, breeder and horseplayer would find valuable. Hopefully our efforts have been useful to some.

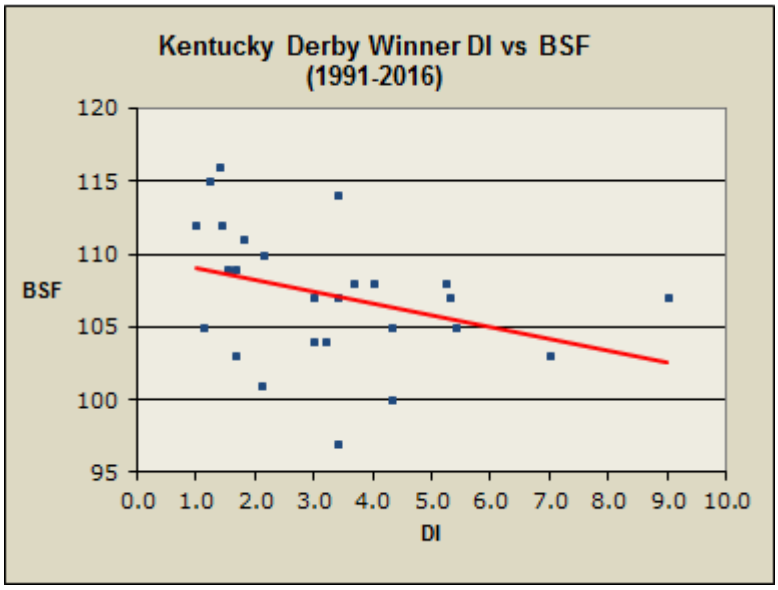
My biggest regret is not having been able to properly frame the connection between Dosage and the American classics, a failure that has tarnished Dosage theory for many despite the fact that the classics were just a minor component of the research. The original observation made in 1981 that no Derby winner since at least 1940 had a

DI over 4.00 was immediately misinterpreted by the turf media led by Andrew Beyer and others as a declaration that no horse with a DI over 4.00 **could** win the Derby. That's the erroneous message a lot of people took away and it is a misperception that persists even to this day. Earlier, in the original Daily Racing Form series on Dosage, we had highlighted the increase in inherited speed in Thoroughbred pedigrees over time as reflected in increasing DIs among divisional champions since the 1940s. Projecting ahead and assuming no dramatic shift in breeding patterns it was clear that the DI 4.00 Kentucky Derby guideline figure was relevant only to that era. The chart on the left below, a version of which originally was published soon after the DRF publication, displayed the DI trend for Derby winners decades into the future and clearly showed that by today (chart on the right) we might reasonably expect an increasing number of Derby winners with DIs exceeding that 4.00 figure. In fact, the current trend line suggests that in the absence of a dramatic shift in breeding direction, we could expect half of all Derby winners to have DIs over 4.00 within the next decade. More Derby winners with high DIs were predicted 35 years ago but the prediction was ignored by a lazy or uninformed turf media.





Beyond just the DI "inflation" factor there is the further statistical correlation between the DI of the Derby winners and their performance in the premier American classic, as alluded to earlier. Ironically, it is Beyer's own data that confirm a decrease in the quality of performance with increased speed in the winner's pedigree, captured in the final chart below displaying the relationship between the Derby winner Beyer Speed Figure and its DI. In fact, the average BSF of the Derby winners since 1991 with DI less than 2.00 is 110.2 while the average BSF for the Derby winners with DI over 4.00 is 105.3, a difference of up to four lengths on the Beyer beaten lengths scale at ten furlongs. Additionally, the difference is statistically significant whether we use the DI at the time of the race or after any changes made since then by the addition of new *chefs-de-race.* This concept, as well, never made it into the public consciousness.



In conclusion, I want to thank the supporters of this web site and of my research for their interest over the years and I wish them and their families all the best. Stay well and good-bye.

June 2016