Bones You Should Know and Love

Skeletal Efficiency

by Leigh Gilchrist
and illustrated by HOWL

The Skeleton of the dog tells a lot about the dogs purpose. Studying this frame and relationship of one set of bones to the other can show you an individual dog's athletic possibilities. The skeleton can, as a basic starting point, indicate the potential for speed, power and endurance.

Leigh and Susan Gilchrist have traveled all over North America measuring top performing sled dogs. Their measurement data spans some 8 years and hundreds of dogs.

Photos and captions arc by Howl staff writer, Harris Dunlap, except as otherwise noted.

FOOTBALL type muscles, while giving strength, may mean this dog would not having optimum sprinting speed. The potential for this dog might be in distance races.

INTRODUCTION

Think of a football player, a basketball player. or a marathon runner. Chances are that each of these brings to mind a "body style." Generally, football players are massive. basketball players al-c tall, and marathon runners are small and lithe. The skeleton of each of these athletes is sports specific, and so it is in the world of canine athletes. You don't see a St. Bernard hody style herding sheep any more than you see a Basset type dog hauling freight in the Arctic. Over countless generations the dogs skeletons have been modified to enable them to perform their specific functions efficiently.

Our major interest in this field has been t" determine just what sort of skeleton is

MARATHON running types, like the field trial HYBRID hunting hound (left), illustrates a different body style largely due to finer bone, applicable size, flatter muscles, besides inherent bred desire to hunt, swim and tree a Coon. SPRINT running types, like the Whippet (on right), are gazehound coursing hunters that sight the game and give chase. Here the muscling shapes the smaller skeleton to affect greater bursts of the DOUBLE SUSPENDED GALLOP...the fastest gait of them all. The Coonhound cross would use a more enduring galloping style, such as the single suspended ROTARY and DIAGONAL GALLOP.

SHOWING sled dogs without running them can alter the outcome. These dogs may have lost most of the breed's initial intended athletic potential.

WORKING field tested hunting dogs, like these Norwegian Short Hair Pointers, often have size, skeletal structure and athletic ability that allows for other work. like these leaders in front of Siberian Huskies in a demonstration and dog show in Sweden.

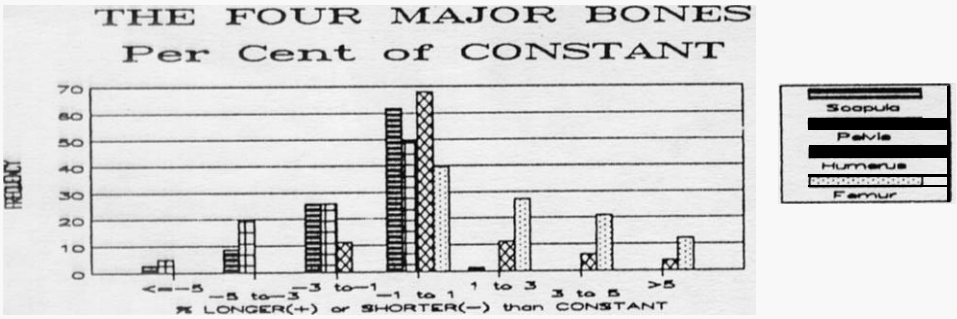
most efficient for a sled dog. Susan learned how to "measure" dogs in 1978, when she took a community college course "DOGS, A HOBBY OR A PROFESSION." Measuring a dog's bone length was only one small part of the course, but one which we felt could have application for our hobby. We had quite a variety of builds in our yard, but our better dogs were also closer to what the book said they should be, so we were encouraged to pursue the matter further.

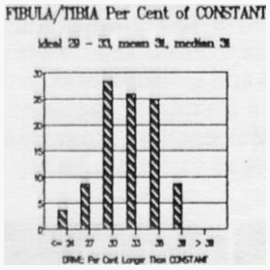
In 1979 we took a bitch down to Doc Lombard's for stud service. His siberians were somewhat different from what we had been used to seeing at the time. We asked Doc to choose the stud. After, the breeding, we then asked if we could measure the dog's skeleton. Doc had Susan measure a few other dogs. He asked questions about the effect of various bone lengths that we really couldn't answer. The questions did get me thinking and many years later, led to a grading system for the skeletal data of a racing sled dog.

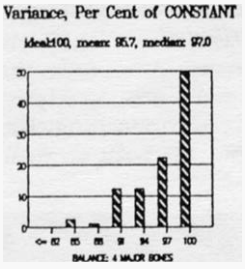
We visited Doc for a number of years. In 1981, he requested that we measure all of his dogs. Doc encouraged us to visit Harris Dunlap, saying that we'd learn a lot. We did so, and gathered data on the dogs that had just won The North American. From questions and input by Doc and Harris, this study has evolved to its present stage. The NORM for RACING SLED DOGS is presently based on over 80 world class sled dogs from the unlimited teams of Harris Dunlap and Mike Boaz, measured from 1982 to 1988. The NORM and accompanying grading system will be updated as more dogs are added.

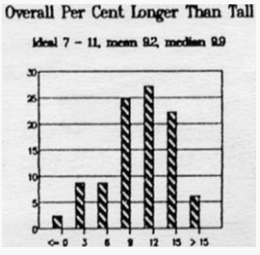
The NORM For RACING SLED DOGS

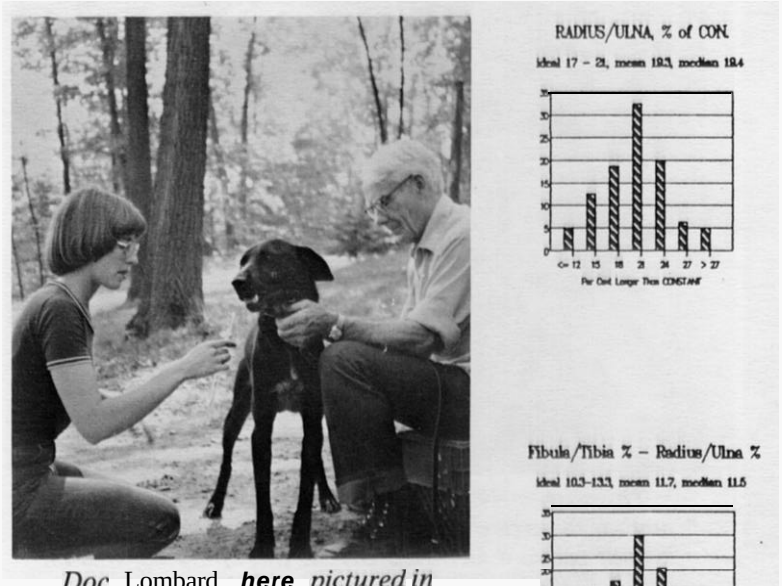
The following graphs represent some of the major skeletal relationships derived from the study of over 80 world class sled dogs from the kennels of M. Boaz and H. Dunlap measured an analyzed by L. & S. Gilchrist, 1982 to 1988.



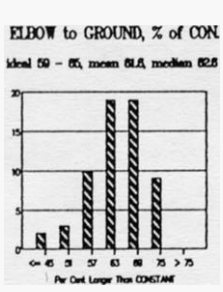


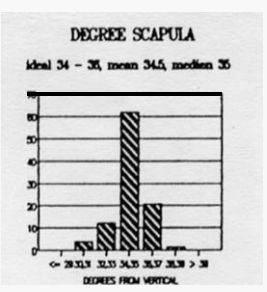


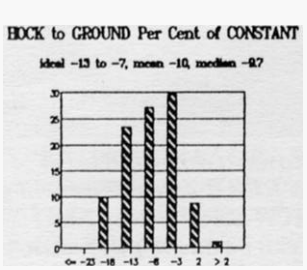


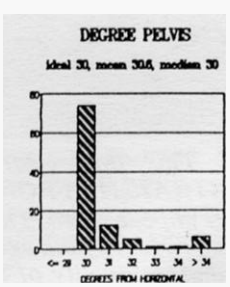


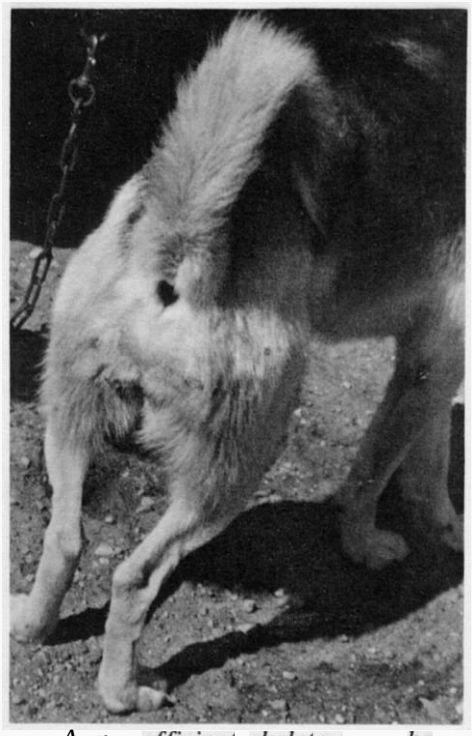
Doc Lombard, ***here*** *pictured in* ***July.*** 1979 ***with Susan*** *measuring* ***BLACKIE, led the*** *Gilchrist's* ***to develop the current skeletal*** *grading* ***system.***











A n efficient skeleton can be distorted by other faults but often it indicates an imbalanced dog. Such is the case with this COW HOCKED dog, whose major four bones were unequal and contributed to unsymmetrical muscling.

Theory

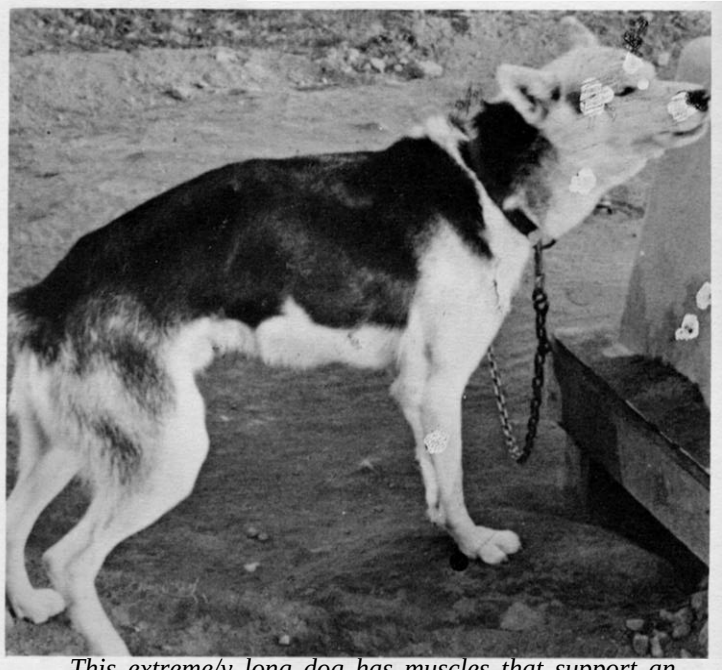
Skeletal data should be used only as an aid and certainly should not take precedence over performance when evaluating a sled dog. Skeletal efficiency determines in part the amount of energy a dog must expend to travel from A to B. It does not indicate how much energy the dog is willing to put out. Skeletal efficiency becomes more important as we raise the levels of stress due to increased speed and distance. It's like fuel economy in motorized vehicles; the faster you go, the lower the mileage; the more out of tune the engine and running gear are, the lower the mileage. An efficient skeleton gives you better mileage. It is also less prone to breakdown.

The intent of a skeletal analysis is to identify the strengths and weakness of a particular dog's skeleton as they apply to the sprint aspect of sled dog racing. Dogs used as the basis of the NORM for Racing Sled Dogs were all world class athletes, they were selected for the team on the basis of performance in harness. All were good dogs. Not all had ideal skeletons.

I have included a few graphs which show some of the skeletal relationships from the NORM and a complete skeletal analysis sheet for Phantom, the sample dog. Raw measurements are from B9 to B31. The CONSTANT, B33, is the average of the four major bones, scapula, humerus, pelvis, and femur. The VARIANCE, B34. is the largest, minus the smallest of the four major bones. D9 TO D34, is the largest, minus the smallest of the four major bones. D9 TO D34 shows the size of each measurement relative to the CONSTANT. The dog is compared to itself; a positive value shows how much longer than the CONSTANT that measurement is. A negative value shows how much smaller than the CONSTANT that measurement is. D34 to D40 show balance relationships. Columns E & F five the score and possible grade for each specific area. The number of marks possible is weighted according to relative importance. Columns G&H indicate the Ideal and Normal Ranges for each area.

The ideal skeleton for an unlimited class sprint dog is balanced, with good rear drive. The four major bones should be fairly closed to equal in length, (see the first graph, it shows D9 to D12). If they are not equal, the scapula and pelvis tend to be shorter, and the humerus and femur longer. One aspect of balance is shown on the middle graph of the top row. Half of the dogs in the study had a VARIANCE Per Cents of CONSTANT greater than 97 (the bar on the right side). This means that the length of the four major bones did not vary by more than 0.5 cm (less than a quarter of an inch) on

This dog clearly shows two faults. A severe STRAIGHT FRONT and REAR assemblage will greatly impede speed. The SLACK BACK (sway back) is often a product of old age, but con be due to poor muscle tone and/or quality of muscle.



This extreme/y long dog has muscles that support an arch. If the arch over the loin is too far forward, it creates a fault called a CAMEL BACK (hump back); this impedes strength. This dog appears to have an incorrect arch. If the arch is correct, it is called a FALLA WA Y ARCH (wheel back) and increases speed. If this dog could run fast, it would lack distance sprinting speed at around IO miles or less.

most of the dogs making up the norm.

The unlimited class sled dogs tend to be smaller than many of the limited class dogs. Size is indicated by the CONSTAST.

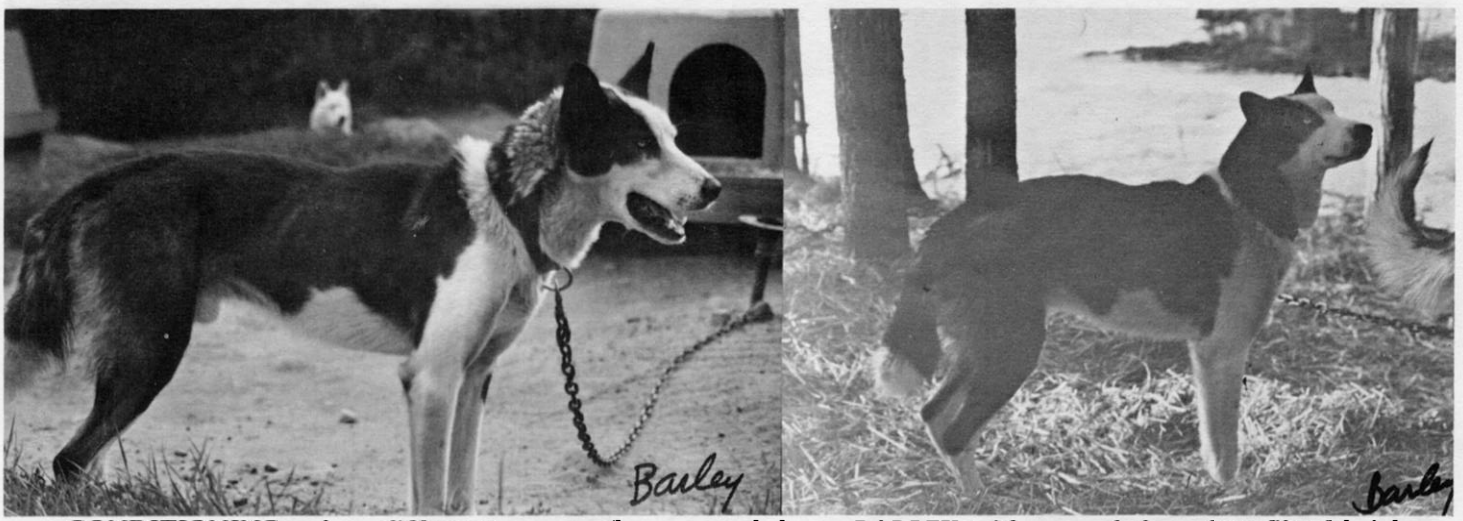
Drive, a prime requirement for the sled dog, is produced by the rear end. The fibula/tibia percent of CONSTANT should be about 31 (= /-2). This would indicate a measurement 31 percent longer than the constant. If the CONSTANT was 19 cm (7 1/2 in.) the fibula/tibia WOULD BE 24.9 CM (A LITTLE OVER 9 3/4 IN.).

The balance, fibula/tibia to radius/ulna, is shown by subtracting their Percent of CONSTANT values. This should give a number around 11 or 12.

The vertical distance, elbow to ground, should be about 61 percent (+ /-4) longer than the CONSTANT, in this case 30.6 cm (12 in.). Similarly, hock to ground percent of CONSTANT should be about -10 (= /-3), or IO percent shorter than the CONSTANT, in this case 17.1 cm (6 3/4 in.).

A sled dog should be about IO percent longer than tall. Here, a dog 57 cm tall (almost 22 1/2 in.) should be about 62.7 cm (almost 24 3/4 in.). Height should also be about 200 percent greater than the CONSTANT. On a hand held calculator, 19 cm = 200 percent gives 57 cm.

The Degree Scapula should be between 34 and 36 degrees, and the Degree Pelvis should be 30 degrees.



CONDITIONING makes a difference eve„ on /he correct skeleton. BARLEY, with a more balanced profile of height to length, is shown in the summer with no conditioning. In the photo at the right, token hy Elaine Martin, Barley is shown just hours before he raced the third heat (30 miles) of the North American Championship in Fairbanks. This is a good example of how conditioning can prepare a good fallaway arch on a proportioned sled dog to maximize potential speed. Perhaps this is /he hardest type of athlete to acquire of all those used for the various sled dog games.

PROPORTIONS of length to height can make a difference in performance. The Gilchrist data indicates.. "A sled dog should be about 10 percent longer than toll." While David Vick's JENNY was only 2 percent longer than tall, she had plenty of determination. Her mental attitudegove her the drive to assist leading to many wins, including the Anchorage World Championship for driver's Dick Brunk and Harris Dunlap.

A SQUARE profiled dog like JENNY, has to compensate by turning sideways at the gallop. This is a fault called CRABBING. Despite this, Jenny possessed such superior A TTITUDE, she was able to speed sprint 30 miles with relative power. Here Jenny (dog furthest right) is caught in the collection phase of a DOUBLE SUSPENDED GALLOP. Note her rear quarters ore slightly turned toward the left, while OATS her companion leader, more classically built, runs much smoother wirh efficient ease. Her better build helped Oats have more speed and greater endurance.

THE FOUR MAJOR BONES
Percent Of Constant

Application

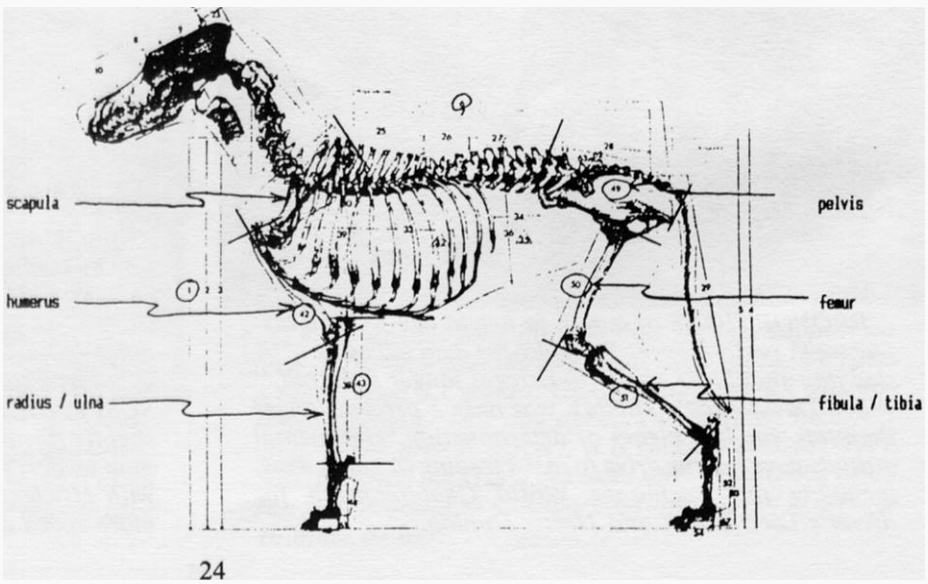
The following chart is a summary of some of the major areas of skeletal analysis. Refer to the graphs and some of the dogs pictured. Scores, from columns E & F of an analysis sheet, are found under the skeletal data.

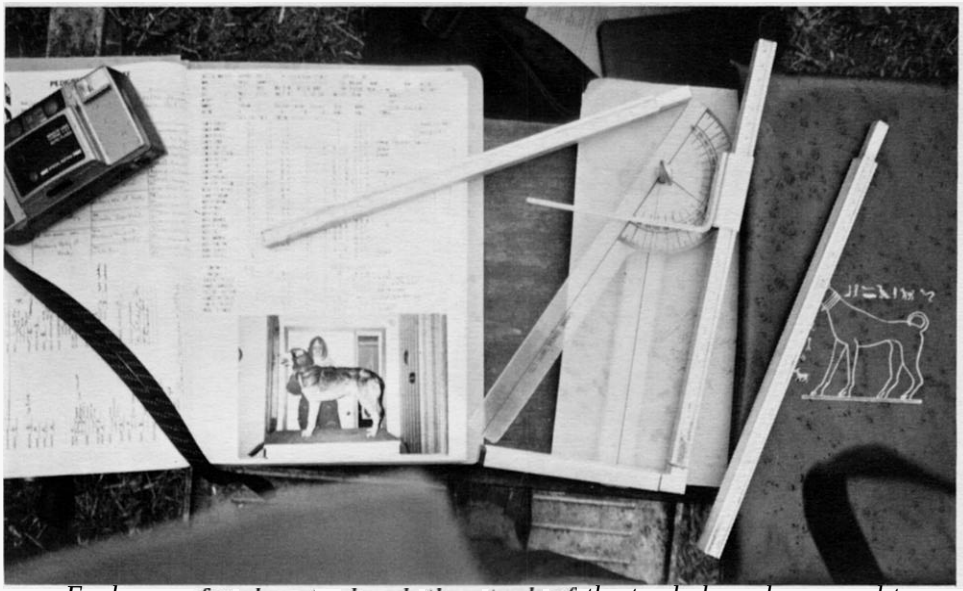
Pistil, Famous, Toots, and Denver are part of the NORM, they are prove" world class sled dogs. Topper and Spitfire are promising two year olds from Dunlap's yard. Wylie and Silver are from our kennel. PISTIL is a Dunlap dog out of Quick by Roots. He fits the pattern very well.

PISTIL, a proven distance sprint dog. The dogs that fit the measurement pattern well, often are the longest lasting athletes. Pistil competed on the first string until he was over 9 years old.

FAMOUS is a Dunlap bitch out of Biter by Durango. She is not as well balanced so does not fit the patter" as well as the other three that are part of the NORM. She has a shorter pelvis and a longer femur. Looking at the top bar graph, her pelvis per cent of Constant (-4.4) would place her into the group second from the left. About 20 percent of the dogs from the NORM fall into this area. Femur percent of CONSTANT (4.4) would place her into the second group from the right, where again, only about 20 percent of the dogs from the NORM fell. Her VARIANCE percent of Constant (91.3) places her into the fourth group from the left in the Variance graph. Less than 15 percent of the dogs in the NORM were this unequal boned. A steep pelvis often appears on a dog with a short pelvis and long femur. Only 7 percent of the dogs from the NORM had a degree pelvis as steep as Famous. Famous has good rear drive and fits the pattern fairly

1. SKELETAL ANALYSIS	sample	ver. 2.1	by Leigh & Susan Gilchrist					
2. name:	Phantom	the sample dog				sire:		feet:
3. age:	2	date:		SKELETAL GRADE		dam:		harness:
4. sex:	male	d.o.b.:		41 per cent		breeder:		coat:
5. weight:	40							colour:
6. owner:			per cent	actual	possible	ideal	normal	
7. rating:	limited class		of	51.5 /	126	range	range	COMMENTS
8.	data (cm)	inches	CONSTANT					
9. length scapula	19.2	7.6	-0.52			0	-2 to 0	
10. length humerus	19.2	1.6	-0.52			0	0 to +2	
11. length pelvis	18.5	7.5	-4.15			0	-2 to 0	
12. length femur	20.3	8.0	5.18			0	0 to +4	
13. length fib/tib	24.3	9.6	25.91	11	20	29 to 33	25 to 37	
14. length radius/ulna	24.0	9.4	24.35	1	5	17 to 21	13 to 25	
15. length pastern	7.7	3.0	-60.10	2	2	-62 to -58	-65 to -55	
16. length chest	34.2	13.5	77.20	0	2	92 to 102	87 to 107	
17. length flank	9.7	3.8	-49.74	2	2	-50 to -46	-56 to -40	
18. length mid back	9.7	3.8	-49.74	2	2	-50 to -46	-54 to -42	
19. len. ster. to pinb.	59.2	23.3	206.74	0.5	2	223 to 235	210 to 248	
20. height tip withers	57.9	22.8	200.00	2	2	194 to 210	178 to 226	
21. elbow to ground	32.1	12.6	66.32	4	5	59 to 65	52 to 72	
22. hock to ground	11.1	6.7	-11.40	5	5	-13 to -7	-18 to -2	
23. hip to hock	41.5	16.3	115.03	1.5	2	120 to 130	110 to 140	
24. depth chest	21.9	8.6	13.47	0.5	2	20 to 27	14 to 34	
25. depth abdomen	15.0	5.9	-22.28	1.5	2	-22 to -14	-30 to -6	
26. width at elbows	13.6	5.4	-29.53	0	2	-12 to -6	-18 to 0	
27. width chest	16.1	6.3	-16.58	0.5	2	-11 to -5	-17 to 1	
28. width abdomen	11.6	4.6	-39.90	1.5	2	-38 to -32	-44 to -25	
29. width hindlimbs	19.2	7.6	-0.52	1.5	2	-7 to -1	-14 to 6	
30. degree scapula	34			5	5	34 to 36	30 to 39	
31. degree pelvis	32			0	5	30	30 to 32	
32.								
33. CONSTANT	19.300	7.6		5	5	18.4 to19.4	17.4 to20.4	
34. variance	1.80	0.7	90.67	0	5	100	94 to 100	
35. scapula% - pelvis%			3.63	0	10	0	-0.7 to 2.5	
36. femur% - humerus%			5.70	0	10	0	-0.7 to 3.5	
37. fib/tib% - rad/uln%			1.55	0	10	10.3 to13.3	7.3 to16.3	
38. flank% - mid back%			0.00	5	5	0	varies	
39. length% - height%			6.74	0	5	21 to 33	7 to 47	
40. overall % longer			2.25	0	5	7 to 11	3 to 15	
A	B	C	D	E	F	G	H	





Each year for almost a decade these tools of the trade have been used to record the data illustrated.

*SUSAN GILCHRIST has measured scores of sled dogs using the special tailored tools which **allow** for consistent bench mark type external values.*

LEIGH GILCHRIST has recorded, refined, and processed the data to achieve meaningful information on skeletal structure. His indicators now can project potential athletic structure for sled dogs. His self engineered computer data analysis has been greatly refined in the process.

well in most other areas. This is the type of build we encounter more often in the limited classes. Famous was doing her job on a world class unlimited team. Nobody in their right mind would cull this dog because her skeleton was not quite what they thought it should be. A skeletal analysis could make a valuable contribution when selecting a dog to breed to Famous. Do not double up on weak areas, increase the odds of getting efficient skeletons in the offspring.

TOOTS is a Boaz bitch, Sanderson lines, out of Tiner by Fritz. She fits the pattern very well. Fibula/tibia and hock to ground are both a bit long, making her a little high in rear, possibly producing a longer elbow to ground for balance.

DENVER is a Boaz dog, Drake lines, out of Rosie by Bourbon. He also fits the pattern very well. If he has any structural faults it is a tendency to be a bit square, that is, he could use a little more body length.

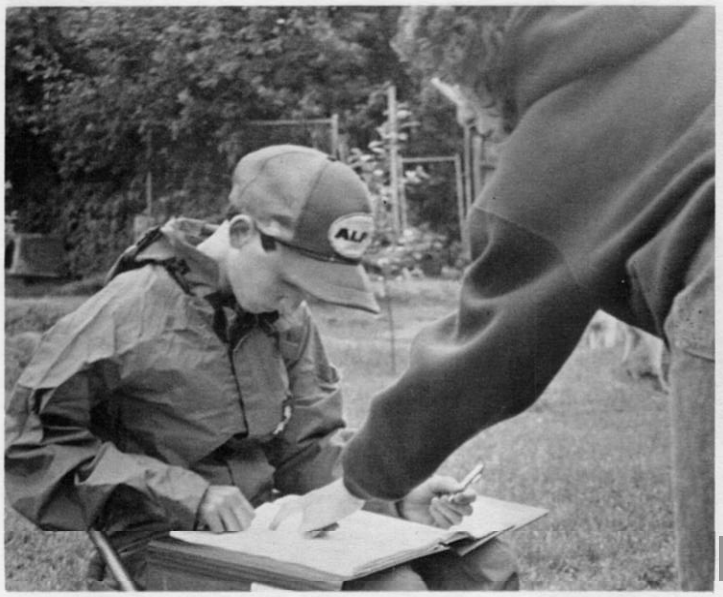
*MEASURING some three dozen sections of a sled dog can be done in less than 15 minutes by ski/led and practiced people. The Gilchrist's **have performed** this service internationally and will travel to Middle Europe this Fall.*

TOPPER is a Dunlap dog out of First by Frozen. Both sire and dam were world class dogs, and are part of the NORM. First, sired by Pistil, is a very nicely built bitch. Frozen, like Famous, was not typical of the other dogs in the NORM. Topper is fairly large, and quite unequal, Variance percent of CONSTANT 90.5. Topper, like some of the dogs in norm, falls into the pattern I call unequal but balanced. The scapula and pelvis are close to the same size, but shorter than the humerus and femur, which are also close to each other. This is allowed for, on a complete skeletal analysis at D35 & D36. Topper's radius/ulna, (and hence elbow to ground) and hock to ground are both short.

This makes him too short in height for his body length, i.e. 14 percent longer than tall.

SPITFIRE is a Dunlap bitch out of Biter by Salty. Salty (Frozen x First) is a well built world class dog, part of the NORM. Biter's skeletal grade is similar to her daughter's, Spitfire is big, especially for a bitch. She is quite unequal boned, Variance percent of Constant 90.1. The pattern of the four major bones here is short pelvis long femur, more extreme than Famous. Elbow to ground is long, contributing to a too square profile.

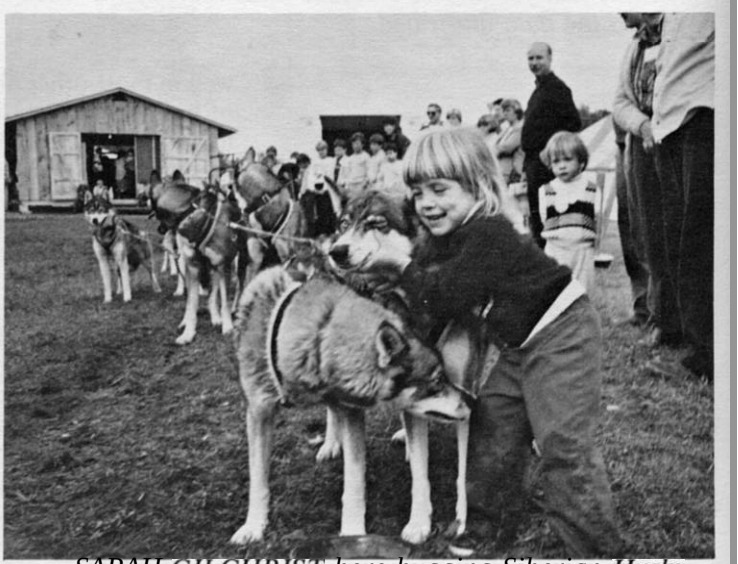
WYLIE & SILVER are littermates form our kennel out of X-Extra by Tango. Tango is a well built inbred Igloo Pak line dog who was on my team for a number of years. X-Extra is an outcross



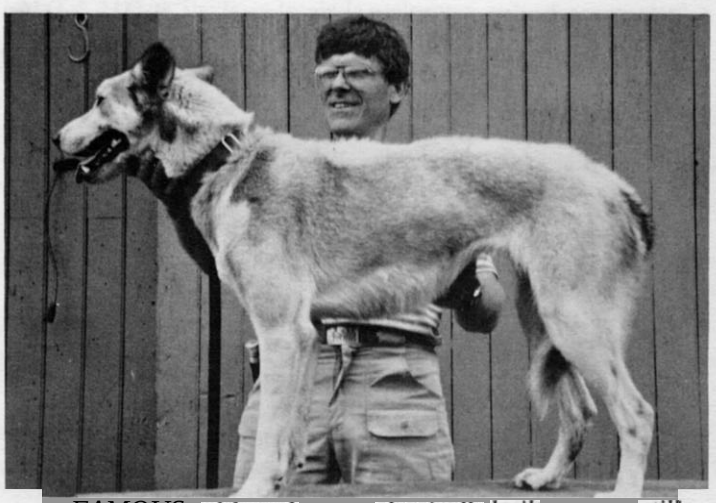
ANDREW FOX of Allentown, PA gets instructed by Susan on how to record measurements.

Each dog gets photographed on the day he is measured as well.

ZERO'S VEGAS at the completion of her measuring and data recording.



SARAH GILCHRIST here hugging Siberian Husky leader WYLIE, has an older sister, ILA.



FAMOUS although not as classically built as most, still has other characteristics to consider in the TOTAL dog. Personality, desire, metabolism, musculature as well as training and conditioning also play a part in making a world class athlete.

TOOTS, being held by Coleen Boaz, while Susan studies a well proportioned athlete. HIGH HOCKS can often indicate early speed; this is more suitable for shorter sprints.

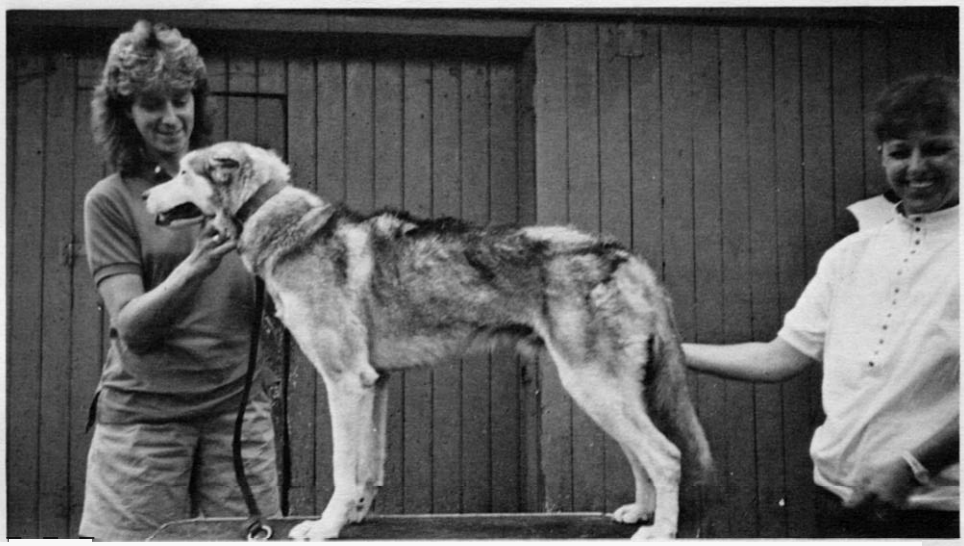
of many racing lines, and is not as well built. Wylie is a smallish bitch, ran first string as a yearling in '85, raced every heat in lead from '86 until mid '89 and has never been injured. She has won the Princess Award as the best leader in the 8 dog class at Saranac. Wylie is very nicely built, and one of the few dogs I've ever owned that I felt might make a world class unlimited team.

Silver, on the other hand, is a basket case as far as having a nice skeleton. He is the only dog to remain in this yard past two years of age and not be able to run on the first string team. Silver has run every race in his life, except one, in lead, but on the second string team. His attitude and desire are second to none. He has good speed for shorter distances, and can do longer distances, at more moderate speeds. Unfortunately, he hasn't the ability to put them together. His gait is different, he moves higher, and places his rear feet outside the front ones at a run. He is poorly balanced (short steep pelvis, long femur), could use more length in fibula/tibia, is too long in radius/ulna, and has a body profile that is too square. Silver loves to go. His poor build is his limiting factor. It just takes more energy than he has available to move his skeleton over longer distances at high speed.

BLACKIE, one of doc's Canadian Border Hounds was among the first world class dogs Susan measured. Blackie was well balanced with good rear drive. (See forward)

FRISKY was a bitch Doc imported, I believe, from Bernie Turner in Alaska. She was very nicely built and is one of my favorite dogs.

DENVER is on example of a very well built sled dog. Here Mike Boaz shows off this classic form.



TOPPER is on example of on unequal but balanced dog. This occurs when the top two bones, the scapula and pelvis ore about the same size, but the lower two, the humerus and femur, while being near equal, ore unequal to the top two. Terri Killam guards the unequal front scapula and humerus, while Dolores Arste brings up the rear two unequal pelvis and femur bones.

CONCLUSION

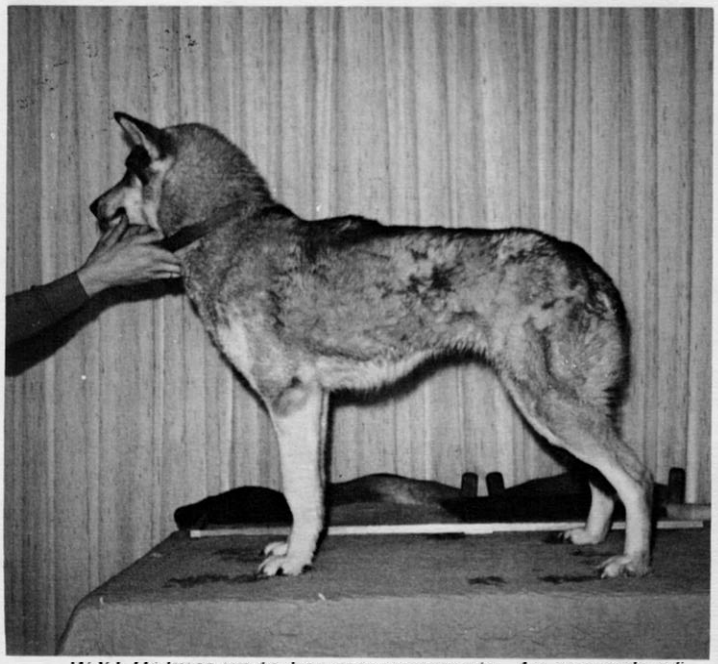
Proper nutrition, training, conditioning, and all around care, are necessary to allow an athlete to reach it's HEREDITARY POTENTIAL. This hereditary potential is determined by the dog's energy generating capacity (such things as cardio vascular efficiency, and muscle type) and the rate at which this energy is consumed (speed, size, work load, and skeletal efficiency). Desire is also a major factor in determining the level of performance. Skeletal efficiency is only one part of the total package which makes up a sled dog.

An unlimited world class sled dog is generally well balanced with good rear drive. A dog running in the limited classes needs drive, but balance is less important due to the shorter distances. Some dogs that perform well at eight miles don't look as impressive at twelve or sixteen miles.

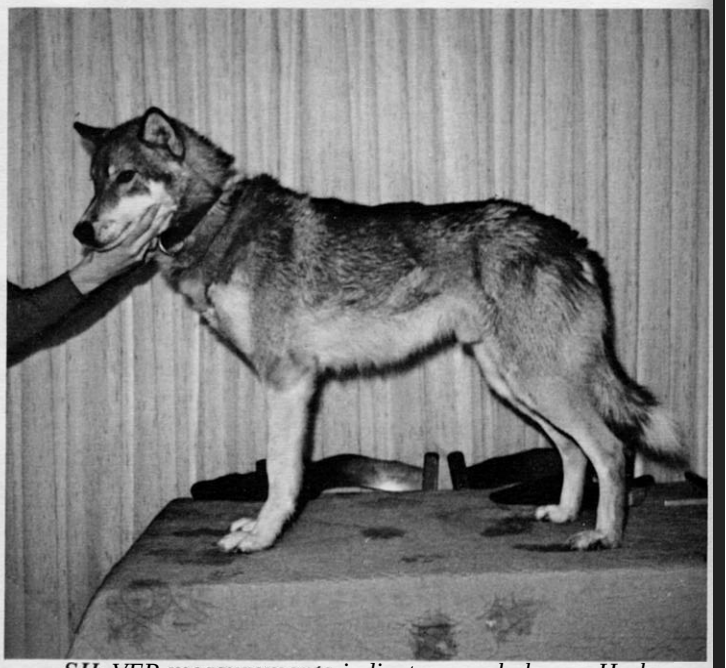
SPITFIRE shows her large size as she towers over Kriyo Dunlop. Spitfire is unequal in each of the four major bones. She could either be a good compensator or lack world class ability.

Knowledge of how a dog is built can be a valuable tool providing insight into how and why a particular dog moves the way it does. It can help to develop an "eye" for a good dog. The skeleton is and inherited characteristic and can be bred for if one knows the strengths and weakness of the ancestors. Only dogs which perform well in harness should be considered, but among that group, one can choose to breed animals which compliment one another. An efficient skeleton does not guarantee the success of the offspring, but it does increase the odds of producing an athlete capable of performing at high speed over distance.

POTENTIAL- IS' INTERESTING, PERFORMANCE IS EVERYTHING.



WYLIE lives up to her measurements. An example of a dog with a good skeleton. A balanced Siberian Husky with speed, power and toughness.



SILVER measurements indicate poor balance. He has a very high attitude, which despite this enthusiasm, does nor compensate for anything but the shorter limited class races.

FRISKY, one of Dr. Roland Lombard's racing sled dogs is very well built and one Leigh favors. This shot was taken in 1981 when a great deal of the first data was collected.