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From the Publisher…

Dear members of PADS and readers of our Journal,

In this issue we publish an article by Alexander Vlasenko about the evolutionary formation of aboriginal dog breeds in Southeast Asia. Information he presents indicates that cynology, as a scientific field of research, still remains almost untouched by biologists to unravel the origins of the domesticated dog. Do they have enough time before the world of aboriginal dogs disappears under the pressures of modern life?

We also publish an article submitted by Perikles Kosmopoulos and Evangelos Geniatakis, who are natives of Crete and breed Cretan Hounds. They love their ancient breed and have dedicated much of their life to its the preservation.

Sincerely yours, *Vladimir Beregovoy*

Secretary of PADS, International

In This Issue…

On the problem of the origin of the domesticated dog and the incipient (aboriginal) formation of breeds

Alexander Vlasenko

Moscow, Russia

In search for an answer to the question about the ancestors of the domesticated dog and where and when it originated, it is not enough to use an approach from the standpoint of one branch of biological science, such as genetics, morphology, comparative anatomy or ethology. Controversial results of genetic investigations and paleontological findings require the use of a complex analysis of obtained data.

Manwell and Baker (1983) wrote that the investigation of the origin of the dog is hampered by "disciplinary dogmatism" and that the origin of the dog out of the wolf is still a hypothesis. Coler-Matznick (2002) thinks that dogs originated from small Pleistocene wolf similar to the Dingo. Not sharing completely the traditional or the innovative point of view, I will try to explain and substantiate my position.

To start with, I will discuss aspects of the biology of the wolf (Canis lupus) as a primary candidate to be an ancestor of the domesticated dog, which is supported by phenotypical

(including behavior) similarities, the results of investigations of DNA and the fact that easy interbreeding between dog and wolf results in fertile offspring.

The contemporary species of wolf is subdivided into 25 subspecies, one of which, the Indian wolf, is separated by some researchers as a different species, based on DNA studies. All subspecies of wolf are capable of breeding with dogs and, moreover, different data indicated that from 5% to 40% of wolves of European populations actually are wolf/dog hybrids. There are breeds of dogs obtained by deliberate interbreeding with wolves: Czech Vlach, Saarloss Wolf-dog, Italian Lupo and currently developing in Russia the Volkosob. Certain wolf subspecies of North America have certainly resulted from interbreeding with dogs. Besides, based on DNA analysis, it is well known that the American Red Wolf (Canis rufus) is a result of the natural interbreeding of gray wolf with coyote, which took place during the last 12,500 years (most likely during the last 2,500 years). In captivity, jackal/wolf, jackal/dog and even coyote/jackal hybrids were obtained, although the natural ranges of jackal and coyote do not overlap. Thus, the fertility of mixed offspring alone cannot be considered as evidence of the origin of dog from wolf.

Furthermore, we should take into account that the contemporary gray wolf evolved under powerful anthropogenic pressure. The wolf became a permanent foe of humans and was subject to extermination since the emergence of livestock. This pressure influenced the wolf's behavior. We know from publications by I. A. Arshavsky (1982) and G. Kh. Shaposhnikov (1966) that the environment with intensive functional stress results in changes of both phenotype and genotype. In other words, environmental stress is a driving force of evolution. Another side of the environmental pressure is the systematic extermination not only of the most bold and trusting wolves in the population, but also whole subspecies and, possibly, species. Besides, a considerable decline of wolf populations often results in the appearance of feral wolf/dog mixes, which become absorbed by the rebounding wolf population. Therefore, it is highly probable that the contemporary wolf is different in many qualities from that wolf, which existed at the time of the origin of the domesticated dog and the results of DNA analysis of their affinity should be treated with caution.

During recent years, international group of researchers led by P. Savolainen has shown that all dogs originated during a short time period between 5,400 and 16,300 years ago in the

southern part of eastern Asia (south of the Yangtze River) out of small group of a few hundreds of individuals of small Chinese wolves. Based on archeological data this time range is between 11,500 and 16, 300 years. The idea of the east Asian origin of the dog out of an extinct Asian subspecies of wolf, Canis lupus variabilis Pei, 1934, is shared by other researchers (Olsen and Olsen, 1977) based on studies of morphology of skulls of wolves and dogs of different populations. However, Tsuda and co-authors (1997) came to conclusion that the dog was domesticated multiple times in different geographic regions.

This point of view is corroborated by the fact that mt-DNA extracted out of skeletal remains of pre-Columbian dogs revealed sequences not detected in samples taken from more then 350 contemporary dogs (Leonard et al. 2002).

Parker et al. (2004) distinguished four groups of dog breeds with definitely different fragments of mt-DNA. They described the process of the evolution of dogs of east Asian origin like the sequential divergence from a primordial wolf-like ancestor, first, the Australian Dingo, then the Basenji and, finally, Laika-like northern dogs. They consider Asian

sighthounds the last group diverged from the dog's ancestral species.

Lindblad-Toh with co-authors (2005) determines the age of the domesticated dog within range of 15,000 to 100, 000 years and proposed multiple domestications. Finally, the group of researchers of R. Wain (2010) published their results suggesting that the haplotypes of dogs are the closest to haplotypes of the Middle Eastern wolf and that wolves of the Middle East were the source of the genetic diversity of the domesticated dog. How can we understand these controversial results, if it is well known that the radiocarbon method determined the age of the oldest fossil skulls of domesticated dogs as 26,000 years (Cauvet Cave, France), 33,000 years (Razboinichya Cave, Altay) and Predmosti (Czech Republic) and even 36,000 years (Goye Cave, Belgium)?

There is no clear answer to this question so far. One possible and most likely cause of the discrepancy in the data is the extinction of several ancient populations of dogs caused by epidemics, such as distemper. In the past century, in the vast territories of the Russian north and in the Far East distemper almost wiped out nearly all dogs. If dogs originated in southern Asia and then they were first to pass selection for resistance to

a virus caused disease, then these dogs migrated to other countries, where their chances of survival would be considerably higher than those of local dogs. It is also possible that the mechanism of "the molecular clock" works not quite as well as modern geneticists believe and the process of domestication and evolution of the dog in different regions of the Earth might be accompanied by a parallel channeled process of recombination of DNA, and likewise the recombination of DNA might take place in the wolf. As a result, the comparative analysis of DNA produced an error.

The results of the Russian-Vietnamese Tropical Center expedition, 2006-2009, the purpose of which was to run a survey of the variation of the aboriginal dogs of Vietnam, allowed the analysis of the origins and evolution of the domesticated dog from a different perspective.

In 2008, in the Ma River Valley (Khanh Hoa Province) I discovered a very small population of wolf-like dogs, extremely similar to Indian and Arabian subspecies of wolves. The distribution of this variety of dog is limited in a small territory populated by Man people, one of the tribes of Miao (Hmong). According to available data, these people are one of the first ethnic groups to have settled in contemporary Vietnam,

which took place about 1000 years ago, near the once large principality of Champa. A high percentage of the people of this principality originally came from India. If 150 years ago Ch. Darwin had reliable information, one of his sources reported that in the upper Gung River the local people had similar dogs. We can believe that this was one hypothetical way of populating Indochina with wolf-like dogs. According to paleontological data, the gray wolf never existed here. However, Dinesh K. Sharma, Jesus E. Maldonado, Yadrendradev V. Jhala and Robert C. Fleischner (2003) are sure that the Indian wolf (from India and Pakistan), which they consider a separate species and part of Himalayan wolves, did not leave a trace in the mt-DNA of the dogs of Vietnam and, therefore, could not originate from their populations. This does not matter. The fact of the survival of an aboriginal population of dogs with considerably greater similarity to wolves than to the breeds of wolf hybrids created by breeders, who were trying to maximize their similarity to wolf by selection, is most interesting. This indicates that the presence of morphological characteristics of domestication is not a necessary feature of domesticated dogs. The very fact of the existence of relic wolf-like dogs tells us that at the first stages of the domestication of the wolf morphological (phenotypical) changes did not exist. It

was simply a socialization of wolf to life with humans. This is done by Australian aborigines with the Dingo until present time. Probably in the past, the behavioral makeup of the wolf allowed this to be done without many difficulties. Thus, a wolf could become a dog and at the same time remain a wolf and even continue interbreeding with free feral wolves.

Based on the description above, I can say that some variety of wolf was one of ancestors of dog, but it was not enough to claim that only one wolf subspecies was the dog's ancestor. Fossil remains of wolves cannot be considered a priori as belonging to the same species, because identical skeletons could belong to animals with different soft parts, systems and behavior, including way of life in general.

The development of morphological characteristics typical of domesticated dogs could appear at a considerably later time, after the wolf became domesticated. Perhaps, the traits of domestication in skeleton appeared last. Comparative morphology shows that in domesticated dogs of different breeds the same muscles can be attached not only to bone, but also with an expanding area of attachment, involving other muscles, tendons and skin and differ in the degree of

differentiation and integration without changes in the shape of the bone.

Analyzing incipient breed formation (performed by the methods of primitive peoples' selection), general trends in changes of dogs' phenotype should be taken into account. Such markers of domestication as piebald color, lop ears, changes in shape of tail and structure of coat, etc. appear spontaneously as a result of systematic selection for behavior. These changes cause a shift in the chain reactions of regulatory mechanisms of homeostasis (D. K. Belyaev and L. N. Trut, 1989). The emergence of these characters in the offspring is not necessarily accompanied by their fixation in the subsequent generations, unless they are deliberately selected for breeding. The direction of selection depends primarily on the practical needs of life and economic activity of a particular ethnic group. Therefore, I see two basic types of selection for visible phenotype, deliberately or not, used in the process of breed formation, depending on the purpose of keeping dogs.

The first type includes cases, when dogs were needed for guarding or hunting. These dogs should retain a body size for optimal performance and have new conspicuous characteristics of the appearance, allowing them to be quickly

distinguished from other animals. In this instance, the choice of traits for selection is determined by the benefits for working qualities and survival.

The second type of selection includes cases, when dogs are considered as food. Then, the best result is achieved by selecting for juvenile traits. Infantile behavior is displayed as dependence on a higher ranking individual in a social group, in this case on the human owner, and a reduction in the size of the territory in which it roams. In physiology this selection favors neoteny, the acceleration of development and the ability to breed at a younger age. In the body structure, preferential traits are a shorter head with a dish face, a stronger pronounced stop, a domed skull and a smaller body size. A smaller dog requires a smaller amount of valuable protein rich food and it shortens the period of susceptibility to diseases caused by malnutrition. Besides, a small dog can be eaten by the family at one meal time, which is also important in an environment with a hot climate and without refrigerators. Such dogs become better adapted to survive on poor quality food, refuse and even coprophagy (Coppinger, R, and L. Coppinger, 2001).

Because the ancestor of domesticated dogs with its characteristic "wild type" met the requirements of humans, it

means that at that time there was no need to distinguish domesticated dog from its wild relatives. This is because they did not present any danger and did not cause any harm to humans. Therefore, the most likely reason for breeding dogs with a different appearance emerged with the appearance of livestock and poultry, subjects to depredation by wild Canidae. At the same time, there was an additional reason for selecting in favor of different dogs. Under conditions of a shortage of hunting grounds and conflicts between adjacent tribes, it was important that hunters could tell apart their own dogs from dogs of neighbors and conspicuous variation in dogs became beneficial. However, in either case, the cause-effect link is traced between population increase, transition to a settled way of life, deficit of food resources obtained by hunting and gathering and the establishment of certain complexes of domestication traits in local populations of dogs.

This is well illustrated by comparing the pattern of the distribution of dogs of certain aboriginal breeds with the dispersion of different peoples in North Vietnam. The aboriginal dogs of Vietnam represent a unique model for study of microevolution, the mechanisms of domestication and the primitive formation of breeds.

In general, the dogs of North Vietnam are represented by a population with very diverse composition, in which all morphological markers of domestication are present. Persistently inherited morphological types are characterized by their own peculiar and limited complexes of characters. Many of Vietnamese breeds are absolutely identical to some old well known breeds, or their original types, of the world in their appearance and body structure. The regions of the world, where these breeds are traditionally bred, are separated by thousands of kilometers from the region of our study. The majority of the breeds we found in North Vietnam can be united in groups of close origin, in which transitional types and ancestral forms can be clearly observed, and they are represented by a series of forming variation.

The dogs I named "Viet Dingo" are smallish dogs with infantile traits. These dogs are associated with the culture of rice paddies and typological traits of local populations allowing the tracing of directions of development of land for this form of agriculture. Thus, the maximal number of typological variants of Viet-Dingo is found in the eastern provinces of Lang Son and Tainguen, where Tai people live. Dogs of Viet-Dingo type are most numerous in North Vietnam, but their share in the

local population declines from east to west and to north-west. The frequency of Viet-Dingo is highest mainly in the fertile valleys cultivated for rice production, but also in other regions with conditions unfavorable for agriculture, where people are poor and do not keep big dogs, because of food shortages. Moving along the river valleys to the west and north-west, the typological diversity of Viet-Dingo dogs declines and local populations are represented only by one-two types instead of the six types found in the eastern provinces. Judging by the variation series, this group of dogs originated as a result of the interbreeding of small Dingo-like dogs with Laika-like dogs either in north-eastern Vietnam or in the border territories with China.

A large type of aboriginal dog is bred mainly by the Hmong, who until recently made a living by hunting, and the distribution of these dogs is clearly associated with the distribution of the Hmong people.

It is possible to say that most probably the bobtail dogs of the Hmong, which are very similar to the now lost bobtail type of Karelian Bear Dog, called Shong were distributed from the Northern Province of Ha Gyang along the Shonglo River and further to the south into the province of Son La. Dogs that

are phenotypicaly similar to Siberian Laikas and Arctic sled dogs (Figs. 1-5) are distributed in the form of a semicircle from the northern part of Lao Cai province, along the Shongda River, across northern part of Yen Bai, Tuyen Quang and Bac Can provinces to the center of Cao Bang province, in other words, from northwest to southeast and further to the east. These dogs are most typical in Lao Cai province and are rather common, but they decline numerically to the east. In Lao Cai, we found the best looking representatives of this breed, very similar to big Japanese Laika-like dogs, and populations of ancestral Chau-Chau (Bakha Dog) are concentrated here. Smallish Laika-like dogs similar to Karelo-Finnish Laikas and Spitzes are most likely the product of mixing with small Dingo-like dogs (Fig. 6).

Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.

Fig.5.

Fig. 6.

The series of variation is best represented in the group of hound-like dogs, starting from a primitive type identical to the hounds of Tibet, West China, known in Russian literature as Mahugou (Fig. 7), to a primitive sighthound type (Fig. 8) and to various variants of analogs of ancient Russian scent hounds (Fig. 9) and dogs similar to the modern Foxhound (Fig. 10), Labrador Retriever (Fig. 11) and to dogs very similar to herding dogs of Scotland (Fig. 12) and also to types of livestock guarding dogs of Tajikistan and Tibet (Figs. 13), Caucasian and Karakachan Dogs, but relatively smaller in size (Figs. 14-16).

Different forms of dogs I included in the scent hound type dogs group are distributed mainly in provinces of Lao Cai, Yen Bai and Tuyen Quang. They were most diverse in Lao Cai province. The uniqueness of this series of variation is in the fact that there is nowhere else in the world a continual transition between types of dogs considered by cynologists as breeds of absolutely different origin and purpose. The theoretical projection of the series of variation in both groups in the direction of diminishing specialization of the appearance brings us to a prototype (archetype) common to both Laika-like and hound-like dogs. I was lucky to find a type of dog that combined in its appearance basic traits of both groups. I think

that the pictures alone show that this prototype is one step different from the wolf. However, if we consider the variation series of the scent hound group, selecting only light and medium built dogs, their hypothetical ancestor would be very different. In this case, the variation series will be ascending to dogs that I tentatively named the Big Chinese Dingo.

Fig. 7.

Fig. 8.

Fig. 9.

Fig. 10.

Fig. 11.

Fig. 12.

Fig. 13.

Fig. 14.

Fig. 15.

Fig. 16.

The North Vietnamese type of Big Dingo (Figs. 17-18) has differences from the South Vietnamese Dingo, which were probably caused by interbreeding with Laika-like and scent hound-like dogs. I can say that this type is closer to the wolf, especially to the Tibetan wolf. The big Indochinese Dingo is not numerous in Vietnam, although it occurs in most of the regions surveyed by the expedition. Its southern morphological type (Fig. 20) is very similar in the appearance to the basic, not mixed, type of Australian Dingo. However, the Australian Dingo often has domestication markers and pedomorphic traits

characteristic of the North Vietnamese "Viet-Dingo". According to the results of molecular genetic studies, the time of divergence of the Australian Dingo from Dingo-like dogs of Southern China, Taiwan and Polynesia, belonging to the same form as the "Viet- Dingo", was determined as 5,000 years (Savolainen, 2002). The Big Indo-Chinese Dingo is probably considerably older than the age of populations in the regions surveyed.

Fig. 17.

Fig. 18.

Fig. 19.

Fig. 20.

The Australian Dingo had been secondarily changed to running wild during several thousands of years until recent times, when a considerable part of its population became mixed with stray dogs of European and American breeds. Nevertheless, it retained and possibly even obtained new, stabile morphological traits identical to the Big Indo-Chinese Dingo. Under conditions of genetic isolation and feral life, the Australian Dingo did not develop traits similar to the wolf or jackal, surpassing those in variation of the Big Indo-Chinese Dingo.

On the other hand, it is even more surprising that in the territory of Indochina a form of the Big Indochina Dingo survived. In the best representatives of it, "wild" traits are even more pronounced than in the Australian Dingo. While being selected for behavior under conditions of domesticated life, the Big Indochinese Dingo should be subject to destabilizing selection and, living among Dingo-like, Laika-like and hound-like dogs, it should be genetically influenced by interbreeding with them. However, for some reason, some of the Big Dingos, living in different corners of Indochina, remain absolutely identical to type and have the same measurements, body structure and appearance. Such stability of morpho-type most likely tells us that other morpho-types, occurring around these dogs, are its descendants.

Based on these observations and considering the origin of dogs diligently, it would be reasonable to suppose that the Big Indochinese Dingo retains an unchanged complex of morphological characters of its ancestor, just as the wolf-like dog of the province of Thanh Hoa retains the traits of the wolf.

Unfortunately, the program of studies of the aboriginal dogs of Indochina was cut short at half way and we did not have enough time to the complete survey of dogs of Southern

Vietnam. Now, using fragmentary and scarce data we can restore the general pattern of typological diversity of the dogs of the southern center of formation of breeds in Vietnam. Probably, its center was near the shores of the Siam Gulf or Andaman Sea. If the Australian Dingo carries intermediate traits of southern and northern Vietnamese dogs, then New Guinea Singing Dogs belong to the southern center of breed formation, to which dogs of Southern and Western Indochina also belong, as well as the dogs of the eastern shores of India (Figs. 21).

Fig. 21.

The result of the comparison of morpho-typical traits of dogs of the southern center of breed formation compels us to accept that the northern morpho-type of Big Indochinese Dingo was primary in relation to the southern one. The northern morpho-type was almost certainly ancestral to the variation series of big Dingo-like dogs. However, with small Dingo-like dogs of the southern center, the picture is not that simple. Among small southern Dingoes, there is one type, which represents the regular result of the reduction of body size, but it is relatively rare. The majority of small dingoes are represented by the variation with too big a hiatus, separating them from the Big Dingo, and, according to known regularities of changes in body structure caused by diminishing size; they cannot be drawn directly out of the Big Dingo.

In the example of the longhaired variation of small Dingo-like dogs of the southern center of breed formation , it seems that the ancestral form of this group had much in common with the morpho-type of red wolf.

The southern morpho-type of Big Indochinese Dingo could be the result of interbreeding the northern morpho-type with an ancestral form of small southern dingoe. Because nothing is known about the existence of hybrids of the Dhole

with dogs and nobody ever checked the possibility of such crossing, we can propose that at some time in the past either a sibling species of Dhole was domesticated or the evolution of big and small Dingo-like dogs of the southern center of breed formation was going on independently at a different time and in different regions.

The origin of small Dingo-like dogs out of wild ancestors is corroborated by the unusual physical peculiarities of the New Guinea Singing Dog that are poorly specialized in running but are well adapted to climbing and agility. Dissection of a small Dingo-like dog killed by an accident, purchased during the work of the expedition, showed that the amplitude of rotation movement of the forearm was about 1.5 times that of an ordinary dog. This dog was very similar to the New Guinea Singing Dog. Study of the proximal radius-ulna joint allowed us to discover the presence of a sesamoid bone, which protects the joint on the lateral side. Unfortunately, I could not confirm the presence of this trait in other representatives of this morpho-type, because of the premature closure of the research program. A similar and not constantly present structure in about the same part of body, the sesamoid bone in the tendon of musculus supinator, is found in the coydog (coyote and wolf hybrid, “Miller’s Anatomy of Dog”).

While discussing topics of comparative anatomy, I will make clear the following: we are interested in the possible inheritance of anatomical peculiarities from wolf to dogs of different breeds, because we have chosen the wolf as the "gold standard" of a healthy anatomy. The goals of my work are rather practical, they are usually considered as topics of veterinary medicine. First, until now, I had in my possession corpses of wolves sampled from populations of Tver, Rostov and Voronezh provinces, all territories known as places where in recent times wolves and dogs have interbred. In two cases I found characteristics of possible crossing with dogs. Second, these territories are very close geographically, and, therefore, I cannot extend the obtained results to all subspecies of wolf across its vast geographic range.

Evaluating the direction of morphological changes, I assume that specialization to running (both wolf and dog are specialized runners) always results in the reduction of the complexity of the locomotion apparatus numerically, for example, the structural consolidation of originally separate muscles with the enhancement of their integration.

Anatomically, dogs of different breeds conspicuously differ from each other. It is not quite a joke, when we say that

the anatomy of dog does not exist; there is only morphology, because the range of variation is too big for one species. When we compare dog with wolf, supposedly dog's ancestor, sometimes we find a mismatch. Some of the traits may be inherited and some may be lost. There are known cases of the loss of muscles as a result of dwarfism or specialization and some muscles can become hypertrophic. Finally, a new trait can emerge, not existing in the ancestral form. However, if we find an archaic trait in some breed of dog, which is absent in the supposedly ancestral form, but is typical of a higher taxonomical rank, then there is reason to doubt whether the modern wolf was ancestor of the dog.

Speaking of hereditary succession, not all found discrepancies can be easily explained. Thus, in sighthounds, whose locomotion apparatus is more similar to that of the wolf than that of other dogs, peculiarities of the integration and differentiation of the muscle-tendon system could be inherited from the wolf or obtained independently in the process of specialization. Therefore, comparing wolf and dog anatomically, I offer only one example, which in my opinion is vulnerable to criticism.

As I mentioned above, some scientists draw a line between wolf and dog based on craniological indexes. I paid more attention to the structure of the frontal bone. As a result of research of skeletal material in our collection, I found the following:

- The posterior chamber of the frontal cavity of the wolf (Figs. 22-23) has a complex architecture, which is relatively low at the medial margin, curved and higher positioned at the entrance and opening into the anterior chamber, which is connected with the dorsal nasal passage.

- In dogs (except the Hortaya, German Shepherd Dog and East European Shepherd Dog, which are similar in these features to the wolf) the posterior chamber of the frontal cavity (Figs. 24-26) is large and high, with a simpler architecture and has a wide, straight and low positioned entrance opening immediately into the nasal passage.

- In the wolf, the area of the perforated plate is approximately 1.5-2 times as large as that in the dog, proportionally to body size.

Fig. 22.

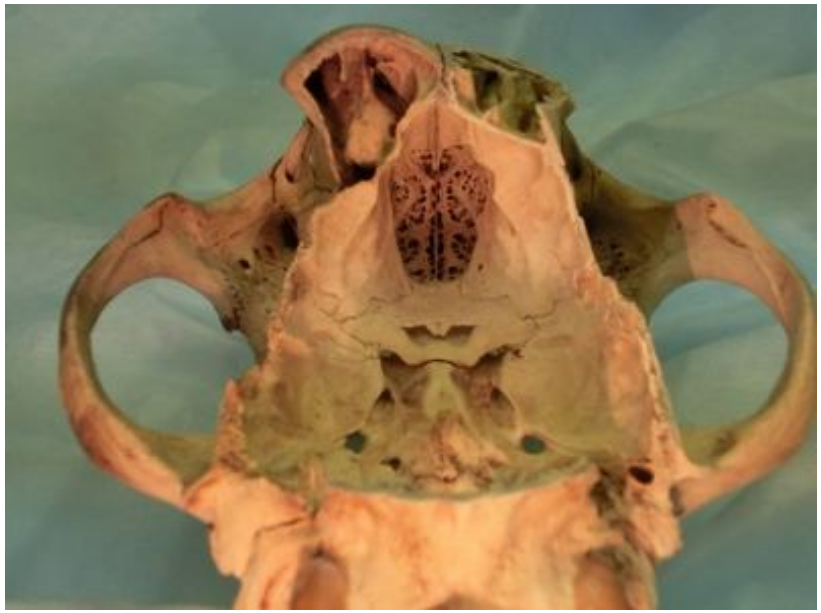

Fig. 23.

Fig. 24.

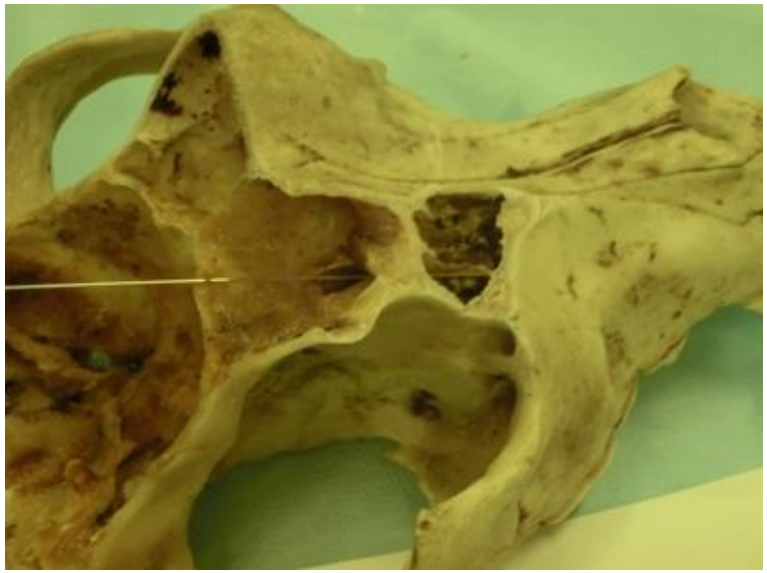

Fig. 25.

Fig. 26.

The differences described above are easy to explain by functional anatomy. Frontal cavities, besides their function of a protective cushioning of the frontal bone, serve as an important part of the thermo-regulation of the body. One major problem of marathon runners is the disposal of excess heat generated in the muscles (Coppinger, L&R. Coppinger, 2002). In the process, maintaining the optimal temperature of the brain is most important (Schmidt-Nielsen, 1972). The main way of cooling the body of the dog and the wolf is by evaporation from the surfaces of the tongue, mouth and nose. However, the perforated plate, bordering the hard wall of the brain and with

the rostral epidural net, serves as an effective radiator of heat as well. This way of cooling the brain is important to such an extent that in puppies, from birth to about one month, when heat loss is dangerously high, the perforated plate is separated from the brain wall with pads of fat (Fig. 27). Under conditions when the air temperature is significantly lower than body temperature, the role of the frontal cavities is to protect the brain from hypothermia.

Fig. 27.

A thin layer of warm air with its low circulation becomes beneficial and this is what we observe in the wolf. However, in the tropics, when high air temperature is combined with high humidity, conditioning the body temperature with this mechanism does not work. In the thermo-regulation of the aboriginal dogs of Vietnam, compared with breeds of European origin, perspiration from the abdominal skin and the reduction of heat generation in the body become very important. In the tropical environment, there is a high danger of overheating shock caused by strong insulation even when weather is cloudy and foggy. Short hair on the forehead of the dog cannot protect the brain from overheating. The surface of the body exposed to the sun can heat up to 10-20° C higher than the ambient air temperature. In such a case, to prevent the transmission of heat from the surface of the forehead to the brain, the frontal large cavities with fast air circulation coming from the nasal passages through a wide entrance opening is very helpful. Thus, the analysis of the structure of the frontal cavities in dogs and wolves shows their original adaptation to different environments, which required different mechanisms of thermo-regulation. In my view, this is a strong argument in favor of J. Koler-Matznik's view that Dingo-like dogs did not originate from the wolf.

Summarizing the results of our work, I think that most likely the domesticated dog originated from several subspecies of wolf and a now extinct wild form of Dingo, not excluding other ancestral forms.

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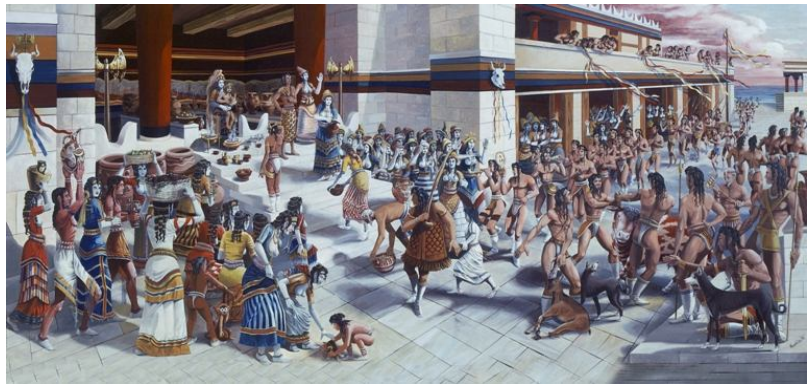
The Cretan tracker (or Kritikos Ichnilatis). Study of a living legend.

by Perikles Kosmopoulos submitted by Evangelos Geniatakis*



Κρήσσα κύων ελάφοιο κατ' ίχνιον έδραμε Γοργώ, έγκυος, αμφοτέρην Άρτεμιν ευξαμένη. Τίκτε δ' αποκτείνουσα. Θοή δ' επένευσεν Ελευθώ άμφω ευαγρίης δώρα και ευτοκίης. Και νύν εννέα παισί διδοί γάλα, φεύγετε, Κρήσσαι κεμμάδες, εκ τοκάδων τέκνα διδασκόμεναι. "The Cretan dog Gorgo, pregnant, was running at the tracks of a deer, praying to Artemis with her double ability. She gave birth while she was killing the deer and quickly Eleftho (Artemis) blessed with successful hunting and good birth. Now she is feeding nine puppies. Go away from Crete young doe, now that you know what kind of children these mothers will breed (Antipatros from Thessaloniki, 268 BC)."

The Cretan Tracker is a product of its environment. In Crete, this means the dog is especially well adapted to rocky mountainous terrain (the island of Crete is characterized by very high mountain ranges that cross its length from east to west). It has traditionally been used to hunt wild boar, wild goat and particularly wild hare. Not many dogs are capable of hunting in such a steep and craggy environment, but the Cretan Tracker can do so very efficiently. As one old man from the village of Schinokapsala in Sitia Province said, 'local hare need local dogs'.

The Cretan Tracker can range in color from creamy white to golden to brindle to black and tan, and the occasional agouti. They tend to have erect pointed ears, a dolichocephalic head shape, an upward curled tail, and highly developed toe and foot pads that help them expertly navigate the mountainous landscape.

Ailianos the great Greek philosopher, noted "the leaping Cretan dog, a mountaineering companion and indeed as such the Cretan people use it, that is where its fame comes from." Libanios, the Greek orator, was among many ancients that spoke of Crete's special scent hounds, emphasizing their reputation as excellent trackers with a famous sense of smell.

The dog has existed on the island of Crete for thousands of years. Ancient Greeks like Aristotle, Xenophon, Opianous, Eliano and others all refer to a dog they refer to as the 'dog Krissa', characterizing it as the 'dog without pain' (diaponi), the 'dog which walks along with horses' an agile dog which lives in the mountains. We find depictions of a Cretan Tracker-like dog all across the Mediterranean, from Spain to Algeria to Egypt and Greece, on old Cretan coins, in cave paintings, and on ancient pottery.

Other ancient accounts describe the local dog as a very good runner which tracks with the nose down and has a short upright, semicircular tail. This kind of tail helps the dog to climb the rocky terrain, and shows that the animal does not chase its prey for long distances, as would a more greyhound-like dog that needs long and agile tail as a counterbalance to maneuver. Instead the Cretan Tracker rushes its prey almost in ambush and if it fails, it continues with tracking.

Accounts from early explorers describe the local dog as wolf or fox-like, for example this excerpt from Joseph Pitton de Tournefort's A Voyage to Crete and the Islands of the Archipelago 1700-1702:

"….The dogs of Crete are all mongrel hounds, badly shaped but agile, and they all belong to the same breed. Their coat is quite ugly and based on their appearance it seems that they are something between a wolf and a fox. They have retained all traits of their former faculty and, of course, they are very good hunters of the hare and of the small boar. When these dogs meet, they do not avoid one another, but they stop and start growling and showing their teeth, which, by the way, do not belong to the ugliest parts of their body. Afterwards, they calmly change course. One does not see another breed of dog on the island. It seems that the breed is there from the era of beauteous Greece. Ancient texts report only the dogs of Crete and of Lakaidemona. It appears that they had been inferior to our own hounds that are very widespread in Asia and in the outskirts of Constantinople, where they can develop their talents, and also in the plains of Thrace and Anatolia. We once kept with us one of these Cretan dogs that would sometimes serve us in the most isolated parts. Arab (or, Arapis) - that was its name, had such an aversion for those who wore turbans, that it would immediately withdraw to one of the corners of our consul's house and waited there quietly to be given something to eat, without daring to enter in the kitchen. As soon as somebody wearing a hat appeared, Arab would go

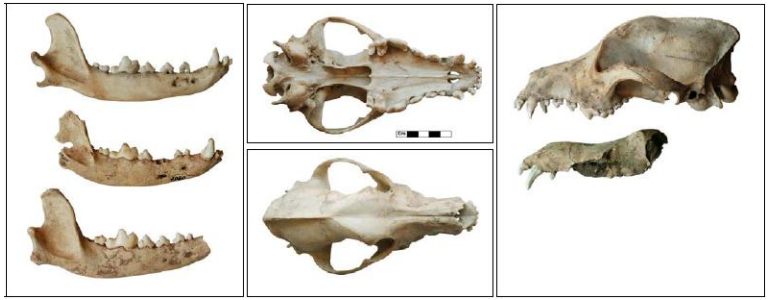
to him and playfully show its delight. We soon became friends with this "automaton", when we realized its virtues, and it attached to us more than to the other French people. In the countryside, all we had to do was to give him the signal that was to clap our hands and shout its name 3-4 times. It would immediately leave in order to hunt and it would not return unless it carried a hare or a little boar…"

Over a century later, by Robert Pashley Esq. in his book Voyages in Crete written in 1834 wrote:

"The Cretan dogs all belong to the same characteristic breed of the island…This dog is smaller than the hound, with a rough and longer coat, while its head resembles that of the wolf. They follow the prey by scenting it, and they are clear-sighted animals that resemble the common dog more than the hound. I am certain that these dogs are direct descendants of those reported by the ancient writers."

Archeological excavations in 1878 unearthed dog remains from the Minoan period (1500 BC). In the 1980's the British School of Archaeology presented the fossils of the excavations at Paleokastro in Sitia and referred to a number of findings concerning dog bones from the Minoan era, which they studied in comparison with bones of today's Cretan trackers. Based on these studies, the president of the Greek

Kennel Club, Dr. Basourakos with his own studies publishes the National Morphological Type of the Cretan Tracker in 1994.

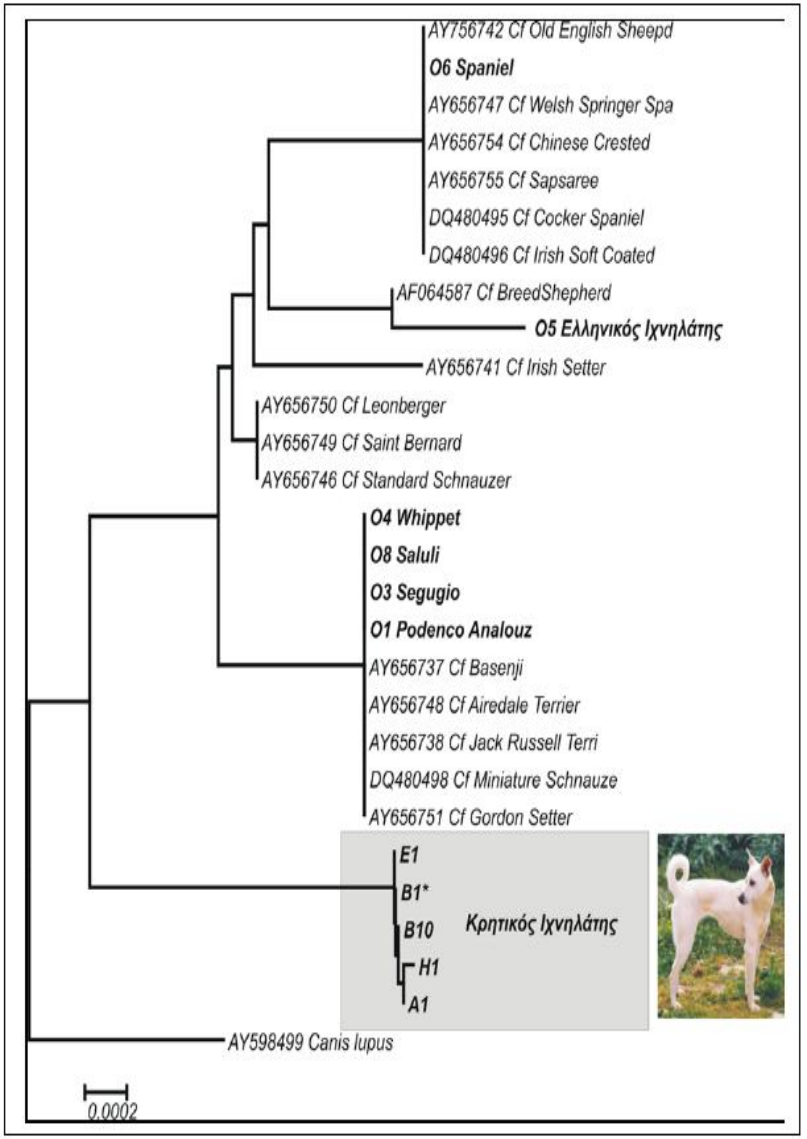


In the years that followed the local club of the Greek Tracker (O.F.K.I.), which was already established, tried to save and preserve the few noteworthy examples. More recently genetic studies have been conducted by University of Crete's Nick Poulakakis through the Museum of Natural History of Crete.

Study of genetic relationships of the Cretan Tracker

The framework of the research program to identify the Cretan Tracker (Canis familiaris) was the exported total of genomic DNA from 49 dogs from the area of Crete, which

were morphologically identified as Cretans Trackers and 6 dogs that live in Crete, but belonged to other breeds. From the entire genome a mitochondrial gene (cytochrome b) was targeted which has routinely been used in genetic analysis of other dogs around the world. Overall, 500 bases of DNA cytochrome b were found and once they were aligned properly so that they could be compared with the corresponding DNA of the other dogs that we collected from the genetic database (NCBI-GenBank), they were analyzed using appropriate statistical software (MEGA, PAUP). The result was a phylogenetic tree, which shows clearly (although the genetic variation is very small) that the Cretan Tracker is different from other dogs. And to be sure that the differentiation we see in the Cretan Tracker is due solely to this breed of animal and not due to the isolation of the island of Crete, we included in the analysis other dogs (different breeds) that live in Crete, but these are grouped with other breeds of dogs such as those that were collected from the genetic databases. All these suggest that the Cretan Tracker is genetically different from other dog breeds. The Cretan Tracker also shows high genetic diversity, as compared to other dog breeds.



The Cretan tracker then is, in my opinion, a 'multipurpose' dog, which has all the elements that his ancestor did. Because it was isolated on an island, without competition or mixed breeding from other more recent dog breeds, it was able to retain all the characteristics of its origin.

Hunting Behavior

The Cretan Tracker has adapted over the millennia to hunt in the very rugged mountainous landscapes of Crete, with highly developed toe pads and also overdeveloped foot pads. The Cretan Tracker is a scent hound, it hunts by smelling the ground, approaching the prey very close and attacking. Its tactics are twofold. The first one is what we call in Crete "Anemistos" (using the wind – sensing the air). The second is tracing or tracking.

"Anemistos"

This tactic is practiced by all dogs and it is derived from the adaptation of our dog to the dry and warm environment that it was forced to live in. In fact, it is performed by the tracking dog because it senses that there is a prey somewhere around it but cannot spot it due to the lack of tracks on the dry rocks as well as the high temperatures. There are many dogs that use this tactic (provided that they have learned it at an early age) through the whole of their life. Other dogs

use it while tracking but only when they lose the tracks of their prey.

The dog sniffs the air near the spot where the hare is supposed to be found, so as to locate it by the remaining scent, and attacks the moment it makes the slightest movement in the bush where it hides. This is a spectacular tactic which allows the hunter and the dog to hunt at midday or in the afternoon and to be successful. This is done by the dog with great attention and assiduity. At first, it gives the impression that it wanders aimlessly, smelling the fallen branches of trees or the paths, wagging its tail or not, walking in small circles, returning to the same spots, going in and out of the bushes giving the impression that it is not looking for something in particular. In this case, the search does not last for long because the dog does not delay by any means on the path that the hare passed through but it directly moves towards the dense vegetation and if the dog is experienced it goes straight to the hare's seat remembering the points where it had previously sensed it. During this hunt it is silent and careful, stopping at times and checking the space by sight and smell. If something troubles the dog we hear it groaning (not barking) something like a complaint and it will turn to its owner and will wait for our attention and encouragement. When it locates the prey and

its position allows the dog to charge, it suddenly becomes violent and at this point we can hear it making the first sounds. If the hare hides inside a big bush and it is possible for it to remain unnoticed, then we see our dog moving abruptly around the spot, wagging its tail spasmodically and standing on its hind quarters in order to be in a position of control.

If the dog is certain that the hare will not come out, then the onrush is so violent that many times the noise made by the broken branches is so impressive that one might think that the dog might be seriously wounded. The pursuit is eager and the voice of the dog makes penetrating and long sounds; its bark then sounds like a sharp howl. There are a lot of dogs that, at the moment they flush the hare out of its seat, don't bark but concentrate on seizing the hare. This keeps them silent and they only start to bark when they are certain that the hare is about to escape. This happens more often with young passionate individuals, which feel that they can catch the hare, and are absolutely devoted to chasing the prey without barking. These animals are often wounded by trees or rocks in their effort to catch their prey. The hunting season occurs in September, October and often in November when the temperature is still extreme and the ground has become dry and

rocky due to the long period of drought that lasts for several months.

Moreover, the dust on the bushes forces the dogs to sneeze continuously, something that complicates their attempts to track. There are some cases of dogs that develop serious problems in the nostrils because of this dust. We, therefore, understand how useful this hunting tactic is for the dog but also for us. Without this tactic, it would be almost impossible for the prey to be located as the hare have adapted to the conditions of Crete as well. Now, it becomes more obvious why a sight hound would have been absolutely useless in Crete. Afterwards, the dog pursues the prey with great speed, which, because of the craggy Cretan landscape and in order to escape, is forced to run making big leaps, jumping from rock to rock and performing zigzags, continuously following paths with many obstacles between it and its pursuer. Obviously, the dog is forced to maneuver quickly otherwise it will fall.

But the Cretan Tracker has adapted well, as it has minimized the length of its body which is equal with its height. That is to say, from being a long bodied hound (if it had been) now it has become square bodied. Thus, its ability to maneuver is impressive. The body lowers and its back is bent and the only thing you hear is the sound of its nails on the rocks in its

effort to hang on the rocks. It springs quickly, leaping from rock to rock, instantly changing direction speed and course, so as to capture the hare. But the hare is smart: suddenly, it stops running, it halts in its position, letting the dog pass over it and changes its course, but the dog is behind it once again. This battle doesn't last long because the hare soon finds an exit, and the dog continues the pursuit as long as it can, depending on the terrain and temperature. If the weather is cool then the pursuit will last for some minutes and if it is winter time then our dog can track the hare while it makes its predetermined circle in order to return back. If the temperature is too hot then the pursuit is suspended and our dog returns to rest for a while and soon it will begin its search for another hare.

Tracking

The second tactic that the dog follows, which is tracking, is spectacular too but also very difficult for familiar reasons. It should be pointed that the dogs which track are more popular, because they allow the hunter to follow-up and to get prepared. However, there are many hunters who have dogs that follow both tactics. The tracking tactic of our dog is the same as that of all trackers with the difference that our dog does not begin tracking at the point where the hare was found the previous night, but after making a fast search within the

limits of the open area, it searches for the point from which the hare came out from the open area and started reaching its seat. Of course, we must point out that here in Crete open areas and big meadows are non-existent and if there is one, our dogs are not directed to hunt there but in dense vegetation or on the rocks. Thus, tracking begins at most 100 metres from the point of the seat. Moreover, because of their large number, our hares do not cover big distances at night (except during the reproductive period) and thus we know that the hare is found somewhere around the point where our dog begins tracking.

Initially, the search is fast and the dog is almost trotting, but as soon as the tracks become more intense then the dog

stops and by almost leaning its nose on the ground it starts sniffing intensely, without making the typical noise that we hear by other trackers. Instead, it seems that it blows the air outwards. It begins to wag its tail, slowly at first, and it never barks over the tracks. It continues in the direction that the hare followed and with slow and careful movements it passes between the thorny bushes trying to stay as noiseless as possible. As it approaches the point, its attention becomes more and more intense; the wagging of its tail increases and observation of the area becomes more accurate. At times, it turns its head to us to see if we are watching it. If there is a clump of bushes in its course, it lifts its nose in the air to check all smells coming from far, then it continues 3-4metres before the hare's seat, so tracking is almost interrupted, and it senses that somewhere ahead there is its prey; with fast movements and with its nose on the surface of the ground it approaches the seat, with its tail tightly curled.

The attack is sudden, abrupt and forceful. Both the hare and the dog suddenly spring and for a moment one thinks that the dog has captured it in its mouth, the hare however with small leaps and changes in its course tries to escape and is successful, either by entering the bushes or by changing its course continuously. The voice of the dog is long, penetrating, resembling a cry or a complaint as if it wants to say 'it is leaviiiiing!' Here attention and calmness is needed because our dog might lose the prey for a moment but often by limiting the hare's movement to a restricted area it can once again find itself close to it. This lasts for a little while and as long as there is optical contact with the prey.

If it loses it from its sight, it continues tracking silently once again but more speedily now than before. If the dog is

experienced and the time suitable, there is a big likelihood that the hare will be rediscovered and suddenly one can see the dog bringing it back many times to the same path. If the weather is very hot, then it is quite possible for the dog to abandon the effort after 500-1000 metres. This happens, in my opinion, because the dog knows that it is difficult to reach the hare again but also because it knows that soon it will find another one. Still, I consider that by adapting to a certain environment, the dog has learned to manage its energy and does not waste it pointlessly. Also, we must say that our dogs use an amount of energy in localizing and pursuing that it is practically impossible to pursue the hare for hours as other trackers do (e.g. the Youra, Greek Hound), so they are limited, as we said before, to the extent that their environment allows them. The same tactic is also followed by other trackers which are found in Crete and which have adapted their tracking tactic to our warm and dry climate as well as their barking over the tracks, as they were compelled to reduce it because of the dry surface of the ground, thus becoming less noisy and more careful. Many of these animals have learned to search for hares on the rocks and in the holes as if they were Cretan Trackers and this is impressive, but after a careful study we realize that the environment and the climate determine a dog's behavior. This

certainly does not only happen with dogs but also with prey and people. Whichever tactic our dog follows we should get to know it and enjoy it, because they have absolutely adapted to our environment and our hunting tactics.

We are dealing with a primitive tracker which has lived with people for thousands of years and has given excellent results. Surely, the dog's fame is not accidental, and has continued until our day. What we should do is to devote ourselves to the dog's selective breeding in order to have the best results. I also think that as hunters we should concentrate

our knowledge and art in order to initially realize the treasure we have in our hands and then to develop it. We should not forget that the good hunter makes the good dog and not the dog the hunter. If we take a look at the use of dogs more generally, we will see that the same dog that we use in hunting, policemen train for drug detection, rescuers for finding trapped people, the blind for guide dogs, others for bringing them their slippers or the newspaper and dog trainers for making them into film stars. In fact, we have a precious companion in our hands which has the ability to comprehend complex ideas and behaviors.

Therefore, we should devote ourselves to correct, patient and persistent training and soon we will be rewarded. I think it is about time we stopped living with the dream of encountering a super-dog that will possibly be so charismatic that without any labor will give us the best results. These dogs are few and are the result of systematic breeding and training on the part of their owners. Also, we should not forget that untrainable dogs are as rare as phenomenal dogs. Certainly, we will also have failures, however, these must not discourage us and lead us to abandon all efforts: on the contrary they must be the cause for a new beginning. Moreover, it is not right for a hunter to just go on the mountain and hunt various types of

prey. Hunting is a dream, an effort, anguish, stories, experience, failures, and success. It's the upbringing of our puppy, our relation with it, its success and its failure. All these and much more compose our love for nature that is summarized in the combination nature-dog-hunting-memories We should not forget that dogs and hunting are the gifts of gods to people which they first offered to the centaur Cheironas and after having taught him how to use them, gave him the command to teach it to the people. Hence, we in turn, have learned it from some other people, and we shall pass on our knowledge improved for our own contentment.

For video clips of Cretan Trackers hunting hare, check out: http://www.kritikosichnilatis.gr/gr/ajikonakinisi.html

For further information about the Cretan Tracker in general, check out:
http://www.kritikosichnilatis.gr/en/abperiechomena.html

*Evangelos Geniatakis is a native Cretan and an avid breeder of Cretan Trackers. He fell in love with the dog as a child, and has devoted most of his life to preserving this ancient breed, finding the most impressive specimens on the island and spending years gaining the trust of local traditional hunters who are very secretive and protective of their dogs. He has worked extensively with the late Dr. Basourakos. He has also contributed DNA samples for the genetic study outlined above. Evangelos chooses dogs based on morphology, but even more importantly on hunting behavior. Other breeders on the island breed their dogs also for show, unfortunately and some have reputedly crossbred their dogs with others breeds in order to achieve a certain look.

To contact Evangelos, you can contact through: www.kritikosichnilatis.gr & www.cynopedia.com

Primitive Aboriginal Dogs Society

LIST OF MEMBERS

Alessio Ottogalli Italy alessio.ottogalli@gmail.com	**Russo-European Laika** Interests: translations from Russian language www.bearlajkit.com
Amelia Price USA arprice@optonline.net	**Laikas, Samoyed**
Andrew D. Poyarkov Russia poyarkov@yandex.ru	**Hounds**
Andrey V. Kovalenko Kazakhstan akoval@nursat.kz	**Borzoi, Laikas** Institute of Zoology, Republic of Kazakhstan Zoology, ornithology, falconry, cynology, aboriginal and hunting dogs.
Anna Frumina USA Afru@yandex.ru	**Central Asian Ovcharka**
Anna K. Mikhalskaya Russia zvanka@yandex.ru	**Hounds**
Anna S. Plakhova Kazakhstan elchor@nursat.kz	**Tazi** Military Institute, Republic Kazakhstan. Veterinary medicine, dogs, inheritance of coat color.

Arianna Spada Italy arianna.spada@gmail.com	**Russo-European Laika** Zoologist www.bearlajkit.com
Borislav Momchilov Kralev Bulgaria kralevborko@yahoo.com	**Laikas and other primitive and aboriginal dogs**
Brad Anderson USA BradA1878@mindspring.com	**Hunting Laikas of Russia and Nihon Ken**
Brandy Parsons USA parsons_brandy@yahoo.com	**Sleddogs, Siberian Husky, Lajki**
Cat Urbigkit USA catu2@mac.com	**Sheep guarding dogs**
Christina Pippin USA christina.pippin@navy.mil	**Saluki**
The Chukotka Sleddog Association of Canada http://www.chukotkasleddogscanada.org/	**Dog sledding and sleddogs of Chukotka**
Debbie Premus USA SibeMusher@aol.com	**Siberian Husky (original/working type), Chukotka Sled Dog and Kamchatka Sled Dog**
Denize Newell USA deni@expeditionsamoyeds.org	**Samoyeds, Alaskan Malamutes, and Siberian Husky breeds** Samoyed Club of America, Northern California Samoyed Fanciers, Bay Area Siberian Husky Club, Northern California Alaskan

	Malamute Association. I've been an executive secretary for 20 years. My experience includes writing and editing professional documents, planning large meetings and events, etc.
Dmitriy E. Dubrovsky Russia dubrovsky@pacc.ru	**Samoyed** Hiking, hunting, dogs
Don and Mary Cranford USA thecranfords@cox-internet.com	**West Siberian Laika**
Dr. Anna Laukner Germany dr.laukner@gmx.de	**German Spitz** Coat color of dogs and its genetics.
Dr. Gertrude W. Hinsch USA ghinsch@tampabay.rr.com	**Saluki**
Eugene Zelenik USA EZelenyk@yahoo.com	**Central Asian Ovcharka**
Franco Milani Italy milani.franco@gmail.com	**Laikas (WEL)**
Gabrielle Schroeter Germany imago.schroeter@t-online.de	**All kinds of dogs**
Gail D. Goodman USA midbarslq@juno.com	**Eastern Sighthounds**
Gregory Alan Newell USA gnewell@samoyed.org	**Samoyed** Editing English Language documents.

Gunilla Jansson Sweden mapptass@privat.ufors.se	**Dogs in general and aboriginal dogs**
Gwen Ross USA Cgr-37@hotmail.com	**Dog sledding and Chukotka Sled Dogs**
Ingvild Espielen Norvegian ingvild.espelien@oya.vgs.no	**Samoyed, taygan, norvegian aboriginal dogs** Preservation of the original type of the Samoyed since 1910
Inkeri and Petri Kangasvuo Finland samans@saunalahti.fi petri.kangavuo@pp.inet.fi	**Sleddogs, Siberian Hasky**
Irina M. Shlykova Sanct-Petersburg Russia shlykova@gmail.com	**Borzoi** Dog kennel «The Russian Wind»,. Preservation of the Old Russian type of the Borzoi. Breeding for open field coursing ability
Jennifer Aimee Lloyd USA lloydjena@gmail.com	**Eastern sighthounds**
Jutta Rübesam Germany Saika.ruebesam@freenet.de	**Afghan Hounds, Saluki, Tazi**
Ken Mac Rury Canada kenmacrury@gmail.com	**Inuit Dog**
Kent Mohan Kathiravelu Norway plutti@hotmail.com	**Livestock protection and Spitz type dogs.**

Konstantin N. Plakhov Kazakhstan elchor@nursat.kz	**Tazi** Hunting Dog Kennel, Institute of Zoology, Republic of Kazakhstan. Teriology, zoogeography, ethology, preservation of wild animals and wildlife biology.
Lada V. Ponomareva Russia	**Borzoy, Oriental hounds**
Lane Bellman USA lanebell.1@juno.com	**Saluki, Taigan**
Lilli Grgat Australia takas-cao@live.com	**Livestock protection dogs**
Linda Wroth USA lwroth@ix.netcom.com	**Akita and other Japan breeds**
Marco Venier Italy mgvenier@gmail.com	**Russian European Laika and other Laikas** Zoologist www.bearlajkit.com
Marina G. Kuzina Russia, Moscow logoveg@mail.ru	**Northern aboriginal dogs** Secretary of PADS; Russian Agricultural External State University, Genetics Department, Moscow province. Preservation of aboriginal dogs of the north, dog behavior, population genetics, phenetics and

	biometry
Ms. Heather Fener USA hfener@aol.com	**Aborigenal Dogs of Europe and India**
Rajashree Khalap India rajashree.khalap@gmail.com	**Aboriginal dogs of India** Geneticist
Sabine van Wel Germany yakutianhusky@gmx.com	**Yakut laika, Samoyed**
Sarah de Monchy The Netherlands s.monchy@planet.nl	**Samoyed** Dutch club of Samoyeds. Aboriginal Samoyeds
Shiri Hoshen USA shoshen@earthlink.net	**Saluki**
Sir Terence Clark UK Sirterenceclark@aol.com	**Saluki, Tazi, Taigan, Afgan (bakhmul)**
Stephen Bodio USA ebodio@gilanet.com	**Tazi, Taigan, Laikas**
Sue Hamilton USA qimmiq@snet.net	**Inuit Sled Dog** **Editor/Publisher, *The Fan Hitch*, Journal of the Inuit Sled Dog International** http://thefanhitch.org
Tatjana S. Dubinina Russia dubininm@mail.ru	**Taigan**

Tatiana V. Desyatova Russia irklaika@gmail.com	**East-Siberian Laika** Secretary of PADS
Tyrone Brown USA Treedog41@yahoo.com	**Aboriginal hunting dogs**
Vadim D. Rechkin Russia rechkinvd@rambler.ru	**Laikas**
Vitaly (Zaur) Bagiev Russia abagiev@gmail.com	**Caucasian Mountain Dog**
Vladimir E. Beregovoy USA vbereg24@outlook.com	**West-Seberian Laika and Saluki** Curator PADS, Retired Zoologist, English-Russian and Russian-English translation, Newsletter PADS, West Siberian Laika, Saluki, Tazy and aboriginal dogs of the world.
Werner Roeder Germany dr-roeder@gmx.de	**Azavak**
William Fantozzi USA Bill@karelianbeardog.us	**Karelian Bear Dog, Laikas**
William Valencia. USA wdvalencia@yahoo.com	**lurchers, Eastern Sighthounds, hunting dogs**

PADS, Interntional Website
http://new.pads.ru

PADS Curator:
Vladimir Beregovoy
1507 Mountain Valley Road
Buchanan, VA 24066, USA
vbereg24@outlook.com

PADS, International Editorial Board
Marina Georgievna Kuzina
P.O. Box 12
Moscow, 115407 Russia
+10-(499)-618-6370
logoveg@mail.ru

Desyatova Tatiana
irklaika@gmail.com

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