THOMAS JEFFERSON AS A PALEONTOLOGIST*

By the late Professor HENRY FAIRFIELD OSBORN

ASKED to mention the men of most outstanding ability who have been President of the United States, I should immediately name George Washington, Thomas Jefferson, Abraham Lincoln, Theodore Roosevelt and Woodrow Wilson. Of these, Thomas Jefferson is of particular interest to me because of his deep preoccupation with the natural sciences; as he phrased it, "the tranquil pursuits of science . . . my supreme delight." Unsurpassed in economics, ranking in power of expression with Lincoln and in culture and education with Woodrow Wilson, whom he surpassed in achievement as a promoter of the various branches of education, from the ungraded rural schools to the great university, Jefferson was a pioneer in the natural sciences and specifically in paleontology. Theodore Roosevelt alone of our presidents rivaled him in his love of the subject.

Actual comparison of these two men is impossible in the light of the vastly different scientific development of their respective periods, yet to both of them paleontology was a relaxation and a satisfaction. Jefferson retreated to it in the bitter controversy roused by his embargo policy in 1806; Roosevelt during his struggles with the New York police department almost a century later, at which time he likened the local politicians to the ancient types of creodonts and carnivores! In studying the life of Jefferson I am constantly impressed with his likeness to Theodore Roosevelt. They were the only two naturalists, or even nature-lovers, who filled our presidential chair. Roosevelt had the greater opportunity; Jefferson was the greater genius. Roosevelt lived in the full tide of modern paleontology; Jefferson lived (1743–1826) before the science of paleontology was even born and died four years before the famous conversations between Cuvier and Geoffroy St. Hilaire defined the science.

In Europe, when Jefferson was a young man, astronomy was the eldest of the sciences, while physics and chemistry were about on a par. Lavoisier, born in the same year as Jefferson, was destined to overthrow the phlogistic doctrine that had dominated the development of chemistry for over a century; his quantitative work appealed mostly to physicists but eventually won recognition by chemists, and his doctrines were spread widely through his "Traite élémentaire de chimie" (1789).

Buffon, a man of great genius, was the foremost zoologist of the time, to whom all the world looked for authoritative utterances, but long before Jefferson came to know him Buffon had retreated from his advanced evolutionary position of 1766 under pressure from the theological faculty of the University of Paris. In his later period he confined his investigations within the limits prescribed by an orthodox belief in the absolute fixity of species. Thomas Jefferson was seventeen years of age when the noted French naturalist advanced his belief in the frequent mutability of species under the direct action of environment: "How many species, being perfected or degenerated (*dénaturées*) by the great changes in land and sea, by the favors or disfavors of nature, by food, by the prolonged influences of climate, contrary or favorable, *are no longer what they formerly were,*" declared Buffon, and he continued: "One is surprised at the rapidity with which species vary, and the facility with which they lose their primitive characteristics in assuming new forms." Jefferson apparently never took up the evolution question in his study of "antiquities" but confined himself to the acquisition of bones and the straightforward description of species. He felt the time was not ripe for theories and he stated his position regarding speculation,[1] once and for all, in 1787:

> [Paris, September 20, 1787. To Charles Thompson.] I thank you also for the extract of the letter you were so kind as to communicate to me, on the antiquities found in the western country. I wish that the persons who go thither would make very exact descriptions of what they see of that kind, without forming any theories. The moment a person forms a theory, his imagination sees, in every object, only the traits which favor that theory. But it is too early to form theories on those antiquities. We must wait with patience till more facts are collected.

It is not surprising that Thomas Jefferson, when he lived in Paris (1784–1789), sought the acquaintance of Buffon; Paris was then the center of the sciences of zoology and botany, and Buffon was at the height of his career. It *is* surprising that Jefferson had both the knowledge and the courage to combat Buffon's idea that the Old World mammals had degenerated, or become *dénaturé,* in the supposedly adverse influence of the American climate. In his "Notes on the State of Virginia" (1781),[2] published privately in

* Address prepared to be read at the dinner of the National Academy of Sciences, Charlottesville, Va., November, 1935; presented in summarized form by Professor W. B. Scott, Princeton University.

[1] "The Writings of Thomas Jefferson," Library Edition, issued under the auspices of the Thomas Jefferson Memorial Association of the United States, Washington, D. C., 1903. Unless otherwise noted, all the quotations herein are taken from this source.

[2] "Notes on the State of Virginia," by Thomas Jefferson. Published by H. C. Carey and I. Lea, Philadelphia, 1825, pp. 57–65.

Paris, he took up the opinions advanced by the Comte de Buffon:

1. That the animals common to both the old and new worlds, are smaller in the latter. 2. That those peculiar to the new are on a smaller scale. 3. That those which have been domesticated in both, have degenerated in America; and 4. That on the whole it exhibits fewer species. And the reason he thinks is, that the heats of America are less; that more waters are spread over its surface by nature, and fewer of these drained off by the hand of man. In other words, that *heat* is friendly, and *moisture* adverse to the production and developement of large quadrupeds.

Jefferson opened his critique of this theory of Buffon's with a study of the relative influence of heat and moisture in the production and development of animals and worked backwards to a refutation of Buffon's premises as to relative size of the animals. In order to illustrate his points convincingly, he took time from his pressing duties in the negotiation of commercial treaties to write to various friends at home, asking for animal skins and skeletons. In 1787 he was gratified to receive the skeleton of a moose that had been procured for him by friends in Vermont and shipped to him in Paris; although he thought the cost of fifty pounds a little high, he none the less sent it off triumphantly to Buffon:

[Paris, October 3, 1787. To Monsieur Le Comte de Buffon.] I had the honor of informing you some time ago, that I had written to some of my friends in America, desiring they would send me such of the spoils of the moose, caribou, elk and deer, as might throw some light on that class of animals; but more particularly, to send me the complete skeleton, skin and horns of the moose, in such condition as that the skin might be sewed up and stuffed on its arrival here. I am happy to be able to present to you at this moment, the bones and skin of a moose, the horns of another individual of the same species, the horns of the caribou, the elk, the deer, the spiked horned buck, and the roebuck of America.

In developing his scientific opinions Jefferson at first quoted the current traditions; later he became a more serious and independent investigator. In 1781[3] he wrote about the mastodons as follows:

Our quadrupeds have been mostly described by Linnaeus and Mons. de Buffon. Of these the mammoth, or big buffalo, as called by the Indians, must certainly have been the largest. Their tradition is, that he was carnivorous, and still exists in the northern parts of America. A delegation of warriors from the Delaware tribe having visited the governor of Virginia, during the revolution, on matter of business, after these had been discussed and settled in council, the governor asked them some questions relative to their country, and among others, what they knew or had heard of the animal whose bones were found at the Saltlicks on the Ohio. Their chief speaker immediately put himself into an attitude of oratory, and with a pomp suited to what he conceived the elevation of his subject, informed him that it was a tradition handed down from their fathers, "That in ancient times a herd of these tremendous animals came to the Big-bone licks, and began an universal destruction of the bears, deer, elks, buffaloes, and other animals which had been created for the use of the Indians: that the Great Man above, looking down and seeing this, was so enraged, that he seized his lightning, descended on the earth, seated himself on a neighboring mountain, on a rock of which his seat and the print of his feet are still to be seen, and hurled his bolts among them till the whole were slaughtered, except the big bull, who presenting his forehead to the shafts, shook them off as they fell; but missing one at length, it wounded him in the side; whereon, springing round, he bounded over the Ohio, over the Wabash, the Illinois, and finally over the great lakes, where he is living at this day." It is well known, that on the Ohio, and in many parts of America further north, tusks, grinders, and skeletons of unparalleled magnitude, are found in great numbers, some lying on the surface of the earth, and some a little below it. . . . It is remarkable that the tusks and skeletons have been ascribed by the naturalists of Europe to the elephant, while the grinders have been given to the hippopotamus, or river horse. Yet it is acknowledged, that the tusks and skeletons are much larger than those of the elephant, and the grinders many times greater than those of the hippopotamus, and essentially different in form.

The term "mammoth," derived from the Siberian vernacular "mammut," was in common use in the eighteenth century for the woolly mammoth (named *Elephas primigenius* by Blumenbach in 1799) and was recognized by Camper and other naturalists to describe practically the same animal as the American mastodon (named *Elephas americanus* by Kerr in 1792); it was not considered possible that nature had produced two such widely different animals as the mastodon and the true mammoth of Asia.

The rapid development of Jefferson's views is shown in a comparison of his rather rudimentary ideas of 1781 with his later observations:

[November 26, 1782. To Mr. Steptoe.] I received in August your favor, wherein you give me hopes of being able to procure for me some of the big bones. I should be unfaithful to my own feeling, were I not to express to you how much I am obliged by your attention to the requests I made you on that subject. A specimen of each of the several species of bones now to be found, is to me the most desirable objects in natural history.

[Paris, July 17, 1785. To Dr. Styles.] I thank you for your information as to the great bones found on the Hudson river. I suspect that they must have been of the same animal with those found on the Ohio; and, if so,

[3] *Loc. cit.*

they could not have belonged to any human figure, because they are accompanied with tusks of the size, form, and substance, of those of the elephant. I have seen a part of the ivory, which was very good. The animal itself must have been much larger than an elephant.

[Paris, October 13, 1785. To Hogendorp.] I have never yet seen Monsieur de Buffon. He has been in the country all the summer. I sent him a copy of the book [Notes on Virginia], and have only heard his sentiments on one particular of it, that of the identity of the mammoth and elephant. As to this, he retains his opinion that they are the same.

[Philadelphia, May 2, 1797. To Louis, Prince of Parma.] Permit me to pay my personal tribute to science and to your Royal Highness's disposition to promote it, by depositing in your cabinet a tooth of the great animal called in Europe the mammoth, of which we find remains in the interior and uninhabited parts of this country; their great distance from us renders them rare and difficult to be obtained.

[Washington, December 14, 1800. To Robert R. Livingston.] I have heard of the discovery of some large bones, supposed to be of the mammoth, at about thirty or forty miles distance from you; and among the bones found, are said to be some of which we have never been able to procure. The first interesting question is, whether they are the bones of the mammoth? The second, what are the particular bones, and could I possibly procure them? The bones I am most anxious to obtain, are those of the head and feet, which are said to be among those found in your State, as also the ossa innominata, and the scapula. Others would also be interesting, though similar ones may be possessed, because they would show by their similarity that the set belongs to the mammoth. Could I so far venture to trouble you on this subject as to engage some of your friends near the place, to procure for me the bones above mentioned? If they are to be bought I will gladly pay for them whatever you shall agree to as reasonable.

[Washington, February 3, 1801. To Dr. Caspar Wistar.] According to your desire I wrote to Chancellor Livingston on the subject of the bones. The following is an extract from his letter dated January 7th: "I have paid the earliest attention to your request relative to the bones found at Shawangun, and have this day written to a very intelligent friend in that neighborhood. I fear however that till they have finished their search, there will be some difficulty in procuring any part of the bones, because when I first heard of the discovery I made some attempts to possess myself of them, but found they were a kind of common property, the whole town having joined in digging for them till they were stopped by the autumnal rains. They entertain well-grounded hopes of discovering the whole skeleton, since these bones are not, like all those they have hitherto found in that County, placed within the vegetable world, but are covered with a stratum of clay,—that being sheltered from the air and water they are more perfectly preserved. Among the bones I have heard mentioned, are the vertebra, part of the jaw, with two of the grinders, the tusks, which some have called the horns, the sternum, the scapula, the tibia and fibula, the tarsus and metatarsus. Whether any of the phalanges or innominata are found, I have not heard. A part of the head containing the socket of the tusks is also discovered. From the bones of the feet, it is evidently a claw-footed animal, and from such parts of the shoulder bones as have been discovered, it appears that the arm or fore-leg, had a greater motion than can possibly belong to the elephant or any of the large quadrupeds with which we are acquainted. Since bog-earth has been used by the farmers of Ulster county for a manure, which is subsequent to the war, fragments of at least eight or ten have been found, but in a very decayed state in the same bog."

From this extract, and the circumstance that the bones belong to the town, you will be sensible of the difficulty of obtaining any considerable portion of them. I refer to yourself to consider whether it would not be better to select such only of which we have no specimens, and to ask them only. It is not unlikely they would with common consent yield a particular bone or bones, provided they may keep the mass for their own town. If you will make the selection and communicate it to me, I will forward it to the Chancellor, and the sooner the better.

[Washington, February 25, 1807. To Dr. Caspar Wistar.] I enclose you a letter from Dr. Goforth on the subject of the mammoth. Immediately on the receipt of this, as I found it was in my power to accomplish the wishes of the society for the completion of this skeleton with more certainty than through the channel proposed in the letter, I set the thing into motion, so that it will be effected without any expense to the society, or other trouble than to indicate the particular bones wanting. Being acquainted with Mr. Ross, proprietor of the Big Bone lick, I wrote to him for permission to search for such particular bones as the society might desire, and I expect to receive it in a few days. Captain Clarke (companion of Captain Lewis) who is now here, agrees, as he passes through that country, to stop at the lick, employ laborers, and superintend the search at my expense, not that of the society, and to send me the specific bones wanted, without further trespassing on the deposit, about which Mr. Ross would be tender, and particularly where he apprehended that the person employed would wish to collect for himself. If, therefore, you will be so good as to send me a list of the bones wanting (the one you formerly sent me having been forwarded to Dr. Brown), the business shall be effected without encroaching at all on the funds of the society, and it will be particularly gratifying to me to have the opportunity of being of some use to them. But send me the list if you please without any delay, as Captain Clarke returns in a few days, and we should lose the opportunity.

[Washington, December 19, 1807. To Dr. Caspar Wistar.] I have lately received a letter from General Clarke. He has employed ten laborers several weeks, at the Big-bone Lick, and has shipped the result in three large boxes, down the Ohio, via New Orleans, for this place, where

they are daily expected. He has sent, 1st, of the Mammoth, as he calls it, frontals, jaw bones, tusks, teeth, ribs, a thigh, and a leg, and some bones of the paw; 2nd, of what he calls the Elephant, a jaw bone, tusks, teeth, ribs; 3d, of something of the buffalo species.

[Washington, March 20, 1808. To Dr. Caspar Wistar.] Between Philadelphia and this place is but two days, and the roads are already fine. I would propose, therefore, that you should come a few days before Congress rises, so as to satisfy that article of your curiosity. The bones are spread in a large room, where you can work at your leisure, undisturbed by any mortal, from morning till night, taking your breakfast and dinner with us. It is a precious collection, consisting of upwards of three hundred bones, few of them of the large kinds which are already possessed. There are four pieces of the head, one very clear and distinctly presenting the whole face of the animal. The height of his forehead is most remarkable. In this figure, the indenture at the eye gives a prominence of six inches to the forehead. There are four jaw bones, tolerably entire, with several teeth in them, and some fragments; three tusks like elephants; one ditto, totally different, the largest probably ever seen, being now from nine to ten feet long, though broken off at both ends; some ribs; an abundance of teeth studded, and also of those of the striated or ribbed kind; a fore-leg complete; and then about two hundred small bones, chiefly of the foot. This is probably the most valuable part of the collection, for General Clarke, aware that we had specimens of the larger bones, has gathered up everything of the small kind. There is one horn of a colossal animal. The bones which came do not correspond exactly with General Clarke's description; probably there are some omissions of his packers. Having sent my books to Monticello, I have nothing here to assist you but the "Encyclopedie Methodique."

[Washington, July 14, 1808. To Monsieur de la Cepede.] If my recollection does not deceive me, the collection of the remains of the animal incognitum of the Ohio (sometimes called mammoth), possessed by the Cabinet of Natural History at Paris, is not very copious. Under this impression, and presuming that this Cabinet is allied to the National Institute, to which I am desirous of rendering some service, I have lately availed myself of an opportunity of collecting some of these remains. General Clarke (the companion of Governor Lewis in his expedition to the Pacific Ocean) being, on a late journey, to pass by the Big-bone Lick of the Ohio, was kind enough to undertake to employ for me a number of laborers, and to direct their operations in digging for these bones at this important deposit of them. The results of these researches will appear in the enclosed catalogue of specimens which I am now able to place at the disposal of the National Institute.

[Monticello, September 10, 1809. To General William Clarke.] The three boxes of bones which you had been so kind as to send to New Orleans for me, as mentioned in your letter of June 2d, arrived there safely, and were carefully shipped by the collector, and the bill of lading sent to me. But the vessel put into Havana, under embargo distress, was there condemned as unseaworthy, and her enrollment surrendered at St. Mary's. What was done with my three boxes I have not learned, but have written to Mr. Brown, the collector, to have inquiry made after them. The bones of this animal are now in such a state of evanescence as to render it important to save what we can of them. Of those you had formerly sent me, I reserved a very few for myself; I got Dr. Wistar to select from the rest every piece which could be interesting to the Philosophical Society, and sent the residue to the National Institute of France. These have enabled them to decide that the animal was neither a mammoth nor an elephant, but of a distinct kind, to which they have given the name of Mastodont, from the protuberance of its teeth. These, from their forms, and the immense mass of their jaws, satisfy me this animal must have been arboriverous. Nature seems not to have provided other food sufficient for him, and the limb of a tree would be no more to him than a bough of a cotton tree to a horse.

These studies of the mammoth were carried on mostly in an unfurnished room of the White House itself during the trying political time of 1801 when Congress was struggling to untangle the confusion resulting from a presidential vote, tied between Jefferson and Burr. Jefferson retreated from the storm to contemplate the mysteries of nature. Five years later, when the country was in an uproar and every day brought fresh denunciation of the presidential embargo policy, Jefferson managed to make intervals in his crowded days for scientific research; this conduct aroused bitter ridicule among his countrymen, to whom science meant atheism. William Cullen Bryant, then a child of thirteen, reflected the popular disgust in a satirical poem entitled "The Embargo," which was later suppressed. He wrote in part:

> Go, wretch, resign thy presidential chair,
> Disclose thy secret measures, foul or fair,
> Go, search with curious eyes for horned frogs,
> 'Mid the wild wastes of Louisianian bogs;
> Or where the Ohio rolls his turbid stream
> Dig for huge bones, thy glory and thy theme.

In 1796 Jefferson came into possession of the bones of the so-called *Megalonyx Jeffersoni,* or great claw. His observations of this creature were characteristic:

[Monticello, November 10, 1796. To Colonel John Stuart.] I have to acknowledge the receipt of your last favor, together with the bones of the great claw, which accompanied it. My anxiety to obtain a thigh bone is such, that I defer communicating what we have to the Philosophical Society, in the hope of adding that bone to the collection. We should then be able to fix the stature of the animal, without going into conjecture and calculation, as we should possess a whole limb, from the haunch

bone to the claw inclusive. However, as you announce to me that the recovery of a thigh bone is desperate, I shall make the communication to the Philosophical Society. I think it happy that this incident will make known to them a person so worthy as yourself to be taken into their body, and without whose attention to these extraordinary remains, the world might have been deprived of a knowledge of them. I cannot, however, help believing that this animal, as well as the mammoth, are still existing. The annihilation of any species of existence, is so unexampled in any parts of the economy of nature which we see, that we have a right to conclude as to the parts we do not see, that the probabilities against such annihilation are stronger than those for it. In hopes of hearing from you, as soon as you can form a conclusion satisfactory to yourself, that the thigh bone will or will not be recovered, I remain, etc.

[Monticello, January 22, 1797. To Dr. Benjamin Rush.] I am indebted to the Philosophical Society a communication of some bones of an animal of the lion kind, but of most exaggerated size. What are we to think of a creature whose claws were eight inches long, when those of the lion are not 1½ inches; whose thigh-bone was 6¼ diameter; when that of the lion is not 1½ inches? Were not the things within the jurisdiction of the rule and compass, and of ocular inspection, credit to them could not be obtained. I have been disappointed in getting the femur as yet, but shall bring on the bones I have, if I can, for the Society, and have the pleasure of seeing you for a few days in the first week of March. I wish the usual delays of the publications of the Society may admit the addition to our new volume, of this interesting article, which it would be best to have announced under the sanction of their authority.

[Monticello, August 15, 1797. To Colonel John Stuart.] On my arrival at Philadelphia, I met with an account published in Spain of the skeleton of an enormous animal from Paraguay, of the clawed kind, but not of the lion class at all; indeed, it is classed with the sloth, ant-eater, etc., which are not of the carnivorous kinds; it was dug up 100 feet below the surface, near the river La Plata. The skeleton is now mounted at Madrid, is 12 feet long and 6 feet high. There are several circumstances which lead to a supposition that our megalonyx may have been the same animal with this. There are others which still induce us to class him with the lion. Since this discovery has led to questioning the Indians as to this animal, we have received some of their traditions which confirm his classification with the lion. As soon as our 4th volume of transactions, now in the press, shall be printed I will furnish you with the account given in to the Society. I take for granted that you have little hope of recovering any more of the bones. Those sent me are delivered to the Society.

The bones were later transferred to the Academy of Natural Sciences at Philadelphia, where they may still be seen.

In 1797 Jefferson was elected president of the American Philosophical Society at Philadelphia and read his first paper on paleontology—a description of the *Megalonyx*. He compared the great fossil claws with those of a lion and concluded that the creature was probably of that species. He was rather in a quandary as to the fate of the great claw, and remarked:

> . . . In the present interior of our continent there is surely space enough . . . for mammoths and Megalonyxs who may exist there. . . . Our entire ignorance of the immense country to the west and northwest . . . does not authorize us to say what it does not contain. . . . In fine, the bones exist; therefore the animal has existed. The movements of nature are in a never-ending circle. The animal species which has once been put into a train of motions, is still probably moving in that train. For, if one link in nature's chain might be lost, another and another might be lost, till this whole system of things should vanish by piecemeal.

These were very sensible conclusions, in view of the limited knowledge of his day, and represented a truly scientific view-point. He maintained an open mind and six years later induced Dr. Samuel Latham Mitchill, professor of geology at Columbia College and United States Senator, to translate into English Cuvier's "Theory of the Earth."

While pursuing the fascinations of paleontological research, Jefferson arranged for Congress to authorize the expedition of Lewis and Clark to the unknown headwaters of the Missouri River and in 1806 sent Pike to discover the peak which bears his name. He selected these explorers with meticulous attention to their training, their physical and mental fitness, their accuracy of observation, their courage, resourcefulness and ability to deal with the Indians. He planned their equipment and the preservation of their records and paid a large part of their expenses from his own funds. Thus were laid the foundations of the United States Geological, Coastal and Geographic Surveys, at the small cost to the nation of $2,500.

Upon his retirement from the presidency, Jefferson returned to Monticello and soon became deeply involved in the task of establishing the University of Virginia, to whose every department he gave his most minute and careful attention until the day of his death. He gradually retired from active work in science; fifteen years before he died at the age of eighty-three, he wrote (May 12, 1811) to Count John Potocki:

> Nothing would be more flattering to me than to give aid to your inquiries as to this continent, and to weave its ancient history into the web of the old world; and with this view, to accept the invitation to a correspondence with you on the subject. But time tells me I am nearly done with the history of the world. . . . I shall serve you therefore more permanently, by bequeathing to you an-

other correspondent, more able, more industrious, and more likely to continue in life than myself. Dr. Benjamin S. Barton, one of the professors of the College of Philadelphia, is learned in the antiquities of this country, has employed much time and attention on researches into them, is active and punctual, and will, I think, better fulfil your wishes than any other person in the United States. . . . He will, I am sure, set a just value on the correspondence proposed, for which I shall take care to prepare him.

ABSTRACTS OF PAPERS PRESENTED AT THE AUTUMN MEETING[1]

Giant skin growth on mammals of normal size: CHARLES R. STOCKARD. The growth of skin and the skeletal framework of the body are regulated so that they properly fit together. Size regulation in development is accomplished more largely through inhibition of unlimited growth tendencies rather than through a stimulation of resisting tissues, if there be such. Overgrowths or giant reactions in organs and tissues also, more likely, result from disturbance in conditions of growth regulation and growth inhibition than from growth-stimulating stuffs. This is well shown by the continuous growth of tissues when removed from the influences of other body parts. The skin in certain individuals may become greatly thickened and enlarged in area so that it hangs in folds and wrinkles, being too extensive to properly fit the person. Such a condition may result from diseases, and the response is as if the skin had been freed from the influence of the growth-regulating factors which still act to preserve harmonious growths among the other tissues of the body. Recently several investigators have found that the injection of extracts from the pituitary gland into young dogs may bring about an overgrowth of skin along with what appears to be a general increase in body size. This was interpreted as a response to a growth-stimulating hormone. As might be expected, the responses to these injections differed somewhat among different types of dogs. For several years we have been studying, through the hybridization of pure dog-breeds, the differences in growth reactions of various tissues and body regions in giant and dwarf animals and in breeds exhibiting localized growth anomalies. In these experiments striking structural disharmonies have arisen as a result of failure in the regulation of growth coordination and harmonious sizes among the systems of the body. Excessive growth in skin area as related to body size has been a frequent feature arising from a number of different breed crosses. Similar skin growths have arisen from internal chemical disturbances and salt deficiencies in some dogs and also as a result of infection with skin parasites. The English bulldog has a short stocky body with smooth skin but a wrinkled face, since a normal amount of skin is fitted over a much shortened and flat-faced muzzle. When the bulldog is crossed with the German shepherd, police dog, a smooth-skinned animal, the first generation hybrids, F_1, have fairly close-fitting skin on a stocky mastiff-like body. When this F_1 is bred back to the shepherd parent a shepherd-like dog with close-fitting skin results. However, the F_1 bred back on the bulldog gives an animal with bull type but with more wrinkled and looser skin than the bull: as though the skin were growing on one pattern and the body on another. The most exaggerated misfits of skin occur in crosses between bulldogs and the short-legged basset-hound. The skin on the basset is loose but not to an excessive degree. The F_1 hybrids in the bull-basset cross have a greatly exaggerated area of skin fully sufficient for a dog of double the size. This skin is not thin but unusually thick, being one quarter to almost one half inch thick on the back of the neck. It hangs in folds from the body and wrinkles along the legs. Among the F_2 hybrids of this cross some individuals have smoothly fitting skin, on others the skin is loose, while on still others there is an excessive extent of skin folding and wrinkling over the anterior parts of the body, head and legs. The looseness of the skin is more marked in some individuals in the F_2 group than in back crosses of the F_1 hybrids on either the bulldog or basset-hound stocks. The St. Bernard dog and the bloodhound as pure breeds have loose wrinkled skin chiefly over the head and front parts of the body. When these are crossed on the smooth-skin Great Dane the F_1 and F_2 hybrids in some cases show excessively loose skin but not more exaggerated than in the wrinkled parent stock. Several other breeds give the same skin reaction on crossing. All breeds with overgrowth of skin have in common other symptoms and characters which indicate that the pituitary gland is functioning in an abnormal manner: in no sense hyper-function. A study of the gross and microscopic structures of these pituitaries reveals frequent cystic conditions and very abnormal cellular proportions and arrangements. The abnormal pituitary in these dogs is further associated with abnormal reproductive processes and modified behavior of the bitch toward her puppies. There is an accumulation of evidence showing the calcium-phosphorus balance to be disturbed. In further line with these interpretations it has been found that puppies with marked rickets of the bones, although from breeds with smooth-fitting skin, may show an exaggerated looseness and folding of the skin accompanying rickets. Dogs on diets low in calcium as well as those developing rickets become most susceptible to infections with sarcoptic mange. On a low calcium diet it is most difficult to eliminate mange from the skin with what is usually an effective external treatment. Also a puppy with severe mange is unusually prone to develop rickets unless careful precautions be taken to prevent it. And many such puppies exhibit an abnormal looseness and folding of the skin. From the evidence at hand we interpret these reactions as being associated with a disturbed calcium metabolism resulting from defective pituitary-parathyroid balance. Bone and skin, having the

[1] Charlottesville, Va., November 18, 19 and 20, 1935.