SCIENCE:

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SOME POINTS IN THE COMPARATIVE OSTEOLOGY OF THE TAPIR.

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So much has been written in the last decade on the evolution of the horse, that I think it will not be out of place to compare some of the skeletal structures of its most generalized relative, the tapir. The tapir represents in the fauna of the present day the most generalized member of the odd-toed Ungulates, and in its osteological structure we find the closest relationship with those old Eocene Perissodactyles, which are now entirely extinct. As a whole, the structure of the tapir presents us with a most generalized form, but the extreme modification of the nasal region of the skull is a modernization, as it is called. Of all the known Tapiroids of the Eocene there is none which shows this extreme specialization of the facial region of the skull for a proboscis. Cuvier in the "Ossemenes Fossiles" compares the osteology of the American and Malayan tapir in a general way, but does not treat the subject in detail.

In the present paper, I wish to speak in particular of the comparative evolution of the foot structure in the tapir. In such widely isolated forms as the American and Malayan tapir we would naturally expect to find some differences in the details of their foot-structure, and such is the case. On evolutionary ground these differences are of great interest, but I do not wish to trouble my readers with a lot of dry anatomical details, without the latter being of some interest.

As a word of introduction I would say, that the derivation of the modern digitigrade Ungulates has been from an animal with a plantigrade foot, the latter having had five complete digits. An approach to this type is seen in the Puerco genus *Periptychus*. Another point of great importance in the structure of this primitive or ancestral foot was that the various elements of which it was composed were arranged one above the other; the serial arrangement as it is called. The carpus and tarsus of the Eocene *Phenacodus* exhibits the serial order of its elements. Now in the evolution of the foot-structure of the tapir, it has departed from the serial order above described, and with this specialization has occurred a loss of lateral toes. However, the tapir has been fortunate enough to lose only one of its anterior toes, whereas the horse and rhinoceros have lost more.

When we compare the structure of the fore feet of the common Brazilian tapir (*T. Americanus*) with that of its Malayan relative, we find considerable difference in the shape and relation of the bones of the carpus. This relationship is due to the comparative specialization in the foot-structure of the one species over the other. In the American tapir the external lateral toe is very much reduced and functionless. In the living tapir this fifth digit transmits little or no weight to the ground. Co-ordinated with the reduction of the fifth digit in this species is the growth of the median digit of the manus. Another co-ordination of the reduced size of the fifth digit in the American tapir is the large articulation of the unciform bone with the lunar. The lunar has also no contact, or a very small one, with the magnum anteriorly.

It has been observed in the evolution of the foot-structure of the Perissodactyles that in the earlier and heavier forms the fifth digit of the manus is always largely developed, and with the large size of this digit is the comparatively small size of the median In this respect, these earlier forms approach more nearly in their foot-structure the even-toed Ungulates (*Artiodactyla*). Again, in these less specialized forms the long axis of the unciform bone is always horizontal.

The position of the unciform is co-ordinated with the large size of the fifth toe; and as a consequence there is a smaller contact between it and the lunar, than in the later and more specialized forms. We observe then, as a rule, that as the unciform begins to rotate upwards and assume the vertical position, the external lateral digit becomes more and more reduced in size.

Another correlation in reference to the large size of the lateral digit is the nearly subequal distal facets of the lunar, an adaptation which is for the equal transmission of the weight of the foot on both sides of the median axis. The magnum is also much depressed and broad in those heavy and more ancient forms.

Turning to the manus of the Malayan tapir, we find the external lateral toe more developed than in the American form. There is also less difference in size between the latter and the median toe. The lunar has a large contact with the magnum anteriorly; the latter bone being broader than in the American form. That less displacement has taken place in the manus of the Malayan tapir is shown from the fact that the unciform and scaphoid bones are widely separated, whereas in the American tapir these bones nearly touch each other. The approach of these latter bones takes place with the reduction of the fifth toe until in some species of rhinoceros they are nearly in contact.

As for the tarsus we observe that the hind foot of the Malayan tapir is broader and heavier than in the American species. A very important difference between the structure of the pes in these two forms is that in the Malayan species both the lateral metatarsals articulate with the ectocuneiform, whereas in the Brazilian form only the internal metatarsal touches this podial element.

In conclusion, we see from the above characters that the manus of the Brazilian tapir is considerably more specialized than that of the Malayan tapir; on the other hand, the pes of the former is not so much modified in structure as that of the latter species. In other details of the skeleton of the tapir, I am not aware that many differences exist. In relation to the lumbar vertebral articulations, I would observe that they are very simple and articulate by plane surfaces. In general, the Eocene Perissodactyles (*Hyracotherium*, *Hyrachyus*) have embracing vertebral articulations.

THE SPEECH OF CHILDREN.

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THE term speech ordinarily signifies articulate vocal utterance in conventional forms, intentionally expressive of feelings or ideas. In treating of speech as a product of intelligence too much is sometimes made of the articulation factor. For articulation is not characteristic of man alone, and among the lower orders, the elephant and the dog, which do not articulate, are more intelligent than the articulating parrots. Moreover, the child, before he can articulate, employs inarticulate utterance with intentional and striking expressiveness.

The first cry of a child, whether or not we call it a rudimentary form of speech, is certainly a vocal utterance strongly expressive of feeling. Though the element of intention is absent for several months, yet there is a considerable variety of expressive quality in the child's cries during this time. This organism, indeed, is like a wind-harp responding in various tones to diverse sense-impressions.

These early cries are expressive simply of pain or distress, and their expressiveness consists partly in tone and party in intensity.

They vary in tone according to the nature of the exciting cause, and in intensity according to its degree. The range of expression is exceedingly limited, for several months being chiefly restricted within the bounds of physical suffering. Here, however, some mothers and some medical men find valuable assistance in the diagnosis of physiological disturbances.

But the young infant's cries do not always express physical feeling merely. There soon appears a quality, which, after very little development, comes to be distinguished as mental. The child H., on the eighth day after birth, was much startled by the sound of a bottle falling to the floor. She made no outcry on this occasion, but on the twentieth day a similar noise drew from her well-marked tones of fear. At the same time a general tremor was exhibited by her, such as accompanies terror in older persons. It is not to be wondered that there should be expressive emotional quality in the cries of such young children when we observe the well-marked variations in facial expression even at this early period. Physical pain shows itself in the countenance from the very first. On the fifth day H. undoubtedly manifested disgust in this way at the taste of a nauseous medicine, but her countenance immediately resumed the normal expression when a pleasant medicine was substituted. On the seventeenth day she showed great distress at the sharp and screaming cries of another child. On the thirty second day she smiled at her mother in response to fondling and caresses. On the thirty-eighth day her countenance plainly expressed wonder when she was taken into a strange room.

The young infant's cries of discomfort soon become differentiated, and among the specific utterances that emerge the cry or call of desire appears early. It is difficult to define the subtle beginnings of this form of utterance; it seemed plain to me in one case in the second month; there is no doubt that it appeared in the tones of another child in the sixth month.

On the thirtieth day the child M. gave utterance to a sound indicative of comfort and satisfaction. By the forty-eighth day this sound assumed distinct form as a low, soft oo. During the nights of the forty-fifth and the forty-ninth days M. laughed heartily in her sleep with a sound that, except for its softness, certainly resembled very much the adult "ha, ha. ha."

This last utterance, perhaps, shows merely one form of vocal capacity at the time, but it seems reasonable to assume that the other utterances described, or most of them at least, possess psychical significance in some degree. It is not sufficient to speak of such sounds as mere non-significant products of muscular movements, reflex, instinctive, or spontaneous. They are really the crude raw material of the vocal element in conventional speech. They soon grow into the sounds of language, which is the joint product of mental and bodily faculties and activities.

Just at this stage the child is in a fit condition to begin any language. These first utterances belong to the common mother-tongue of the race. What particular form of speech the child ultimately learns depends altogether on his environment. He begins wildly and indiscriminately with various sounds, but in course of time some, lacking the stimulus of example and encouragement from those about the child, fall into disuse, while other sounds, under that stimulus, are drawn out and cultivated. The speech of the adult is the result of a long evolution under the influence of environment and unconscious selection.

The observer of child language must note development along two lines, in the mind and in the vocal organs. We will follow the latter chiefly. The inarticulate cries and calls of children soon come to be interspersed with articulate sounds. The easier vowels come early. The child M. uttered freely and clearly ah and oo early in the third month. These sounds appeared spontaneously, but could afterwards be evoked in imitation.

Of the consonantal sounds, the first to appear in the cases of O. and M. were b, f, p, d, t, m, n, ng, h, k, and g guttural as an initial. O. could make these sounds in the tenth month, but for several months afterwards he could pronounce them only singly or in easy combinations. Slowly, and with greater or less difficulty, the others were acquired. At two years O. could pronounce the vowel and dipthong sounds except oi and ew, and all the consonants except th, v, and the trilled l and r. He still had considerable difficulty with the guttural g as a final, for which he substituted d until his fourth year. For k final he invariably used t for about the same period; v was sounded b for a while, th was entirely omitted as a thick sound, as a thin sound f or s was substituted until the fourth year. Various consonantal combinations were especially slow in being perfected, as ks and kw. and all combinations with s as initial. l and r gave trouble until the fifth year. At first they were omitted entirely in any situation, then y and w began to appear respectively as initial substitutes, and the preceding vowels began to acquire breadth and prolongation when l and r were medials or finals. The child M., however, acquired r final early in the second year.

The mispronunciations of children may seem arbitrary and altogether irregular to the casual observer, but in reality nearly all of them can be readily classified and arranged under law, the same law that appears in the broken speech of foreigners attempting English, and indeed in the history of the changes that have come over the sounds of English words themselves. A child is a foreigner learning the language, and he pronounces the easier sounds rather than the difficult. The omissions and substitutions of children represent the difficulties in sounding the vocal elements and combinations of our speech — difficulties that adults struggled with and overcame at so early an age that they do not recognize them as difficulties.

In the speech of the child O. during his first four years the following classes of consonantal substitutions regularly appeared.

First classifying the sounds according to the organ of articulation: —

	Sound attempted.	Sound made.	Example.	Comparison.
Labials.	f	p	Eppie = Effie	(L) pater, father
	wh	f	file = while	cough
	v	f	ofer = over	five, fifty
	v	b	balise = valise	have (O.E), habban
	p	m	moon = spoon	Polly, Molly
	m	p	Pata = Martha	Patty, Mattie
Dentals.	d	n	ness = dress	
	t	n	nats = tacks	
	th	t	cot = cloth	
	t	d	bodde = bottle	(L) duo, two

Second, classifying the sounds according to their duration in utterance: —

Spirants (sharp).	th	s	sissle = thistle	loves, loveth
	f	h	hind = find	laugh
	th	f	fumb = thumb	Fedor, Theodore
Mutes (sharp).	k	t	fots = fox	
(flat).	g	d	pid = pig	
	g	j	jive = give	joy, (L) gaudere
	b	j	janana = banana	
	d	j	jit = drink	
(nasal).	n	m	timy = tiny	lime, linden

Besides these there were several other regular permutations, which do not fall into any of the above classes. I have not observed any interchanges in the use of gutturals, palatals, or sibilants, or in the flat spirants. One child I knew of regularly interchanged the trilled spirants, as in "I rost my ling" (= I lost my ring).

The speech of children shows all the features which, in standard language, we consider as the product of phonetic decay in the various forms of aphœresis, syncope, and apocope. The omission in both cases is due to the same cause, namely, the excessive effort that would be required to articulate the sounds.

As far as my observation goes, children rarely add new elements in sounding words. Transposition, however, is not uncommon; O. regularly said kit for tick and krunt for trunk.

The ability to discriminate vocal tones, which infants possess in a remarkable degree, is a potent factor in the acquisition of language. This ability is manifested very early, showing itself in looks of distress or outcries even, in response to harsh language, and in a return to placidity when softer tones follow. Such manifestations are, of course, instinctive, and are precisely of the same nature as the exhibition of terror referred to as made by H. on the eighth day of her life at the falling of a bottle to the floor. Again, the child M. in her tenth month was trained to keep away from a hot-air register by the use of the simple word "burn," spoken to her several times with considerable intensity of warning in the tones. A soothing effect is produced on children not only by soft and musical sounds, but by sibilation,

either by the voice or by such means as the rustling of paper. Almost any novel sound induces temporary distraction from crying.

Imitation plays an all-important part in the acquisition of conventional speech. In the case of O., the faculty of imitation appeared first in manual actions and during the tenth month. Vocal imitation was first observed in the thirteenth month, when, under the stimulus of the shouting of other children at play, he, also, began to shout vociferously. Shortly afterwards he began, under instruction, to imitate the sound of a watch's "tick-tick." But in this instance, and others which followed, there is no argument for an onomatopoetic origin of language, for in no case did the child originate the imitation. He merely imitated an imitation first made by his parents. From this period imitation showed itself frequently, and the child was delighted with his successful attempts; the delight was increased when these attempts were appreciated and reproduced by those about him.

It is scarcely necessary to mention that infants understand a considerable range of language long before they can speak. A child readily learns a few words for simple objects or actions before he is a year old, and some children can be taught to understand "No" as a sign of prohibition as early as the eighth month. This last is a similar development of intelligence to that early gained from an experience of pain resulting from contact with injurious objects. In his seventh month O. was accidentally allowed to touch a hot lamp chimney, and, being burnt, he would always afterwards draw back on being brought near a lamp.

We may sometimes hear it said that the first words uttered by children are nouns, in respect to grammatical function. The truth is that, though an infant's first words are commonly such as are used by us in nominal relations, yet in the infant's speech these words are not nouns, but equivalent to whole sentences. When a very young child says "water," he is not using that word merely as the name of the object so denoted by us, but with the value of an assertion something like "I want water," or "There is water." the distinction in meaning between the two expressions being shown by the child's tone of utterance.

There is no form of linguistic study more instructive and interesting than the observation of the successive and correlative processes in the growth of such interjectional expressions as this into the various and complex forms of conventional sentences. With the child O. some of the various steps along the straight line of development from the single word to the full, simple sentence were as follows: "Water," "drink water," "want a drink of water," "baby wants a drink of water," or "him wants a drink of water," "I want a drink; *baby* wants a drink of water," "I want a drink of water." No instruction was given the child in the case, and it took him more than two years to develop the conventional sentence after he had begun to use the word "water." The natural difficulty which children have in acquiring the use of the personal "I" appears in the foregoing examples. Even after O. began to use "I" as a name for himself he seemed to think it necessary to explain or justify the word to himself by repeating the statement and using instead of "I" the name "baby" or "Oscar." Occasionally he used the noun first and repeated, as in "Baby want a drink, I want a drink."

Similarly, the child was long in learning to use the objective personal "me." The earlier mode of expression was to employ the name baby, as "Papa, carry baby." Before reaching the regular use of the possessive "my," O. always expressed this relation by "its," as in "Papa, take its hand," "Mamma, wipe its eyes." Thus until nearly three years of age, the child apparently regarded himself only as object and not at all as subject. Other curious forms of expression in habitual use shortly after this were such as "I am going down, me," "I'm going home, I'm are."

Notional words were acquired before those indicating relations, and of the latter the simpler and more notional were first acquired. Vocabulary and expression developed considerably without the use of the verb "to be." Interrogative pronouns, interrogative adjectives and adverbs came into use early, the relative or conjunctive pronouns much later — nearly two years. Adverbs came before prepositions. At first the prepositional function was served by placing the related words in juxtaposition, as "See old man (with) head down." In this sentence note also the omission of the comparatively noticnless word "the."

Color names caused great difficulty, their proper application depending, of course, on a considerable development of the perceptive powers. During the early part of his third year O. used "blue" freely, but he applied it to any striking color, as to a white horse and a red book. Similarly with number names, O. could not use the simpler names properly beyond one and two until nearly his fourth year. Any number beyond two he called "nine." "No" was easily acquired; "yes" cost a great deal of effort, not in pronunciation, but in comprehension and application. At three years of age, to give an affirmative answer he would repeat the question in the form of an affirmation, or reply by "it is" or "it does." Then, after beginning to use "yes," it was applied irregularly, as in answering the question, "Will you do that any more?" O. said, "Yes, I won't." This is not a self-contradictory expression, as it would superficially seem. The child meant by "yes" that he was willing to obey, and the "I won't" defined the form the obedience would take.

The strength of the linguistic instinct in children is shown by the remarkable shifts they will make to find forms of expression for their perceptions or feelings. An examination of these shifts will show that the energy of the child manifests itself along precisely the same lines as have been taken by the languages of the races of mankind towards their ultimate forms. Thus, lacking the work "wide," O. said, "Open the door loud," extending the meaning of the word "loud" precisely as we do when we apply it colloquially to colors. So, too, he called a raccoon a "cat," just as we speak of "plumes" of horse-hair. Other illustrations I have without number, but will add only a few. "I have a headache in my neck," "There's a boat swimming," "Mamma, you never cut the toe-nails off my fingers." "Cows eats drinks of water, cows do," "I broked it (cp. wept)," "He goed," "Papa's gooder than you," "Papa can the see (i.e., light) come in here," "Which would you rather have, Mary *and* Rhoda?" "Papa's got *that* coat on," (i.e., a new coat). In the lack of a knowledge of negative forms, O. used some curious expressions. Thus, not wanting me to go out, he said, "Papa, come in; papa, stay home;" again, not wanting his coat taken off after being out, he said, "Put baby's coat on."

The most common means by which infants enlarge their powers of expression is by the metaphorical extension of terms already known, as where O. called a piece of fur "kitty." Now this ability to use words metaphorically implies the possession of the power of abstraction in some rude degree, for metaphor-forming is a mode of abstraction. It is a remarkable thing that very young children can form these abstractions. Thus O., at the age of eighteen months, having learned the name knee from a limb in a bent position, afterwards called his mother's chin "knee," and presently applied the same term to the projecting corner of a pillow. A more striking instance occurred shortly afterwards. Being a delicate child, he was just then at the stage of beginning to stand alone. He had been frequently told to "stand up like a man." The first time he tried this feat with entire success he said "man!" with much self-approbation. Within a few days he applied the same term to his doll when standing upright, and also to a long, narrow box when set upon end. All this time he was perfectly familiar with the common uses of the names man, doll, and box. Evidently, then, in the special cases noted, he was using the term man in the sense of "the upright thing," a considerable abstraction for an infant under two years.

Finally, children invent entirely new words. A few of O.'s original were "oüah" = water, "ōbō" = music, "gladdies" = dandelion flowers, "aneen" = wagon. The last word may be a case of aphœresis and substitution, but it seems hardly likely. The others are inexplicable, except as pure inventions. I know of two cases where a pair of children, besides acquiring their mother-tongue, invented a full vocabulary entirely unintelligible to any one but themselves. It is on the observation of such cases as these that Mr. Horatio Hale has very reasonably based his theory that the closest of blood relationship may exist between tribes or races of people whose languages differ in every particular.