just in front, so as partly to cover it and make the ventral portion of the *sylvian* coincide with the ventral branch of the *ectosylvian*, (Es); the frontal region is less prominent, and the outline of the cerebellum is quite different. In the Asiatic lion the left *coronal* is wholly independent; likewise the right *coronal* of the African; but the right of the former joins the *lateral*, which is the usual arrangement, while the left of the latter joins the *supersylvian* in a similar fashion. Other differences might be pointed out both between the two brains and the two halves of each; but it seems to me that these alone are enough to make us hesitate from basing a *diagram* of the fissural pattern of this species upon any such number of specimens as are likely to be found in any museum; while the same peculiarities present almost insuperable obstacles to a recognition of particular folds as organs of special mental faculties separated by certain fissures.

[The figures illustrating this paper are given in the plates, between pages 248 and 249, and their explanation will be found on page 249.]

CEREBRAL VARIATION IN DOMESTIC DOGS, AND ITS BEARING UPON SCIENTIFIC PHRENOLOGY. By BURT G. WILDER, of Ithaca, N. Y.

THE following observations are based upon the careful study of thirty-two dogs' brains, representing fifteen to twenty breeds. There were four of the same family, a mother and three children of different ages; two others nearly related to them, and two pair of brothers of different ages; the others are not known to be related; most of them are supposed to be of pure breeds.*

*The figures referred to in this paper are included with those of the preceding paper in the plates placed between pages 248 and 249.

LIST OF DOGS' BRAINS PREPARED AND DRAWN BY ME, AND FORMING THE MATERIAL UPON WHICH THIS PAPER IS BASED.

M. C. Z.* No.	Breed.	Age.	Sex	Weight of Body, in grams.‡	Weight of Brain.	Ratio, in thousandths.	Fig.
1	Pomeranian or Spitz.	adult.	♀	8,837.	,068	.007	20
3	" children of No. 1, by the same father, but of 2 separate litters.	5 weeks.	♀	1,316.	,047	.035	21
2	"	4½ "	♀	1,006.	,041	.040	22
4	"	54 hrs.	♂	,132.	,008	.060	23
215	" later children of mother of father above mentioned.	3 days.	♀	,213.	,010	.047	24
216	"	3 days.	♀	,247.	,011	.044	25
	Eng. rat terrier (small blk. and tan).	at birth.	♀	,092.	,005	.054	
522	Eng. rat terrier brother of above.	24 hours.	♂	,081.	,008	.099	
	Spaniel ¾ pure.	at birth.	♀	,221	,007	.030	
511	Eng. blk. and tan terrier (small).	6 mos.	♀	1,320.	,038	.028	12,13
512	Shepherd.	young.	♂	1,952.	,055	.028	
540	Shep. cur (pt. terrier?)	6 weeks.	♀	2,228.	,058	.021	
541	Mexican (Chihuahua).	17 years 8 mos.	♂	2,436.	,050	.020	
6	Eng. terrier brothers.	9 mos.	♂	5,300.	,074	.014	
7	" brothers.	3½ yrs.	♂	5,300.	,069	.013	25
526	Italian greyhound.	1 yr.	♂	6,074.	,067	.011	
8	Ital. greyh'nd impure.	adult.	♂	4,367.	,065	.010	
520	Spaniel (large impure).	adult.	♂	6,158.	,062	.010	
536	Chinese (hairless).	9 mos.	♂	7,026.	,074	.010	1
503	Skye terrier.	15 yrs.	♂	7,800.	,072	.009	
578	Hound.	20 yrs.	♂	22,450.	,108	.005	
9	Setter (large).	12 yrs.	♂	25,400.	,106	.004	
	Newfoundland.	adult.	♂	38,345.	,120	.003	26
13	Bull and cur.	12 yrs.	♂†	40,570.	,125	.003	
	St. Bernard.	old.	♀	40,820.	,098	.002	
25	With seven others the record of which is more or less imperfect.						

No. 7 was not weighed; he was slighter in form than No. 6, but the weights are assumed to be equal; the "fresh weight" of the brain is computed by forming a proportion with another brain

*This is the number on the Catalogue of preparations of Domesticated Animals in the Museum Comp. Zool.

†Castrated at about six years old.

‡For uniformity, a *full stop* is placed after the number of grams (the unit of weight), and a *comma* after the number of kilograms (1000 grams).

of nearly equal weight when hardened, but the fresh weight of which was also known: as to the weight being greater than that of the older brother's brain, I can only adduce the greater mental and physical activity which it displayed.

The brains of dogs are by no means common in museums, and figures of them are even more rare, partly, perhaps because the very commonness of the species induces delay in its examination,* but partly, I am inclined to think, from a notion that since they are all called dogs, there can be no great anatomical differences between them. Yet aside from any question of their origin from different specific forms of feral *Canidæ*, the fact is patent that our various breeds of dogs differ among themselves in respect to size, color, form and habit far more than would be required for the discrimination of species among wild animals; and there have not been, so far as I am aware, any investigations to show whether, or not, these external distinctions coexist with structural peculiarities.

It had long been my wish to undertake such an inquiry; and the liberality of Prof. Agassiz, in authorizing me to make for the Museum of Comp. Zoology a collection to illustrate the neurology and embryology of domesticated animals, has afforded me the means of commencing the investigation.

The table of absolute weights of brain and its ratio in thousandths to the whole body is mainly confirmatory of the general rule that young mammals have proportionally larger brains, and that the smaller species and varieties in like manner excel the larger; but the difference between, for instance, a little tan terrier and a Newfoundland is something prodigious, as seen by the following selected table, where the large dogs are represented by the Newfoundland, the medium sized by the English terrier (common size) and the small and young dogs by the small terrier and youngest Pomeranian.

No.	Variety.	Age.	Body.	Brain.	Ratio.
4	Pomeranian.	54 hrs.	,132.	,008.	.060
8	Eng. terrier (small).	6 mos.	1,320.	,038.	.028
7	" " (large).	3½ yrs.	5,300.	,069.	.013
	Newfoundland.	adult.	38,345.	,120.	.003

*As the house fly and mosquito are seldom among the first captures of the entomologist.

Generalizations like the above, and others which might be made respecting the ratios at different ages, in the two sexes and in various breeds, are evidently provisional until we have a much larger mass of material.

I would add that measurements were taken of the intestines; the capacity of the stomach and coecum was recorded and all viscera were weighed, so that I shall at some future day be able to present some statistics respecting them, and also respecting the degree of variation in the form of the stomach and coecum, of which many specimens are preserved, inflated, either at Ithaca or in Cambridge. This is the case also with all the other mammals here mentioned.

TABLE SHOWING THE RATIO OF BRAIN AND BODY WEIGHTS OF A FEW MAMMALS, CHIEFLY CARNIVORA.

M.C.Z.	Scientific name.	Common name.	Age.	Sex.	Weight of body.	Brain	Ratio.	Jaw-flexors.
577	Macacus?	White faced.	5 yrs.	♂	2,939.	,082.5	.028	
	Vulpes fulvus.	Red fox.	adult.	♀	2,918.	,047.	.016	.073
530	Canis lupus.	Gray wolf.	4 days *a. p.*		,460.	,009.	.019	
	Canis familiaris.	See special table.						
	Felis catus dom.	See special table.	average of 6 adults.		2,847.	,027.	.009	
552	Felis leo.	African lion.	7½ mos.	♂	11,230.	,162.	.014	.117
12	Hyæna vulgaris.	Striped hyæna.	old.	♀	33,770.	,110.	.003	.800
502	Ursus Americanus.	Black bear.	1 yr.	♀		,240.		.550
577	Procyon lotor.	Raccoon.	adult.	♂	5,540.	,044.	.008	.040
528	Putorius Noveboracensis.	Weasel.	nearly grown.		,100.	,005.	.050	
188	Equus caballus.	Mare.	14 yrs.	♀		,684.		
379	" "	"	adult.	♀		,597.		
175	" "	Horse.	adult.	♂		,580.		
347	" "	Colt.	at term.	♂		,361.		
354	" "	"	?		15,938.	,190.	.012	
325	Bos taurus.	Durham bull.	2 yrs.	♂	590,000.	,337.	.0006	
537	Camelus bactrianus.	Camel.	?	♀	299,813.	,615.	.0025	1.247

In comparing the weight of the brain with that of the flexors of the lower jaw (*temporals* and *masseters*) we find, for instance, that

the jaw muscles are about eight times heavier in a hyæna, four times in a Newfoundland, twice in a bear, a fox, and camel, but the same weight in a tan terrier, while in the young lion (552) they are only about two-thirds the weight of the brain, although this ratio must alter greatly as the animal grows older.

TABLE OF TWENTY-THREE DOMESTIC CATS.

M.C.Z.	Variety.	Age.	Sex.	Body.	Brain.	Ratio.
220	Common? } same litter.	17 days.	♂	,180.	,013.	.072
219	" }	"	♂	,202.	,013.	.049
218	" }	"	♀	,250.	,013.	.052
222	"	5 days.	?	,128.	,018.	.063
40	"	3 days.	?	,080.	,004.	.050
38	"	at birth.	♀	,110.	,005.5	.050
39	" (sister of 37).	36 hrs.	♀	,075.	,003.5	.047
37	"	12 hrs.	♂	,092.	,003.5	.038
542	Maltese.	?	♂	,560.	,022.	.037
48	"	23 days.	♂	,359.	,014.	.039
25	" (in part).	?	♀	,648.	,021.5	.033
24	" " "	2 mos.	♀	,800.	,025.	.031
34	Common.	3 days.	♀	,099.	,003.	.030
510	Maltese (in part).	?	♀	,963.	,023.	.024
26	"	?	♀	1,770.	,026.	.015
32	Common.	adult.	♀	1,882.	,025.	.013
	"	"	♂	2,591.	,031.	.012
20	" (striped gray).	young.	♀	1,912.	,023.	.012
30	Common.	?	♀	2,276.	,027.	.012
23	"	adult.	♀	2,370.	,028.	.012
28	"	"	♀	2,978.	,027.	.009
22	Maltese (in part).	"	♂	4,550.	,031.	.007
21	" " "	"	♂	2,712.	,025.	.007

The following inferences may be drawn, provisionally, from the foregoing table.

1. The ratio of brain to body, in the adult cat, is about the same as in the adult dogs of the medium sized breeds: namely, .007 to .015.

2. In kittens of the same litter (as 218, 219, 220 and 37, 39) the brain weights are more uniform than the body weights, and the latter causes a variation in the ratio.

3. Although the increase of the *body weight* is much more rapid than that of brain weight, when the whole period of growth is considered, yet a comparison of 38, 39, 37, 34 with 218, 219, 220, 222, 48, shows that the brain must grow very rapidly during the first two or three weeks after birth concomitantly with the increase in bodily powers and the use of the senses.

A comparison of 2 and 4, among dogs, looks the same way; and in both cats and dogs, it will be remembered that the formation of fissures proceeds very rapidly during the earlier days. With pigs, calves and colts, on the other hand, I have found the fissures already deep and numerous long before birth, and it will be interesting to contrast the relative increase of brain and body weights in the *Carnivora* and *Primates* which are born helpless, and the *Herbivora*, which are in fuller possession of their faculties at birth.

General Form.—Some dogs' brains are high and rounded, while others are low, long and narrow in front; of the latter type are those of setters, Newfoundlands (Fig. 26), St. Bernards, shepherds and bull dogs; in all of these the olfactory lobes are visible for about half their extent when the brain is seen from above but they are wholly concealed by the hemispheres in the Pomeranians (Fig. 20), greyhound (Fig. 16) and terriers (black and tan, Fig 12), the Chinese and Chihauhau dogs; and between the two groups come the bull terrier and skye terrier.

In the fox and wolf the brain is narrow and low in front, but in the lion it is rather high; while in the domestic cat, though low, the frontal region is very broad; evidently, however, it is not easy to discriminate between the effect of large size of a certain region and the relatively small size of an adjoining one, and it must be remembered that in all very young dogs' brains the olfactory lobes are hidden, but this is probably from their own undeveloped condition.

The greater prolongation of the olfactory lobes and of the adjoining region of the cerebrum, in front of the *presylvian*, which generally prevails in the larger dogs at least, as compared with the *Felidæ*, might be held to indicate their superior power of scent; but this proves nothing respecting any *mental faculty*.

M.C.Z.	Animals.	Fig.	Length of Hemisphere in millimeters.*	In front of frontal.	Ratio.
13	Bull and Cur.		.069,	.023,	.333
7	Tan terrier.	25	.053,	.010,	.188
14	Pointer and shepherd.	14	.045,	.013,	.288
	Cat.	17	.032,	.003,	.094
510	Lion.	18	.071,	.013,	.183

The above table is in no way intended as an index of the zoological or psychological relations of the several animals, but as a single proof of the impossibility of basing generalizations respecting groups upon one or even several individuals; for in respect to an element of brain form which might naturally be noted in any attempt at characterization, there is nearly as much difference between two dog varieties as between two Feline species, or between the cat and the terrier.

Fissural Complexity.—There must be, of course, a limit to the depth of fissures (or to the elevation of folds), although we have, as yet, no means of ascertaining the nature of the limitation, nor whether it is uniform in all brains; but supposing it to be equal in two given cases, it is evident that a larger number, or length, whether of branches or secondary fissures, indicates a correspondingly larger amount of gray matter; and this, supposing its *quality* to be equal in the two cases, indicates a greater amount of brain power.

1. Now the cerebral mass is capable of expending nerve force in three directions, which are ideally distinct, at least in their purpose, but practically linked together in most cases.

1. Physical,
2. Mental, } for the individual.
3. Sexual, for the species.

At present we have no way of ascertaining from the brain alone, whether its peculiarities relate to greater mental, physical, or sexual power.

We would naturally account for the more numerous fissures of dogs, as compared with the feral *Canidæ*, upon the ground of

*A *full stop* is placed after the place for the number of *meters* (the unit of measure), and a *comma* after the millimeters (thousandths of a meter.)

their higher mental capacity; and upon this ground must be explained the somewhat remarkable fact that the brain of an adult Pomeranian female (Fig. 20) has fewer fissures than that of her five weeks old pup (Fig. 21); for the father was a trained dog, while the mother was comparatively unintelligent.

But the wolf, according to Gervais' figure, has more secondary fissures than the fox, and this must be accounted for by its greater *physical* power.

Perhaps this is also the explanation of the great fissural complexity of the young lion, as compared with the adult cats or even most dogs; but Professor Agassiz has suggested to me that the greater power indicated by the condition of the lion's cerebrum may be connected with its prodigious *virility*, the complete sexual act having been performed nine times in an hour, under his observation, and the same rate having been maintained during at least two successive nights.

In a young lion's brain (Fig. 19) the depth of the *supersylvian* fissure is at least one-half the thickness of the hemisphere at that point and in its plane; while in an adult cat's brain the depth was only one-fourth, and in a dog's about one-third; all the other fissures were very deep in the lion, and the layer of gray matter very thick.

I hope to make a careful measurement of several dog's brains, according to the method adopted by Wagner, with such suggestive results.

2. There are *individual variations* among the adults which do not affect the presence or relative position of main fissures, but their length, direction, branches, connections and continuity, and, by inference, the manner of their formation; these variations enable us to recognize any brain and may in some cases approximate them to other carnivorous families.*

3. The two sides of the same brain present just such variations as those above described between different individuals.

The few instances cited show to what extent this variation may exist; so great is it, indeed, that I do not think it possible to "mate" two hemispheres by their fissural pattern alone, without taking into account the similarity of size, or general form.

* The resemblance of the *ectosylvian* fissure of certain dogs to that of the cats is referred to in the preceding paper.

The number of specimens is not yet large enough to justify any inference respecting the sexual peculiarities of brains.

4. There are resemblances between brains of the same breed, which lead us to suspect the existence of a uniform modification of the general pattern for different breeds.

This is noticeable in the Pomeranian series; but in the first place some other brains show the same tendency of the *ectosylvian* to join the *sylvian*, and in the second place the near relationship of all the younger dogs to the single adult prevents our knowing how far the resemblance is one of *family* and how far of *breed*, in general.

The same doubt exists respecting two tan terrier brothers (6 and 7) whose brains are similar, especially since they do not particularly resemble those of others of the same breed.

5. All of these dogs' brains are comparable in respect to the fissural pattern, both among themselves and with the feral *Canidæ*.

There is *something* which leads even the child to call all dogs by that name, whether they be terriers or St. Bernards, greyhounds or bull-dogs, poodles or mastiffs; just what this feature is, has not, so far as I am aware, been scientifically described; nor have I any suggestion to make; the case seems to be similar with their brains; I do not think I should mistake the brain of a dog for that of any other animal, but I cannot yet say upon what grounds, and am by no means sure that my diagnosis would be correct in all cases.

But it is evident that in order to ascertain whether or not there is any peculiar dog pattern, and if so, what it is, a much greater amount of material is required than is now accessible.

If nothing else, I have at least shown that no fissural pattern involving several fissures can be correctly known from the examination of a single brain, much less one side of such brain. The collection at Cambridge is very large as compared with that of most museums, but far too small for any final conclusions. I merely venture to express the hope that when we are able to compare say twenty-five brains of the same breed of dog, we may be reasonably sure what are its cerebral characteristics, and probably several hundred specimens will be required to demonstrate the essential features of the dog's fissural pattern as contradistinguished from all other *Canidæ*.

The immense cost of such a collection raises the question of the value of the result, and this is only part of a general question not sufficiently considered when scientific inquiries are begun.

If a thing is to be done at all, it can be accomplished far more completely and economically by one person or one institution than by several working separately or at different periods. I would therefore ask members of the Association to bear me in mind when they have or know of a dog of pure blood and well known character, which has outlived its usefulness; a careful transportation and death by chloroform will obviate distress on the part of both the animal and its master.

THE RELATION OF THESE VARIATIONS TO SCIENTIFIC PHRENOLOGY.*—In using the phrase "scientific phrenology" I place myself between two fires; for the professional phrenologist claims that all phrenology is scientific, while many scientists deny the compatibility of the terms. Let it be understood then, that I use phrenology in a general sense, and to avoid coining a new word, to indicate the study of the brain as an organ of the mind; and, further, that I am not in the least biased by the views of others, but am trying to learn the truth by a new method of investigation. In justice to myself also, it is right to state that I speak as an anatomist and not as a physiologist, much less as a psychologist. With all due respect for the latter classes of investigators, I believe that they have been hitherto building upon very slight foundations, and that an immense deal of hard work in the way of anatomical comparison must be done before they can be sure of the grounds upon which their experiments and conclusions can be based. Further, I hold that most of the facts already at hand are not of the right sort; and that we have begun at the wrong end and in the wrong way in our efforts to correlate brain and mind.

MENTAL ASSOCIATIONS OF PARTS OF THE BRAIN MASS.—Four methods may be employed in order to ascertain the mental associations of parts of the brain mass:

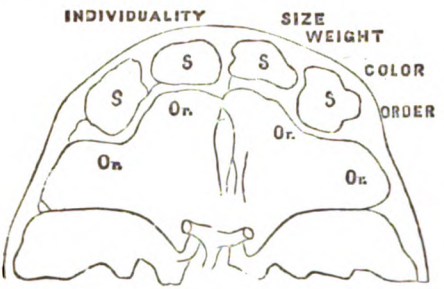
1. The Phrenological. The skull was accepted as an index of the form of the brain, and a certain number of cases of correspondence between cranial forms and marked characters was held to demonstrate the locality of mental faculties and propensities.

*This phrase is used by Gervais (Nouvelles Archives du Museum, tome vi, Pl. 9, Fig. 2). This author gives admirable lithographs of many brains and moulds of the cranial cavity, and suggests the value of a comparison of carnivorous brains, for the advancement of "scientific phrenology."

That this method is not satisfactory appears from the following considerations.

a. No definite and constant correspondence whatever exists between folds and fissures of the brain and the outer cranial surface.

b. Several important faculties are located over the frontal air sinuses, as pointed out by Dr. Cleland, from whom the accompanying figure (Fig. 27) is copied.*



c. No phrenologist has ventured to draw the accepted map of mental faculties upon the surface of the brain itself; and, from what we have learned, it is certain that what would fit one side would not fit the other.

d. No allowance is made for the extensive sheet of gray matter which covers the mesial surfaces of the hemispheres, and which, so far as has been shown, differs in no way from the rest.

e. To all appearance, the gray matter forms a continuous sheet, which may be more or less folded in the adult but was perfectly even at an earlier stage.†

f. By the failure (in several cases, though one is enough) on the part of the most expert phrenologist to determine correctly the character of an individual by examination of the head.‡

2. The Pathological. By comparing cerebral lesions with mental manifestations observed during the life of the individual. This is at present unsatisfactory, because:

*The lingering admirers of Phrenology. Popular Science Review.

† This is perhaps not so conclusive an objection as might at first appear; for the present non-recognition of lines of demarcation is no proof of their non-existence; and the experiments of terrier and others seem to demonstrate something like a localization of power in respect to *muscular action*; this, however, would not seem to require the same circumscription of area as in the case of distinct mental faculties.

‡ My views in respect to phrenology are given in "The Tribune Extra," No. 3, and my personal experience in "The Ithaca (N. Y.) Democrat" for Jan. 29, 1873. They will shortly appear in a republication of the lecture above referred to in the "Half-Hour" series of Messrs. Estes and Lauriat.

a. It has failed of absolute demonstration in respect to an apparently single organ, the cerebellum, for Dr. Hammond accepts neither the view of Flourens that it coördinates muscular action, nor that of Spurzheim that it is connected with sexual feeling, and concludes that it has no special function.*

b. The large number of cases in which aphasia coexisted with lesions of a tolerably definite region of the left hemisphere has not yet convinced the highest authorities that the mental faculty of language is there situated.

c. There is reason to suppose that peculiar mental conditions may exist when no cerebral lesion is recognizable, and that lesions may exist without mental disturbance.

d. Finally, Brown-Sequard concludes "from the study of every symptom of brain disease, that all parts of the brain may, under irritation, act on any of its other parts, modifying their activity, so as to destroy or diminish, or to increase and morbidly to alter it."†

3. The Experimental. This has been introduced by Fritsch and Hitzig, Beaunis and Nothnagel,‡ who, by galvanic or chemical irritation or destruction of certain cerebral regions of dogs, have demonstrated the existence therein of centres of action for different sets of muscles. This method promises great results, but, it may involve injury and abnormal action, and thus far has

* Quart. Journ. of Psychological Medicine, April, 1869.

† On the mechanism of production of symptoms of diseases of the brain, Archives of Scientific and Practical Medicine, vol. i, p. 117.

In this connection the following conclusions of Brown-Sequard (which I have but lately seen in the original, Feb., 1874) are of great significance: "An immense variety of symptoms in different individuals may be caused by a lesion in one and the same part of the brain; and the same symptoms may result from the most various lesions." Archives of Scientific and Practical Medicine, March, 1873, p. 259.

The above, together with the decided disbelief in the correctness of the generally accepted views of nervous physiology, which are elsewhere in the same journal expressed by the same high authority, should lead us to be cautious in our deductions from any single series of observations.

‡ FRITSCH AND HITZIG.—Ueber die electrische Erregbarkeit des Grosshirns. Archiv für Anatomie, Physiologie und wissenschaftliche Medicin, 1870. p. 300.

HITZIG.—Ueber die beim Galvanisiren des Kopfes entstehenden Störungen der Muskelinnervation. Archiv für Anat. Physiol. und wissenschaftliche Medicin, 1871, p. 716.

Weitere Untersuchungen zur Physiologie des Gehirns. Do., 1871, p. 771.

BEAUNIS.—Note sur l'application des injections interstitielles à l'étude des fonctions des centres nerveux. Gazette Médicale de Paris, 1873. Nos. 30-31.

NOTHNAGEL.—Interstitielle Injectionen in die Hirnsubstanz. Centralblatt für die med. Wissenschaften, 1872. page 705.

Experimentelle Untersuchungen über die Functionem des Gehirns. Virchow's Archiv, 1873, p. 184.

The above references are taken from Prof. H. P. Bowditch's excellent report on Physiology, Boston Med. and Surg. Journal, July 17, 1873, p. 79.

shown only a connection between cerebral substance and *muscular organs*, not of brain and mind.

The above method has been later employed by Ferrier,* who, however, used faradic instead of galvanic electricity.

Dr. Ferrier's results are interesting in the highest degree, and it is only to be regretted that he has not at once published a diagram of a brain, so that all may know to what parts he refers in his description.

It is worthy of note that in the following expression he jumps at no conclusions respecting the localization of *mental faculties*.

"There is reason to believe that, when different parts of the brain are stimulated, ideas are excited, but it is difficult to say what the ideas are. There is, no doubt, a close relation between certain muscular movements and certain ideas."

But the results of such experiments can hardly be accepted as indicative of the localization of mental faculties in the human brain, or that of any animal than the one experimented upon, until it is shown that homologous folds exist in both; and even then the fact that the same faculty, for instance, *combativeness*, is manifested by a dog with its jaws, by a horse with his hind legs, by a bull with his horns, and by human beings, with hand or foot, or only with tongue, renders the practical *phrenological* application a very difficult one. The following suggestion was made by me a year ago (lecture on the brain above referred to).

"To apply galvanic stimulus to the supposed organs of prominent and distinct faculties, either indirectly, through the skull, or directly, in cases of accident; perhaps it is not too much to suggest that the *experimentum crucis* could be tried, if an enthusiastic believer would allow himself to be trephined, through a few protuberances. We could then witness the manifestation of friendship or combativeness, as the subject clasped the operator in his arms or planted a blow between his eyes.

It cannot be denied that trephining is one of the perilous operations, but a healthy man would have a fair chance; a criminal would do well to accept the risk in case of possible slow strangulation, and should he die during the operation, it would merely anticipate by a score of years the method of execution, namely,

*FERRIER.—"Experimental Researches in Cerebral Physiology and Pathology." British Medical Journal, April 26, 1872. Also: "A new method with the brain;" read before British Association for Advancement of Science, 1873, and printed in "Nature," and in "Popular Science Monthly" for Dec., 1873.

by an overdose of chloroform, to which I believe we shall be compelled to resort, in the interests of decency, humanity, and even artistic effect."

But while convinced that this method of investigation will throw great light upon the question of the correlation of brain and mind, I am by no means confident that it will demonstrate the localization of mental faculties in certain cerebral folds. On the contrary, although satisfied that my present material is too small for final conclusion, I am more and more inclined to think that a cerebral hemisphere acts as a unit, either singly or with its fellow; that, other things being equal, a greater number and depth of fissures indicate a greater mental or bodily power, and that the actual number of the fissures has only a *general functional significance, analogous to coils of intestine, or corrugations of mucous membranes;* but that like these, or like the peculiar turns of horns and the arrangement of turbinated bones, their arrangement in what is called the fissural pattern may be fairly accepted as indications of *zoölogical relationship*, more and less remote. The extent of their value in this regard must be ascertained by much more extensive comparison than has been made.

4. Cyno-phrenology. The method here advocated is, in theory, that of the phrenologists, but its practice differs therefrom in two important respects: *a.* In employing the brain itself for comparison, in using large numbers, in comparing the two sides, and in keeping the brains for such study as is impossible from figures. *b.* In employing not human, but canine brains, upon the grounds of their simpler fissural pattern, their smaller size, and consequent easier preservation in large number, and the possibility of an accurate acquaintance with the mental characteristics of the dogs. At present we are well acquainted with the natures of our family, our friends, and of public men; their brains are rarely at our disposal for scientific investigation; so we study the brains of paupers and uncultivated persons whose characters are known to us either not at all or very imperfectly. With dogs, the brain and the mind of the same individual are at our disposal; while lateral, epochal, individual and sexual variations, together with those appertaining to families and breeds, may be more easily observed and separated.

I have records of the habits and disposition and mental attainments of several dogs, but the material is far too slight for

anything like a scientific deduction. I even hesitate to associate the great width of the supersylvian fold of a bulldog, with his fighting powers, for his *disposition* was gentle enough.

EVEN DISTRIBUTION OF FISSURES.—I cannot help thinking that at least one of the elements of the fissural pattern is the subdivision of the surface into approximately equal areas. This is best demonstrated by projecting the surface of a hemisphere upon a plane. But the only brain on which I have as yet done this is less satisfactory than I expected; and I shall hope hereafter to offer sections of the hemispheres which will better indicate both the distance between the fissures and their depth.

If particular folds are the organs of either mental faculties or distinct groups of muscles, and if as such organs they are circumscribed by the intervening fissures, then how can we explain the following facts?

1. That these folds are generally continuous around the ends of the intervening main fissures.

2. That even where "islands" are formed by the extension of branches or by secondary fissures, there was a time when these surfaces were continuous upon the same level.

3. That no one has yet demonstrated any structural lines of demarcation corresponding to the fissures.

4. That there may be differences between the two halves of the same brain equal to or even greater than those which distinguish individuals or even species.

The zoologist and comparative anatomist would not hesitate to call attention to the greater or less width of a certain fold, and would regard it as of possible taxonomic value; but the cautious physiologist would certainly shrink from the inference that this was conclusive proof of the greater or less power of certain muscles or mental faculties; and he would be yet more loath to infer that the apparent obliteration in many dogs of the posterior leg of the front or lowest fold (which in fox intervenes between the *sylvian* and *ectosylvian*) indicated the absence of either the muscles or the faculties which the fox exercises through it; or even to infer that the apparent transfer of the anterior leg of this fold in hyæna, to behind the *sylvian* fissure indicated a real transfer of a mental or muscular "organ;" although, should the fissural arrangement prove constant, it would be unhesitatingly accepted as of great taxonomic value.

Plate 1. FORMATION AND NOMENCLATURE OF FISSURES IN CARNIVORA.

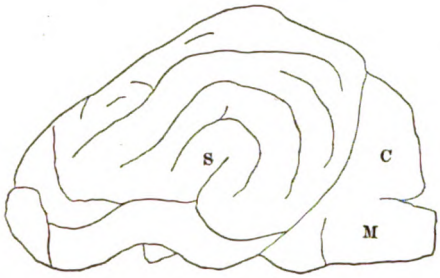


Fig. 3. Fox, *V. fulvus*. ♂ adult.

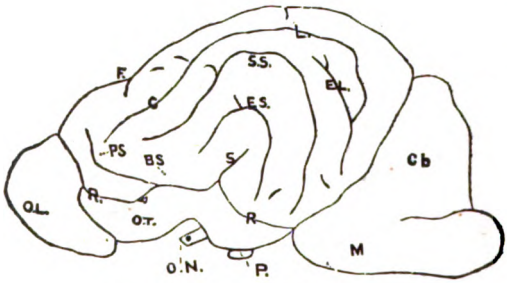


Fig. 4. Fox, *V. fulvus*. ♀ (513.)

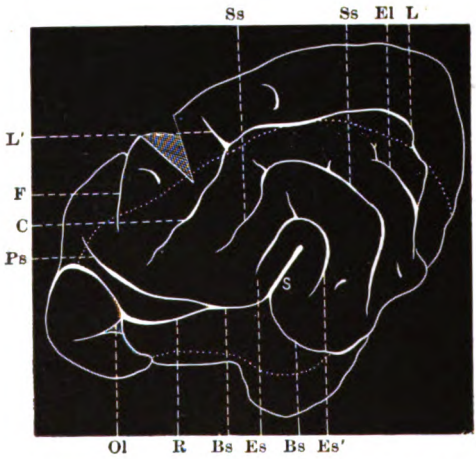


Fig. 5. Fox. Same as 4, projected on a plane. (See page 218, note.)

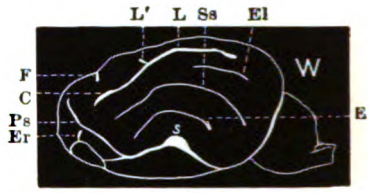


Fig. 6. Fœtal Wolf (*Canis occidentalis*): four days before birth. (530.)

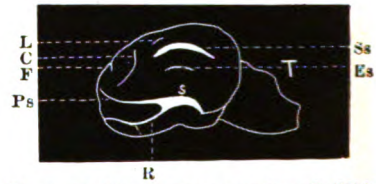


Fig. 7. English Terrier: one day. ♀ (532.)

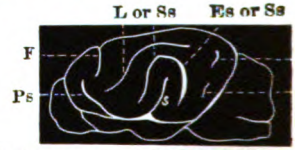


Fig. 8. Weasel. *Putorius Noveboracensis*. Nearly grown. (528.)

Fig. 1. Appendicular lobule of Cerebellum, left side, of Chinese dog. (p. 217.)

Fig. 2. Median lobe of Cerebellum of Kitten (K) and Cat (C), showing contortion during growth. (page 221.)

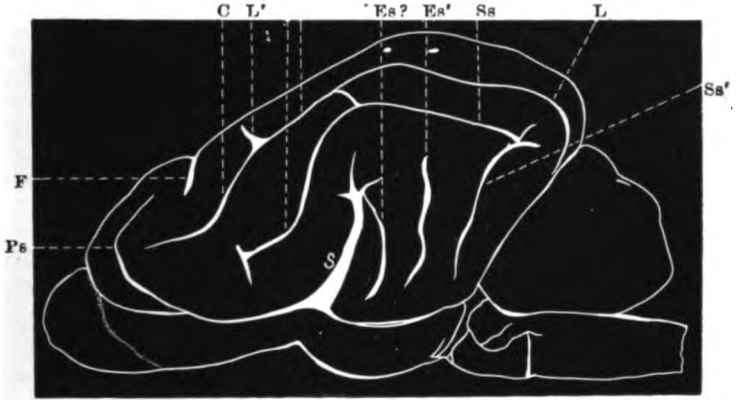


Fig. 9. *Hyæna vulgaris*, ♀ old. (12.) (p. 229.)

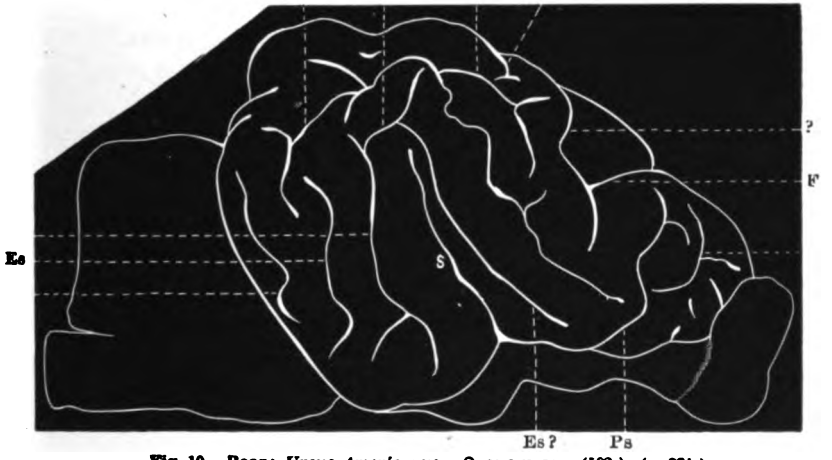


Fig. 10. Bear: *Ursus Americanus*. ♀ one year. (502.) (p. 231.)

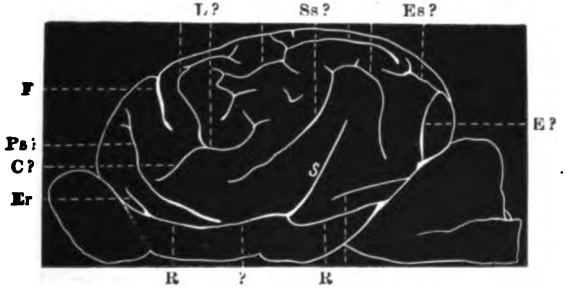


Fig. 11. Raccoon: *Procyon lotor*. Adult. (577.) (p. 225.)
(I am in doubt respecting most of the fissures in *Ursus* and *Procyon*.)

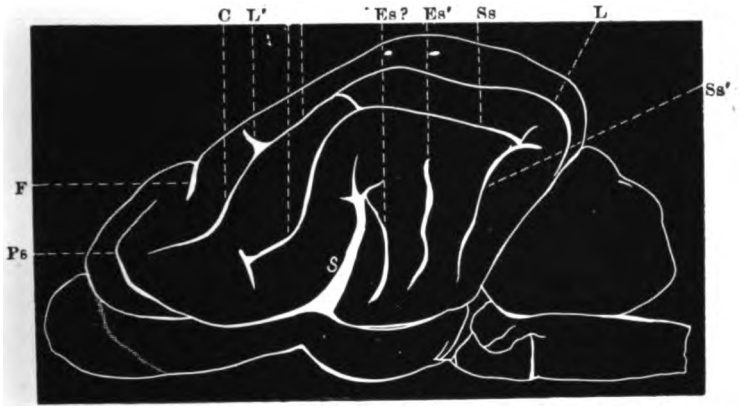


Fig. 9. *Hyæna vulgaris*, ♀ old. (12.) (p. 229.)

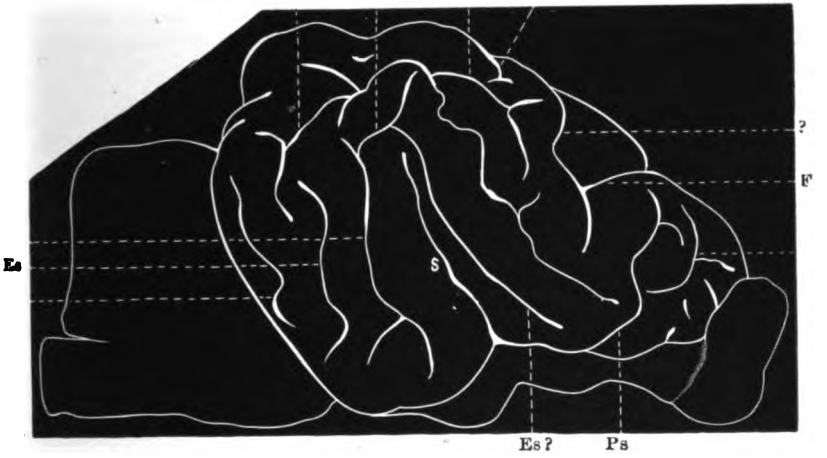


Fig. 10. Bear: *Ursus Americanus*. ♀ one year. (502.) (p. 231.)

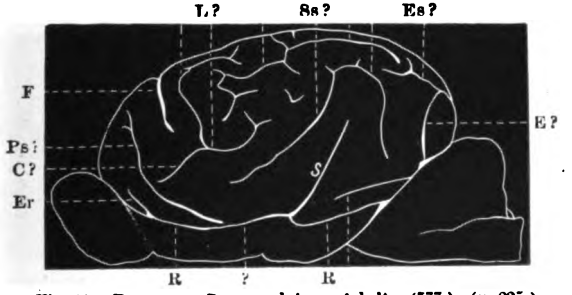


Fig. 11. Raccoon: *Procyon lotor*. Adult. (577.) (p. 225.)
(I am in doubt respecting most of the fissures in *Ursus* and *Procyon*.)

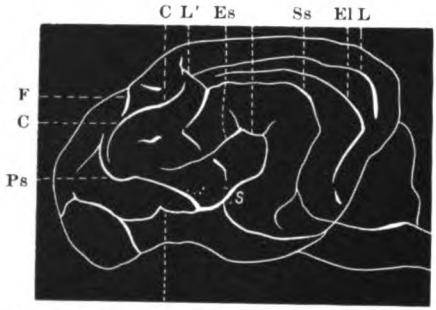


Fig. 12. Small bl'k and tan Terrier, ♀ (left side) six months. (511.)

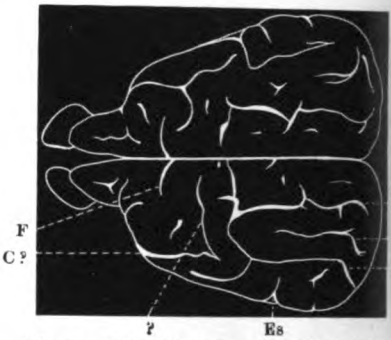


Fig. 14. Young Pointer and Shepherd, ♂ (14.)

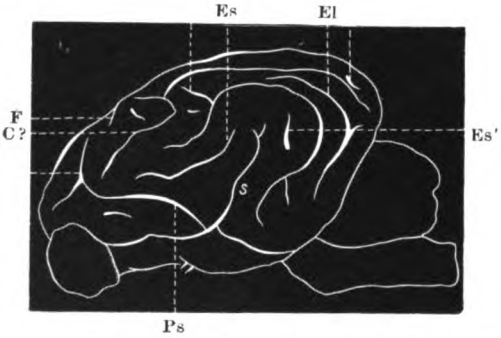


Fig. 13. Same as fig. 12 (right side reversed).

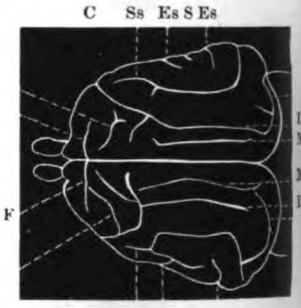


Fig. 15. Cat, Half grown, ♂ (20.)

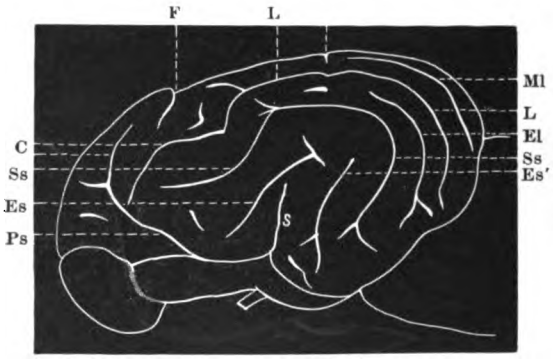


Fig. 16. Greyhound, one year, ♂ (526.) (p. 229.)

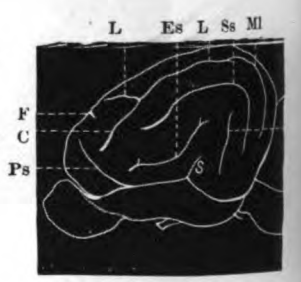


Fig. 17. Cat, adult. (p. 232.)

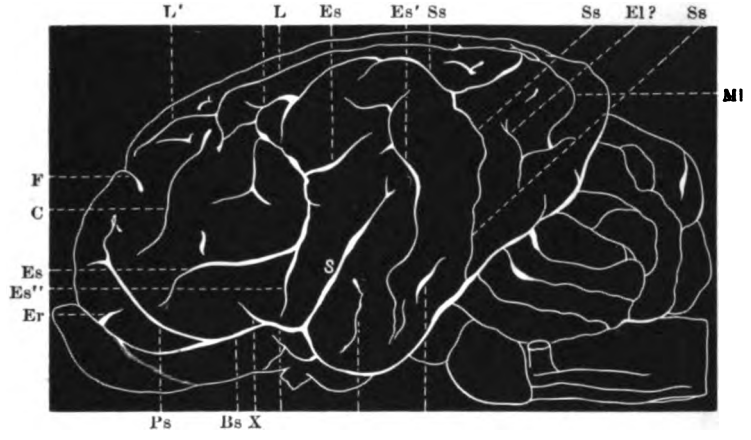


Fig. 18. Lion. ***Felis Leo***, var. ***Asiaticus***: seventeen months. Cerebellar lobes shown in part. (510.) p. 233.

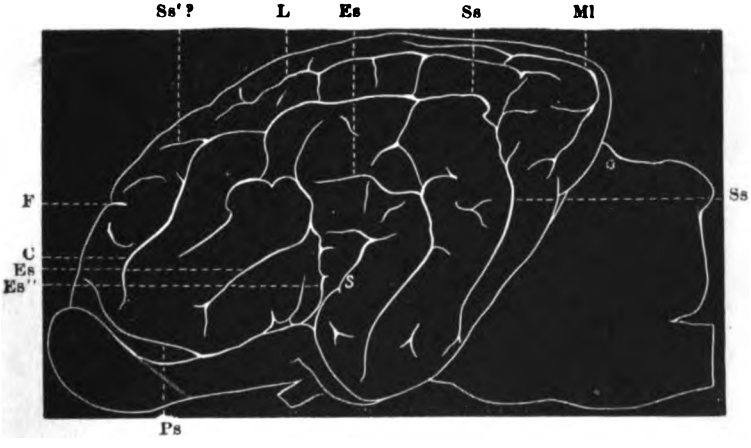


Fig. 19. Lion. ***Felis Leo***, var. ***Africanus***, ♂ seven and one-half months. Cerebellum in outline only. (552.) p. 233.

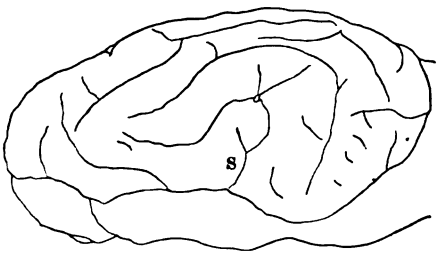


Fig. 20. Pomeranian dog, ♀ adult (1). (Mother of 21, 22, 23.)

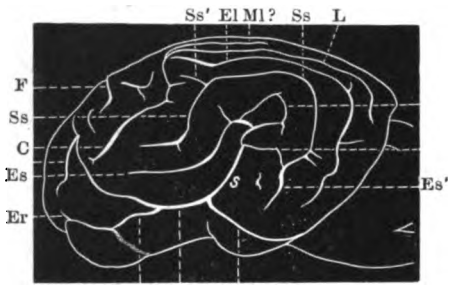


Fig. 21. Pomeranian pup, ♀ five weeks. (3)

Fig. 23. Pomeranian pup, ♂ fifty-four hours. (4)

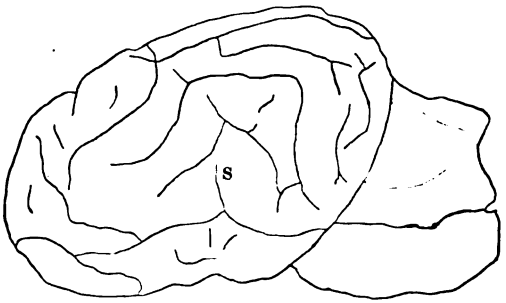


Fig. 25. English terrier, olf. lobe hidden; three and one-half years. (7) (p. 228.)

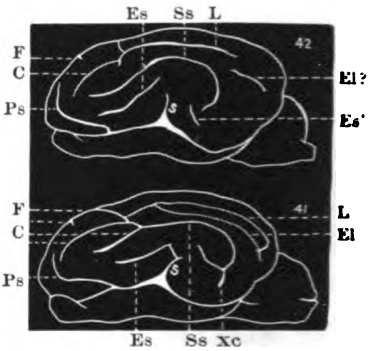


Fig. 24. (41 and 42) Pomeranian pups, ♀ three days.

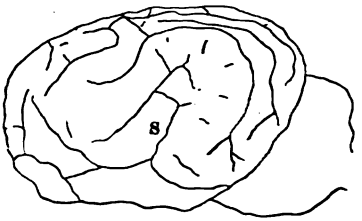


Fig. 22. Pomeranian pup, ♀ four and one-half weeks. (2)

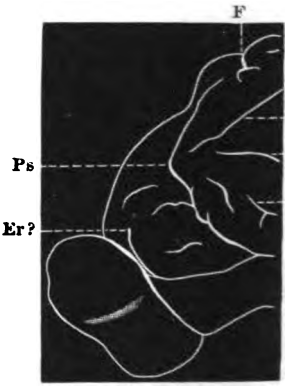


Fig. 26. Newfoundland, ♂ adult. Olf. lobe exposed.

Fig. 1. Left brain, left hemisphere: weight, ,182.

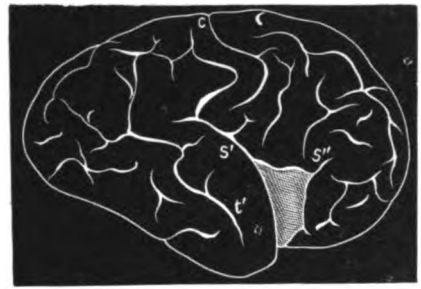


Fig. 2. Left brain, right hemisphere: weight, ,190. (drawn after drying.) See page 250.

Weight of left brain, ,372.

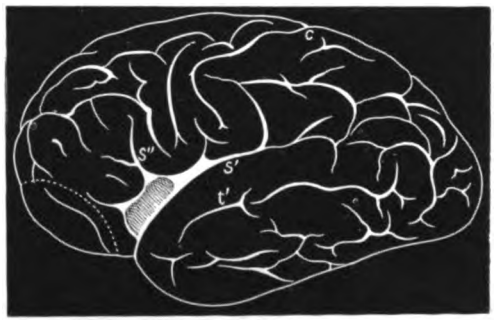


Fig. 3. Right brain, left hemisphere (the dotted line indicates a part of the frontal lobe which was destroyed): weight, ,196.

Fig. 4. Right brain, right hemisphere (drawn after drying): weight, ,209.

Weight of right brain, ,396.

All the facts indicate that while it is not impossible or even improbable that different areas of the cerebral surface may be in functional relation to either movements or mental operations or both, yet these areas are not *always, if ever, circumscribed by the fissures;* that the fissures merely increase the amount of gray matter wherever they are; their signification being rather quantitative than qualitative.

This question might be decided by Dr. Ferrier's method, exploring not only the free surface of the folds but also the hidden walls of the fissures.

EXPLANATIONS OF FIGURES.*—With two exceptions (Figs. 10 and 13) the brains are shown from the *left* side, and all the drawings are made from specimens hardened, and thereby shrunken, in spirit. The olfactory lobe is given in outline; also the cerebellum and medulla oblongata: but neither the nerve roots, nor the cerebellar convolutions are indicated. As stated on page 218, note, each fissure is drawn as it appears to the eye placed over *it* perpendicularly to the surface on which the brain rests.

Figures 3, 4, 20, 22, 25, showing the fissures dark on a white ground, have been kindly loaned to me by the "N. Y. Tribune," from those which illustrated the report of my lecture on "The Brain, and the present scientific aspect of Phrenology," printed in the "Tribune" Extra, No. 3: a few inaccuracies which could hardly be avoided in the hasty preparation for the press, have been since corrected.

The remaining figures, in which the fissures are shown white on a dark ground, have been drawn on wood and cut by Mr. Philip Barnard of Chicago (now a student in Cornell Univ.), to whose patience and accuracy I gladly bear witness. All the drawings were made by me from specimens which I had prepared.

The fissures are lettered uniformly throughout.

S — Sylvian.
Bs — Basisylvian.
Ps — Presylvian.
R — Rhinal.
Er — Ectorhinal.
F — Frontal.
C — Coronal.
Es — Ectosylvian.
Es' — Its posterior branch.
Esv — Its ventral branch.
Ss — Supersylvian.
Ss' — Its medial branch.
L — Lateral.
L' — Its medial branch.
El — Ectolateral.
Ml — Mediolateral.

* The numbers in parenthesis refer to the Catalogue of the Neurology and Embryology of Domesticated animals at the Museum of Comparative Zoology.