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The horse has a stomach which is decidedly small (8.15 L.) and a dorsal motor X nucleus which is equally small (comp. fig. 3), the ruminantia have an enormous stomach (cow ± 200 L.), which in some compartments is very rich in musculature and glands. In accordance we find a very large dorsal X nucleus in the cow (see fig. 4).

Also the pig is well provided in this respect if we consider the small size of its body (stomach 7.8 L.) and equally the dog. In the latter the stomach varies considerably according to the race, but as a rule is well developed (according to MENTZLAFF 8.26—29.31 % of the body-weight). Among our ruminant animals we find the difference that a ventricular compartment, which in the cow is very muscular is poorly developed in the goat and the sheep. Perhaps this explains the fact why in the latter the dorsal X acquires only its greatest size in its frontal third part, whilst in the cow the nucleus already acquires its greatest dimensions in the middle and keeps this maximum over a much longer distance than the sheep and the goat (see fig 2).

Now comparing the shape of the caudal part of the floor of the fossa rhomboidea with the above mentioned differences in the size and form of the dorsal motor nucleus, we understand why in those animals where this nucleus is more considerably developed and contains a great many motor cells the floor protrudes in the ventricle.

That this is not so in the dog may depend on the fact that this nucleus is only small directly in front of the calamus, and only acquires its greatest size in the frontal third part.

Finally I make use of this occasion to rectify a slip of the pen that has occurred in C. U. ARIËNS KAPPERS's VII[th] communication on Neurobiotaxis, on p. 97. Dealing with the dorsal motor nucleus of the horse the author says: "Nur *beim Pferd* fand VERMEULEN ihn erheblich grösser, was er mit dem grossen Magen dieses Tieres in Verbindung bringt". This must be of course "nur beim Rinde".

Anatomy. — *"On the relation between the quantity of white and grey substance in the central nervous system."* By Dr. A. J. HOVY, Utrecht. (Communicated by Prof. L. BOLK).

The relation between white and grey substance in the central nervous system has frequently puzzled the mind of neurologists. So authors (CHIARI, HESCHL, JELGERSMA and others) have alluded to it when dealing with the gyrated surface of the brain.

The quantitative relation has however rarely been measured with any amount of exactness. The greatest obscurity still exists as

far as this relation in regard to the evolutionary standpoint of mammals is concerned. It is even difficult to find a trustworthy method for measuring this relation and still more difficult to explain an eventual result. Doing so there would be a considerable chance to leave the field of exactness and to grasp in the darkness of theories.

The many factors that may act a part in this relation have been mentioned by ERNST DE VRIES [1]).

Several other authors (SNELL [2]), WEBER [3]), DUBOIS [4]) have demonstrated that there exists a relation between brainweight and the place occupied by the animal in the evolutional series, but specially between the weight of the brain and that of the body in such a sense that small animals have as a rule a greater relative brainweight than large animals of the same order.

From this appears that at least two factors, the evolutionary stage and the size of the animal have an influence on the mass of the brain.

Equally in the study of the relation of grey and white matter different factors have to be considered.

The author intended to study only one of these factors, viz. the influence of the size of the brain on the relation between white and grey matter.

This relation has very rarely been examined with exact methods.

The first who tried to obtain really exact results was DANILEWSKY [5]), who made use of the physical method of ARCHIMEDES to define the quantitative relation of two constituents of a mixture, by measuring the specific weight of each of the constituents, and then the specific weight of the mixture.

With this method DANILEWSKY found the relation between grey and white matter in a dog's brain to be 50 : 50 in one case and

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[1]) Dr. E. DE VRIES, Das corpus striatum der Säugethiere. Anatom. Anzeiger. 37ster Bnd. 1910. p. 386.

[2]) SNELL, Die Abhängigkeit des Hirngewichts und die geistigen Fähigkeiten. Archiv f. Psychiatrie. Bnd 23, 1892.

[3]) WEBER, M. Vorstudien über das Hirngewicht der Säugethiere Festschrift f. Gegenbaur 1896. WEBER, M. Over het Hersengewicht der Zoogdieren. Kon. Akademie v. Wetensch. te Amsterdam, October, 1896.

[4]) DUBOIS, E. Ueber die Abhängigkeit des Hirngewichts von der Körpergrösze bei den Säugethieren Archiv. f. Anthropologie, Bnd 25, 1897.

[5]) DANILEWSKY. Die quantitativen Bestimmungen der grauen und weiszen Substanzen im Gehirn; Centralblatt für die medizinischen Wissenschaften N°. 14, April 1880 p. 241.

The results here referred to were already mentioned by the author at the congress of naturalists in Charkow, 1878.

57 : 43 in an other. In the human brain DANILEWSKY found as an average result of several experiments this relation to be 39 : 61.

These results are highly interesting and it is a great pity that DANILEWSKY has not continued this work and that the only results which he mentions concern two subjects with such a different development of the nervous system. I will however call attention to the fact that in the larger of the two — man — the author found a much greater relative amount of white substance (11% more) than in the smaller.

Intending to examine only one of the factors that may influence the relation between white and grey matter: the size of the brain, I have thought it convenient to study corresponding regions in small and large representants of the same orders, thus avoiding as much as possible the influence that might be exercised by differences in evolution. I found the spinal cord to be the most fit for this purpose on account of the circumscript form of its constituents and since the cervical cord of a large amount of material was at my disposal in the Central Institute for Brain Research I have made use of this.

That the brain of large and small animals of the same sort shows a difference in the quantitative relation of the above mentioned constituents was remarked already by BRANDIS [1]) in 1893 and independently of this author by ERNST DE VRIES (l.c.)

The former found that in the spinal cord of a large bird (Anser) the white matter was not only absolutely, but also relatively larger than in a small bird (Regulus, see fig. 2).

It seemed useful to me to test this occasional remark by a larger amount of material chosen from all classes of vertebrates and from as many orders of mammals as were fit for this research. My material contained:

Two sharks.
Two chelonia
Three lacertilia
Four birds
Three rodents
Two ungulates
Two carnivora
Four platyrrhine apes
One elephant.

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[1]) Untersuchungen über das Gehirn der Vögel. Archiv. f. mikr. Anatomie. Bnd. 41, 1893. pag. 177. Theil I.

In all these groups small and large representants were compared — except that there is no small proboscidean to be compared with the elephant [1]). I have however taken into consideration also the latter because it shows so well the general law in the relation between white and grey matter as will be seen in my table (fig. 1).

The following method was used:

The sections coloured after WEIGERT—PAL were drawn in a projection-apparatus, in about the same size. Since it is only a question of relation the magnification is not of importance, and can only in so far act a part as a stronger magnification enables us to greater exactness in drawing the details of the circumferences.

These drawings were made on waxplates of constant thickness [2]), and the circumference of the grey and white matter cut out.

The outcuts were weighed and their relation expressed in percents. They are represented in the table of figure 1. In each column the grey matter is represented by the black colour, the white substance by the white colour; the number under each column indicates the percentage of grey matter.

In those columns where a large and a small representant of the same order are compared, we constantly see that in the larger representant the relation is very much in favour of the white matter. Equally in the elephant the enormous prevalence of white substance is striking.

In two animals — Hexanchus and Scyllium — the grey substance is not very compact but shows a rather reticular arrangement, the openings of the reticulum being filled up with white substance This made it very difficult to make trustworthy outcuts, for which reason I have omitted to reproduce the results — which however was not in contrast to the general rule.

Since the four ptatyrrhine apes did not all differ considerably in size, I have only represented the relation in the smallest and largest monkey.

The general rule expressed by my table for small and large adult material seems to be equally striking in the development of the central nervous system as appears from the interesting researches of R. STERN [3]), who has pointed out that during the development of the spinal cord from infant to adult the white substance increases

[1]) The tapir might be used for comparison being nearest akin. This animal however has not been stained. It is fairly large moreover.

[2]) As used for waxreconstructions after BORN and PETERS' method.

[3]) R. STERN. Beitrag zur Kenntnisz der Form und Grösze des Ruckenmarks querschnittes. Arbeiten aus dem Neurologischen Institute der Universität Wien 1908, p. 367.

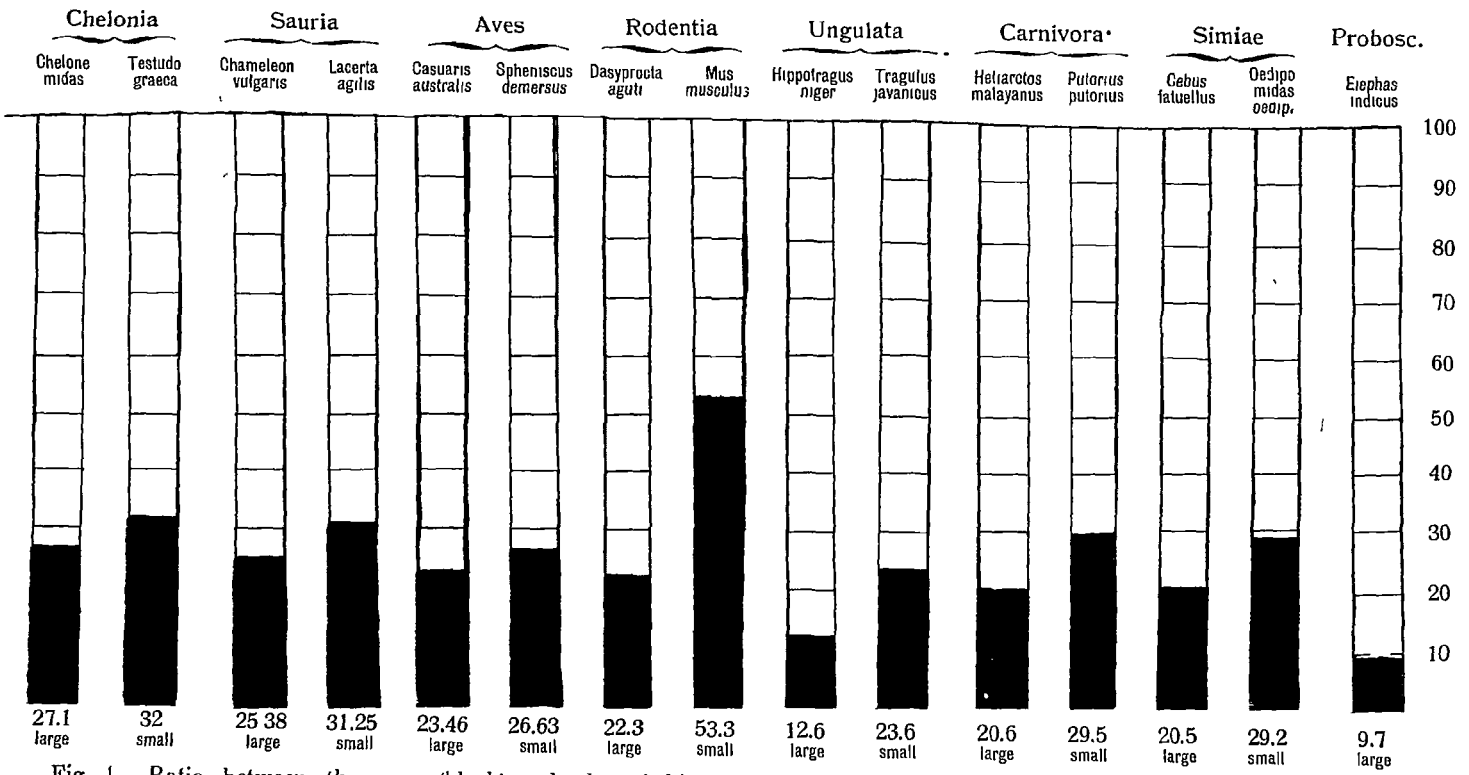

Fig. 1. Ratio between the grey (black) and white (white) matter in the cervical cord of small and large representants of the same orders,

much more than the grey substance (the difference being about 10%).

It seems to me that the rule demonstrated here has to be explained by the factors pointed out by ERNST DE VRIES viz. that if a brain increases in size, the number of myelinated fibres increases with the number of cells (that is with the grey substance) but since each fibre (each myeline sheath) becomes so much longer[1]), the whole quantity of white matter increases in a higher degree than the quantity of grey matter.

Apart from the differences mentioned above, I found also a difference in the shape of the grey substance in small and large representants of the same orders (see fig. 2).

As a rule the butterfly-like figure representing the grey matter has a clumsy form in small animals whereas in the large ones it is much more gracile. Specially the grey commissure between the left and right horns becomes more gracile as is strikingly demonstrated by a comparison between the mouse and the elephant. It seems that the increase of white substance in the posterior and anterior funiculi causes an enlargement of the distance between the horns.

Finally I want to remark that also the form of the cervical cord as a whole seems to be modified in large animals in such a sense that in small animals this form is more round, while in large animals it is more oval (see fig. 2).

It may be possible that this difference has to be ascribed to a greater opportunity for bilateral extension in the cervical part of the vertebral canal in large animals. It is however equally, if not more possible that the increase of white substance in large animals does not take place in the same degree in all the funiculi of the cord and that special parts are favoured, so it may be that the considerable enlargement of the posterior and anterior funiculi, which causes the horns to lie at a greater bilateral distance of each other, causes at the same time an enlargement of the cord in bilateral sense.

I do not believe as yet that this phenomenon may be considered as a rule, but I wanted to call attention to it since R. STERN (l. c. p. 322) has pointed out the opposite during the growth of the human spinal cord, stating that the spinal cord of the infant has a more oval, the one of the adult a more circular form.

[1]) Moreover the longer myeline-sheaths are often a little thicker. This is however not of great importance relatively and may practically be neglected.

On the other hand the fact that in larger brains some cells are somewhat larger, as has been demonstated still recently by OBERSTEINER for the Purkinje cells of the Cerebellum (Arbeiten a. d. Neurologischen Institut der Universität Wien Bnd XX, 1913), may be also neglected, since its influence on these relations is relatively unimportant.

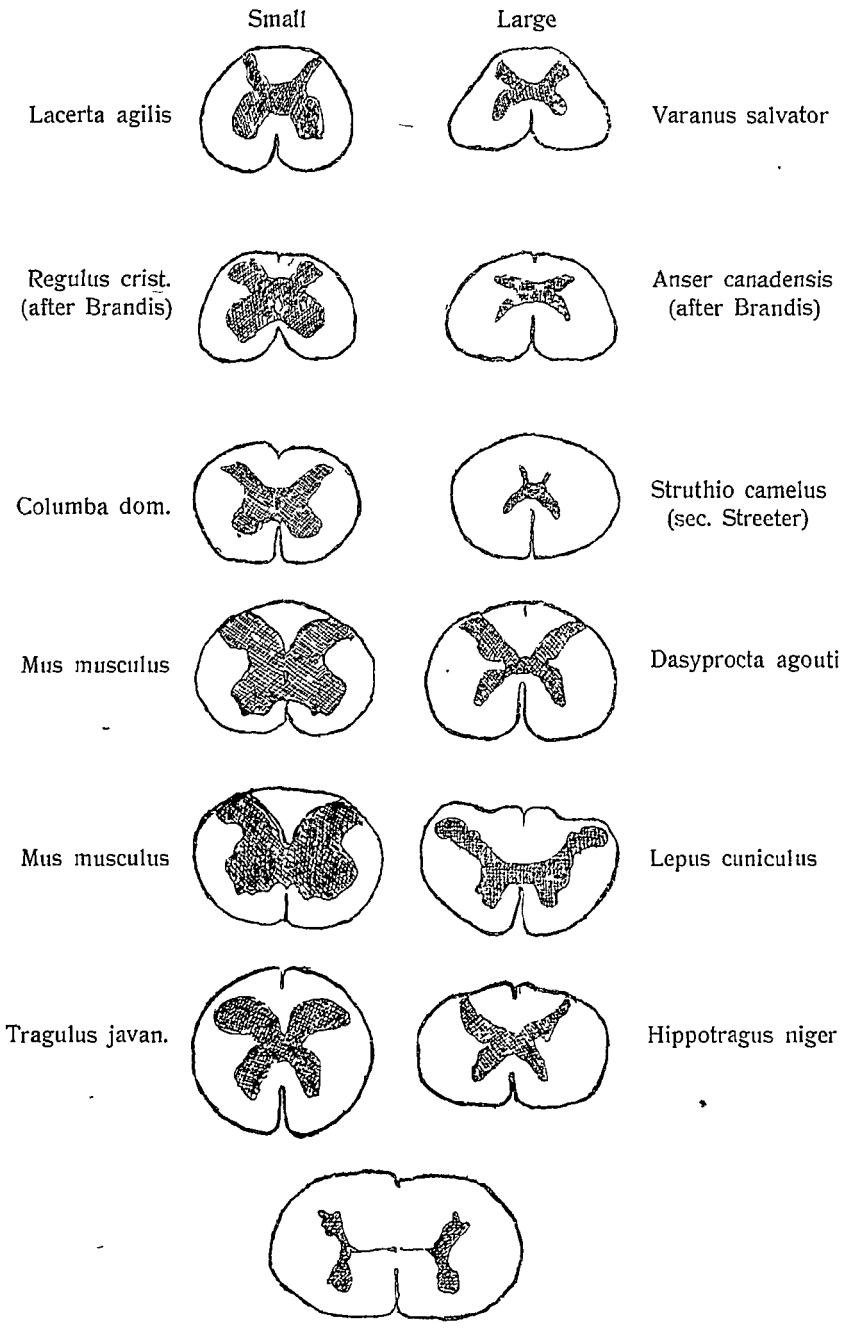

Fig. 2. Relation between grey (black) and white (white) matter in the cervical cord of small and large representants of the same orders. (The sections are drawn in the same size in order to show better the relative enlargement of white substance).

This observation of STERNS seems not to be applicable in a comparison of small and large adults.

Resuming my results, I may state the following conclusions:

1st. In the spinal cord of large individuals of the same order the relation of the white substance to the grey is much more in favour of the white than in small individuals.

2nd. This rule holds good for all the classes and orders examined.

3rd. This phenomenon can be explained — and according to my opinion has to be explained — by the explication given by ERNST DE VRIES (vide supra).

4th. Also the shape of the grey mather shows a modification in large animals in so far as it becomes more gracile, which is chiefly demonstrated by the distance of and the grey connection between the horns.

Physics. — "*The magneto-optic* KERR-*effect in ferromagnetic compounds.*" IV. By PIERRE MARTIN of Geneva. (Communication from the BOSSCHA-Laboratory by Prof. H. DU BOIS.)

In a former paper [1]) I have given the dispersion curves of the KERR-effect for certain manganese and iron compounds. It should be particularly noticed that almost all of these curves, as has been further confirmed with new material, show an algebraic maximum and minimum between or near the limits of the visible spectrum In the present research I have determined some new dispersion-curves and have also investigated in the case of a few substances the relation between the KERR-effect and the temperature.

For this purpose the material was cut into small discs of the same size as the pole-top (V, 7 mm.) face, and this entire system completely insulated from the pole-shoes by a layer of asbestos. The heating was accomplished by means of an ordinary Bunsen burner. Up to 300° the temperature was measured with a thermometer imbedded close to the mirror. For higher temperatures up to 450° a compressed nitrogen thermometer was used.

By regulating the flame the temperature could be kept constant to within about 5°. In order to prevent as much as possible oxydation and "tarnish colours" the mirror was constantly bathed with carbon dioxyde which had been led over $KMnO_4$, $SnCl_2$,

[1]) P. MARTIN. These Proceedings **15**, p. 138, 1912.