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Anatomy. — *"The red nucleus in Reptiles"*. By Dr. S. J. DE LANGE. (Communicated by Prof. C. WINKLER).

When studying the midbrain of Reptiles I was struck, first in Lacerta agilis, by big multipolar cells, which I found in the region of the most frontal oculomotor roots and which had much resemblance with the multipolar cells of the red nucleus such as are known in mammals.

With this aim in view, it was not difficult to state the same group of cells in other reptiles.

The group of cells, determined in this way, was localized almost in the same region, which VON MONAKOW[1]) and HATSCHEK[2]) have given for the magnocellular part of the nucleus ruber, only with this difference, that the fibres of the oculimotor roots do not run through the nucleus as we see it in mammals. Consequently there is a little dislocation of the whole nucleus in a lateral direction, which can find an interpretation by the fact, that in mammals the second part is situated laterally from the magnocellular part and therefore the former part is displaced in higher vertebrates to a medial position.

In the Varanus Salvator it seemed as if there were also a parvocellular part of the red nucleus, situated lateroventrally from the magnocellular part and extending towards the front. On more exact examination the above mentioned interpretation appeared not to be the correct one, for it was very improbable, that in the lower vertebrates we should find some parvocellular group of the red nucleus, this group being one of the connexions of the neocortex with the lower parts of the central nervous system and reptiles having no neocortex. It is rather to be granted, that the conclusion of HATSCHEK is true when he says, that both parts of the red nucleus in mammals show us variations relative to the higher or lower place in the system, occupied by the animal we have to examine. He has stated, that the magnocellular part is diminishing in higher mammals and that in man we can find back but a rudiment of this magnocellular part. This rudiment is situated near the oculimotor nucleus and among the rootfibres. In man the magnocellular part, in which the tractus rubro-spinalis originates, is localised in a more caudalr egion than the part we are accustomed to call in man the nucleus ruber and which is composed exclusively of small cells. Therefore the highest mammal

[1]) C. VON MONAKOW. Der rote Kern, die Haube und die Regio subthalamica bei einigen Säugetieren und beim Menschen. Arb. a. d. Hirnanat. Inst. in Zürich 1910.

[2]) R. HATSCHEK. Zur vergleichenden Anatomie der Nucleus ruber tegmenti. Festschrift z. Feier. d. 25 j. Best. d. Neurol. Institut an der Wiener Universität 1907.

has a great development of the parvocellular part of the red nucleus and only a rudiment of the magnocellular part. This is the reason of the fact that the tractus rubro-spinalis in man is also rudimental. Moreover we find in the localisation of both parts the reason, that tumors in the nucleus ruber in man but seldom cause degeneration of the rubro-spinal tract, unless the tumor has a caudal extension by which the rest of the magnocellular part is destroyed.

Descending in the series of mammals we see the parvocellular part diminishing, the magnocellular part growing on the contrary. With good reason v. MONAKOW calls the parvocellular part "the cortical part" of the red nucleus. He means that this part by its connexion with the neocortex is changing in size relatively to the extension of the neocortex, hence it is diminishing in the lower vertebrates with smaller evolution of the neocortex.

Fig. 1.
Section of the midbrain of Lacerta agilis.

In reptiles the cortex cerebri having hardly any but genuine olfactory qualities (it may be that we can suppose in some of the highest reptiles an indication of a neocortex in the thalamo-striato-cortical tract) we might expect only the pars magnocellularis of the red nucleus to be developed.

Subjoined I have collected some sketches of the principal representatives of reptiles. In all of them the bigness of the cells and their

Fig. 2.
Section of the midbrain of Varanus Salvator.

caracteristic multipolar form are clear. It makes an impression as if scattered reticular cells as they are found everywhere in the reticulum (See VAN HOEVELL's article) [1]) have concentrated in one place by a biological stimulus and in this way have formed a nucleus.

By the wealth distinctly of fibres in this region it was impossible forme to see which fibres descend from the nucleus caudally; therefore I have no right to speak of a tractus rubro-spinalis. Perhaps (and I am sure it will be as I think) it will be possible

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1) J. J. L. A. Baron VAN HOEVELL. Remarks on the reticular cells of the oblongata in different vertebrates. Kon. Acad. v. Wetenschappen 1911.

to show us this tract also in reptiles by experimental degenerations.

In fig. 1 I have sketched the nucleus ruber of Lacerta agilis, such as we find it in rather a great series of sections coloured after the method of NISSL. The section is taken from the middle part of the midbrain, there, where the tectum opticum shows its greatest development. It shows the frontal beginning of the oculimotor nucleus. So we have here the frontal pole of the red nucleus.

I give also the nucleus at its greatest development, somewhat more caudally (fig. 2). Here the oculimotor nucleus is distinctly divided in its three parts and laterally from the place, where the root fibres are going out of the central trunk we find a great deal of big multipolar cells, being of the same type as those we have seen in

Fig. 3.
Nucleus ruber in Boa constrictor.

Lacerta. It is clear, that here the nucleus is situated more ventrally than in Lacerta, but partly we have to seek the reason of this localisation in the fact, that this section is a more caudal one. This very distinct preparation is coloured with an infusion of elderberries according to a method, which soon will be described by C. U. ARIENS KAPPERS.

Figure 3 shows the nucleus in Boa constrictor. The section is coloured after the method of VAN GIESON. There are much fewer cells than in the former species of animals, but the form of the cells and their localisation just near the oculimotor root fibres make the identification with the former groups of cells undoubtful.

Much clearer is the situation in the Alligator sklerops (fig. 4). The Central Institute of Brain research has a very beautiful series in

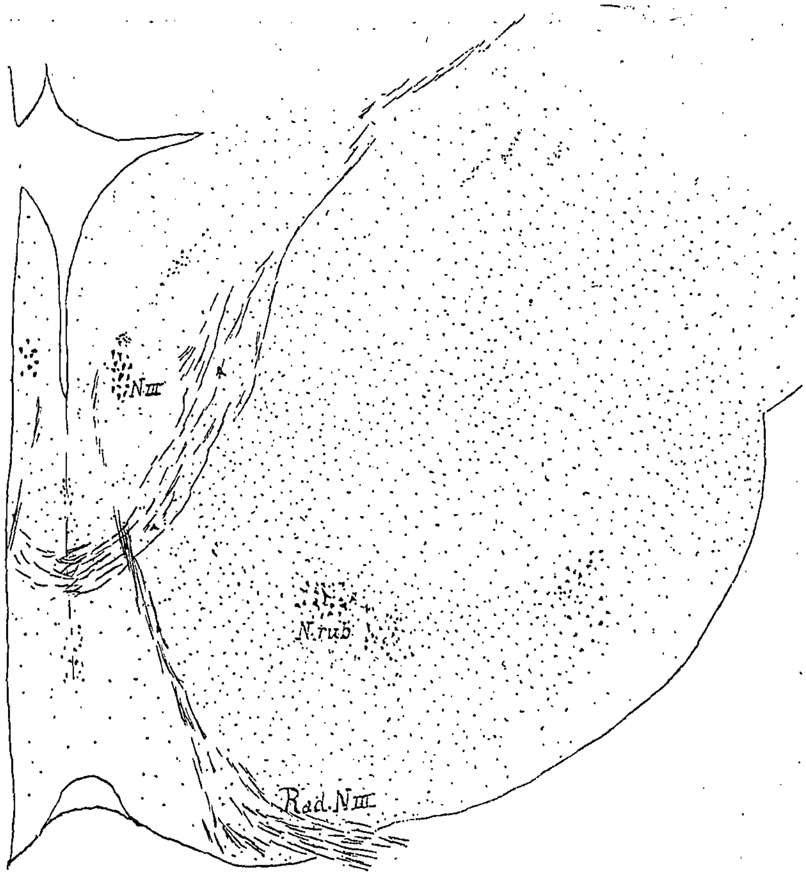

Fig. 4.

Nucleus ruber in Alligator sklerops.

two colours (VAN GIESON and WEIGERT-PAL). The localisation of the distinctly circumscribed group of cells near the roots of the nervus oculimotorius makes the diagnosis very easy.

Also in the lower reptiles we can find back without difficulty the group of cells. In fig. 5 I sketched the situation in Testudo graeca. Here also we find the oculimotor nucleus in the section and we see

Fig. 5.

Nucleus ruber in Testudo gracca.

several big multipolar cells, united to a distinct nucleus. The preparation is coloured with cresylviolet.

To my knowledge the red nucleus has never been described in reptiles yet. By the annexed figures I think I have demonstrated with sufficient certitude the existence of the magnocellular part of the nucleus ruber in reptiles.

But it is not only in reptiles that I found the red nucleus, also in amphibians it is possible to see a distinctly circumscribed nucleus, localized absolutely in the same way, so in the region of the root-fibres of the oculimotor nerve. It is again the same reticular elements which have concentrated to a nucleus. In fig. 6 I give a section of the brain of Rana, showing very clearly the group of cells. Two sections more caudally we find the frontal pole of the oculimotor nucleus, whilst the oculimotor roots are going out of the central trunk, as we can see in the control-section, which is coloured after the method of WEIGERT-PAL. In this section, only the cells are coloured and therefore the rootfibres are invisible.

When for the identification we use the scheme of TRETJAKOFF [1]) such as he made it for Ammocoetes, we see, that he mentioned a

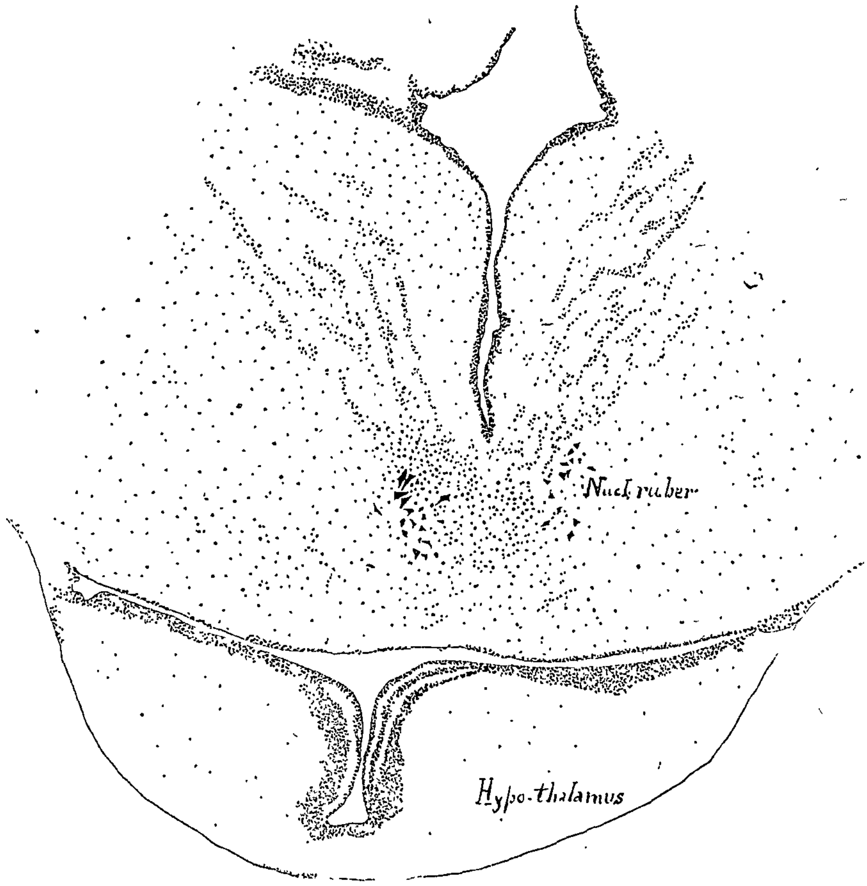

Fig. 6.
Nucleus ruber of Rana.

mesencephalic group of reticular cells, except the more caudal groups of reticular elements which all have been refound by VAN HOEVELL [2]).

In this lowest vertebrate the group consists of few very big multipolar cells, which we may consider as the prototypes of the magnocellular part of the nucleus ruber and which we can find back in all fishes. The cells are always localized in the region of the oculi-

[1]) D. TRETJAKOFF. Das Nervensystem von Ammocoetes. II. Gehirn. Arch. f. micr. Anat. und. Entwicklungsges.

[2]) Loc. cit.

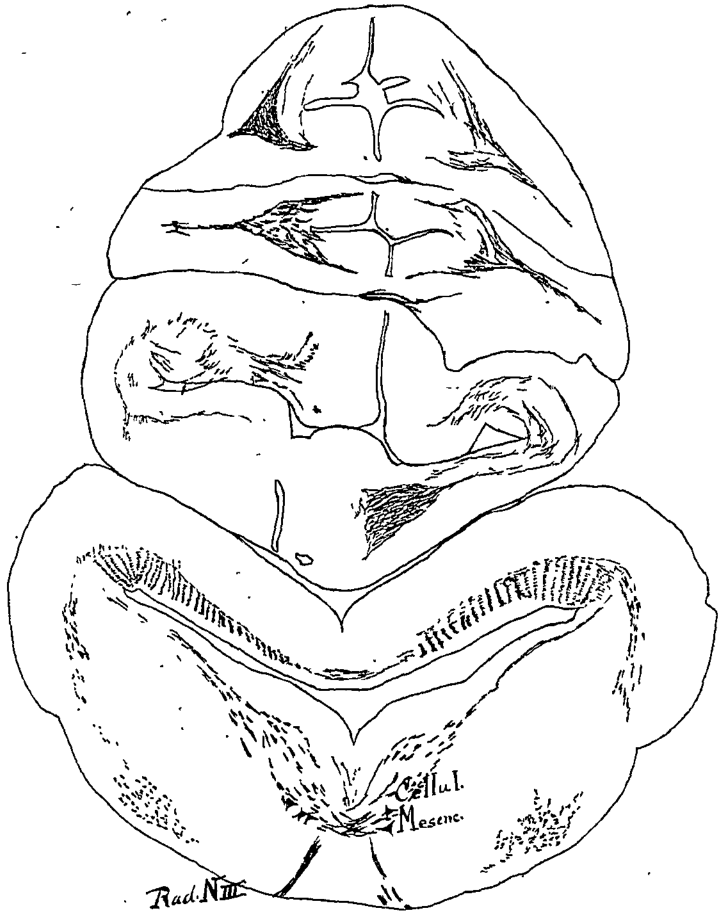

Fig. 7.
Section of the mesencephalon of Selache.

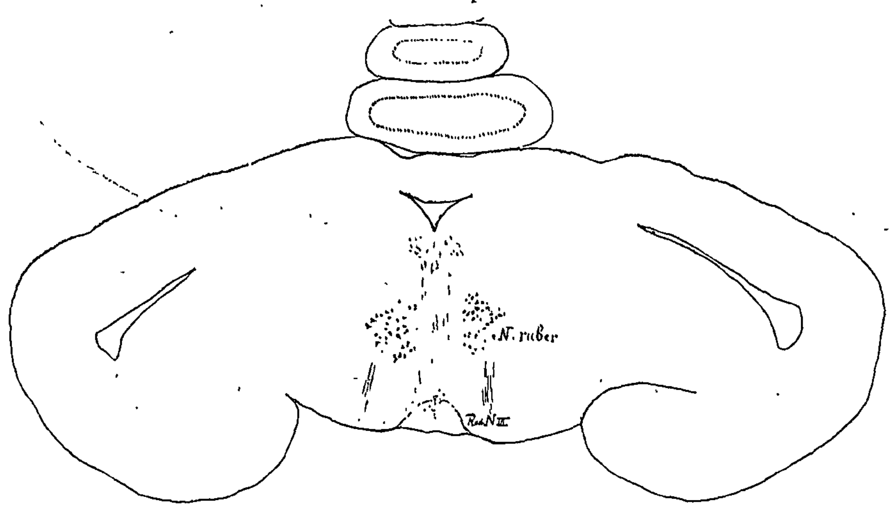

Fig. 8.
Nucleus ruber in Ciconia alba.

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motor rootfibres. As a specimen I give here a sketch of Selache (fig. 7) where on both sides we find two big multipolar cells.

To show the situation in birds and the transition to the lower mammals I add two figures.

1st a bird, 2nd one of the lower mammals.

I chose the Ciconia alba, having a very fine series of this bird (fig. 8), but it is very easy to find back the red nucleus in all other birds. I saw it in Columbus, in Casuaris, in Spheniscus.

At last the form as it is to be seen in the opossum (Didelphys marsupialis) (fig. 9).

I am of opinion that in all these cases the identification is so easy and so simple, that all confusion on this point is excluded.

Fig. 9.
Nucleus ruber in Didelphys marsupialis.