Anatomy. — *"Nucleus facialis dorsalis, nucleus trigemini posterior, nucleus trochlearis posterior"*. By Dr. C. T. VAN VALKENBURG. (Communicated by prof. L. BOLK.)

Studying some fetal human brainstems, my attention was drawn to the constant presence of a few groups of cells — nuclei — not yet described, which I could demonstrate too in the neonatus, and in the fullgrown man. They are the following:

1. *Nucleus facialis dorsalis*: By KÖLLIKER [1]) and ZIEHEN [2]) the existence of a dorsal facial nucleus in monotremata (ornithorhynchus, echidna) has been demonstrated (normal brains). In other mammals, inclusive man, it has not yet been found. Experimentally KOHNSTAMM [3]) and YAGITA and HAYAMA [4]) have shown a number of more or less scattered cells dorsally to nucl. VII, degenerated after resection of the submaxillary nerve resp. chorda tympani.

The japanese authors localise these cells closely to the medial part of the substantia gelatinosa Rolando of the descending trigeminusroot. According to the periferal lesion, the cells are supposed to represent a nucleus salivatorius nervi facialis.

The brainstem of a *fetus of* 27 *c.m. length*, cut transversally, was first examined.

Near the frontal end of the nucleus facialis, 1.4 mm. in front of the caudal ending, a cell-group appears dorsomedially from this nucleus, lateroventrally from the nucl. abducentis. This cell-group has a length of 200 μ (fig. 1).

The number of the cells is about 70; they are of the motor type, show distinct dendrites in the direction of the common facial nucleus (fig. 2). The staining with haematoxylin does not permit us to distinguish the cylinderaxis. 200 μ frontally to the rostral end of the cellgroup, the ventral nucl. VII disappears.

The brainstem of a *fetus of* 14 *cm.* was examined in the same

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1) KÖLLIKER: Oblongata u. Vierhügelgegend von Ornithorhynchus und Echidna. Leipzig ENGELMANN 1901.

2) ZIEHEN: Das Centralnervensystem der Monotremen und Marsupialier 2er Theil, 2er Abschnitt. SEMON's Forschungsreisen 1908.

3) KOHNSTAMM: Vom Centrum der Speichelsecretion etc. XX Congress für innere Medicin.

DERS. und WOLFSTEIN: Versuch einer physiolog. Anatomie der Vagusursprünge etc. Journ. f. Psychol. u. Neurol. 1907. S. 190 flgg.

4) YAGITA und HAYAMA: Ueb. das Speichelsecretionscentrum Neurol. Ctrbl. 1909. N°. 14.

YAGITA: Weitere Untersuchungen üb. das Speichelzentrum. Anat. Anz. 1909. N°. 2 u. 3.

way. 950 μ before the caudal beginning of the nucleus facialis a cell-group appears at the same place as mentioned above; the longitudinal dimension is 150 μ, the number of cells about 66. The protoplasmatic dendrites extend ventrolaterally in the path, also taken by the ascending axones of the ventral nucleus. Frontally the cellgroup ends in the same transversal plane with the ventral nucleus VII.

A *fetus of* 7.4 *cm.* showed principally the same features. The sections being made in a more horizontal direction, it was impossible to make quite exact and comparable measurings without modelling. About the relation of this cellgroup to the nucl. VII, it must be mentioned that the former was situated somewhat more laterally. The frontal endings of both were visible in one and the same plane; the horizontal length of the little nucleus was about 20 μ; it was impossible to determine exactly the number of cells in it.

I think it to be in a high degree probable that the indicated little nucleus is a dorsally situated cellgroup belonging to the facialis. The quite constant situation above the most frontal part of the nucleus VII, amongst the ascending rootfibres of this nerve, which after KAPPERS' [1]) description indicate the way phylogenetically and ontogenetically taken by the facial nucleus, is a strong support to this interpretation. Moreover the cells are of a purely motor type, and I am not able to find a relation with any other bulbar nucleus or root, particularly not with the nucleus abducentis, whose ascending way from the base to the fourth ventricle lies far more medially.

Of course it is desirable to indicate exactly by means of appropriated methods (silverimpregnation) cylinderaxes passing from the described cells into the nervus facialis.

To complete my observation I looked for this nucleus in the brainstem of a *child of* 14 *days,* and in that of a fullgrown man. Both showed the cell-group in absolutely the same situation. The former was stained with the PAL-method and it was due to the accidental colouring of the nerve cells by the chrom-haematoxylin that I could identify the elements in the ascending facialisroot (fig. 5). By the incompleteness of the series it was impossible to make trustworthy measurements.

The series of the *fullgrown,* stained after the method of VON GIESON, was strictly without gaps; the characteristic local connexions above mentioned were easily to be seen (fig. 6). In 14 preparations I counted 59

[1]) See e. g.: ARIËNS KAPPERS u. H. VOGT: Die Verlagerung der motorischen Oblongatakerne in phylogenetischer und teratologischer Beziehung. Neur. Ctrbl. 1908,

cells, in very satisfactory accord with the numbers obtained in fetal brains. Summarizing I believe I am qualified to conclude that a dorsal nucleus facialis occurs in man with great probability. The situation of this nucleus, during ontogenesis, changes no more, or at best very little, with respect to the neighbouring elements, particularly to the ventral nucleus facialis, as soon as the latter has reached its definite ventral place (in every case before the 3d month). It seems to be very probable, that the described cellgroup may be considered as a nucleus salivatorius giving origine to the secreto-motor fibres in the chorda tympani; my investigations cannot decide this question. The fact of the dorsal situation gives — in reference to ARIËNS-KAPPERS' neurobiotaxis-doctrine — a hint to a close connexion with the dorsal part of the substantia gelatinosa Rolando nervi trigemini [1]). After the examination of WALLENBERG [2]), EISENLOHR [3]), which I could confirm in a pathological case, it is highly probable that this part receives mandibular rootfibres. Therefore it is obvious to localise in this nucleus a function, closely connected to the sensibility of the oral mucosa. It is clear, that the action of the glandulae submaxillaris and sublingualis must be considered in the first place.

Security will only be obtained by cases of degeneration, which at the same time will indicate or explain the apparent difference from the experimental results in the dog.

The nucleus described here is most likely the same as VAN GEHUCHTEN believed to have found in a hen-embryo, and which afterwards was brought to degeneration in the rabbit by this author. He considered it as a nucleus abducentis ventralis (See: Les nerfs moteurs oculaires Journ. de Neurol. 1898). LUGARO confirmed the existence of this nucleus (Sull' origine di alc. nerv. encef. Archi di Ottalmol. 1894), and also PACETTI (Sull' origine dell' abducente. Ric. fatte nel Labor. d'Anat. norm. di Roma 1896). SIEMERLING and BOEDEKER contradicted it (Chron. fortschr. Augenmuskellahm. etc. A. f. Psych. Bd 29).

My preparations are contrary to v. GEHUCHTEN's interpretation. Moveover I am able to confirm SIEMERLING and BOEDEKER's observation, who did not find — in a case of abducens-paralysis — any cell-degeneration out of the region of the nucleus VI. In a case of atrophy of the eye muscle-nuclei the little cellgroup in question was undamaged.

The results of KAPLAN and FINKELNBURG (Beitr. z. Kenntn. des

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[1]) And with the frontal continuation of the nucleus of the fasc-solitarius?

[2]) Deutsche Ztschr. f. Nervenheilk. 1897, p. 400.

[3]) Arch. f. Psych. 1892, p. 314.

sogen. ventr. Abducenskernes. A. f. Psych. Bd 33) are somewhat uncertain.

2. *Nucleus trigemini posterior.*

Fetus 27 *c.m.* 200 μ frontally to the rostral border of the described nucleus, a cellgroup appears in a somewhat more lateral situation, but in the same horizontal plane. Proximally it continues directly into the nucleus trigemini, which has a much larger dorsoventral dimension (fig. 7). It would be unnecessary to take this cellgroup as a separate nucleus if in younger stadia clear limits did not exist.

Fetus 14 *c.m.* shows the little nucleus in the middle between nucl. fac. dors. and nucl. trigemini; the number of its cells is about 96. As in the former fetus, it lies more laterally than the dorsal facial, dorsomedially to the trigeminus nucleus (fig. 8). The dendrites run partly in a lateral direction, but most of them are not visible: this is due to the plane of section, which cuts the cells vertically on their longitudinal diameter. The common nucleus motorius V lies, as said above, more ventrolaterally, increasing in frontal direction especially to the ventrolateral side, approaching the end-nucleus of the sensory trigeminus [1]).

Fetus 7.4 *c.m.* In consequence of the more horizontal sections, the connexions are not distinct enough to permit any conclusion. Therefore I examined an embryo of 6.5 c.m., where the plane of section through the stem was more strictly transverse. Here the existence of the same cellgroup in quite homologous connexions was esaily to be seen. I was not able to make a sufficient photogram.

In the neonatus, nor in the full-grown man the described nucleus was to be found. It is true that a remarkable diminution in the number of cells is obvious in the distal parts of the nucl. V motor, which is followed behind and before by a rather sudden increase. But it is difficult to value exactly such a grouping, which occurs in other parts of the same nucleus too, and in a similar way in several other nuclei.

In every case we have to do with an ontogenetical confluence of two parts of the trigeminal nucleus between the 3^{l} en the 5th month. It cannot be stated with absolute certainty whether the nucleus posterior shifts forward, or the nucleus principalis goes backward. The connexions with other nuclei which could serve as points de repère are not reliable by the fact that the latter have not yet —

[1]) In teleosts and some reptiles a distinct cellgroup belonging to the motor V nucleus, behind this latter, occurs; it remains in this place during the whole life (ARIENS-KAPPERS).

at least in all details — obtained their definite situation and form. The sagittal direction of the greater part of cell dendrites gives a strong support to the presumption that nucl. posterior is "drawn" to the nucl. principalis. The cells of the latter send their protoplasmatic projectures mainly ventrolaterally, in the direction of the sensory V nucleus, where the stimuli arrive, by the influence of which the motor nucleus descends.

I am not able to give any interpretation of the initial separation and the later confluence of the two nuclei. Nor do I know anything of the functional nature of the nucleus posterior.

3. *Nucleus trochlearis posterior.*

Fetus 27 *cm.* 1.5 mm. behind the caudal pole of the nucleus trochlearis a cellgroup appears in a quite analogous part of the fasciculus longitudinalis posterior. It consists of large, motor cells, about 26 together, and measures sagitally 200 μ (left side). On the right side the distance between the caudal poles of nu. IV and nu. IV post. is 850 μ. De cell-corpuscle with its dendrites, is generally stretched from medioventral to laterodorsal, sometimes sagittally.

Fetus 14 *cm.* On the right side the same little nucleus as in fetus 27 cm. is present. It continues, with a few cells directly in the nucl. IV propr.; its length is about 250 μ. In the left half it appears already 600 μ behind the nucl. IV and measures 200 μ. The horizontal dimension of the nucl. IV is no more than 250 μ, whereas the right one measures 500 μ.

The left nuclei together are 550 μ, the right ones 750 μ. (fig. 9 and 10, 13, and 14).

Fetus 7.4 *cm.* could not give any information because it was cut in a too horizontal plane.

The same occurred in fetus 6.5 cm.

In the brainstem of a neonatus and of a normal fullgrown no nucl. trochl. post. was to be found.

In a case of ophthalmoplegia completa dextra I found behind the atrofied trochlearis nucleus another smaller nucleus equally atrofied On the other side this nucleus was unimpaired (fig. 11). The rootfibres go off in exactly the same way as from the nucl. IV principalis, which lies 1.680 mm. frontally to the posterior one. The sagittal length of the latter is 1.260 mm.

The nucl. trochlearis changes phylogenetically [1]) and ontogenetically its place in a frontal direction; a result of the frontal migration of the nucleus is the caudal situation of the point, where the root leaves the brain.

[1]) TRETJAKOFF: Das Nervensystem von Ammocoetes Arch. f. mikrosk. Anat. Bd. 74.

It is evident that certain, still unknown influences cause in some cases an incomplete migration, in consequence of which a group of cells remains on its way at a smaller or greater distance from the spot, that should be reached. Highly characteristic with regard to the inconstancy of this phenomenon is the above mentioned asymmetry [1]).

The cause can only be spoken of in general terms. The principal ground for the migration of the nucl. IV lies in the fact, that it acts under the influence of stimuli by which the nucl. oculomot. is stimulated at the same time. Regarding the very predominant role of the oculomotorius it is obvious, that the common stimuli of both nuclei, and the coordinated action of musculi innervated by them, draw the trochlearis nucleus forward more than the oculomotor one backward. Of course the stimuli received by nu. IV together with nu. VI for a common action, must be regarded too, though these may be of much less importance than the above mentioned ones. Now it seems possible to see in the caudal staying of a part of the nucl. IV the anatomical expression of the influence of common stimulation and common action with nucl. VI.

Only in a minority of cases this influence, which of course always exists, can be demonstrated in such a striking way.

EXPLANATION OF THE FIGURES.

Fig. 1. Transverse section through the oblongata of a human embryo 27 cm.
Fig. 2. The same, stronger magnif.
Fig. 3. Section on the same level, embryo 14 cm.
Fig. 4. „ „ „ „ „ „ 7.4 cm.
Fig. 5. „ „ „ „ „ child 14 days.
Fig. 6. „ „ „ „ „ fullgrown man
Fig. 7. Transverse section through the pons of human embryo, 27 cm.
Fig. 8. „ „ „ „ „ „ „ „ 14 cm.
Fig. 9. Transverse section through the mesencephalon of a human embryo 14 cm.
Fig. 10. „ „ „ „ „ „ „ „ „ 27 cm.
Fig. 11. „ „ „ „ „ „ „ fullgrown man.
Fig. 12. „ „ „ „ „ „ the same 1.300 m m. frontally to fig. 11.

Fig. 13. Projection on a sagittal plane of nucleus VI, VII ventralis, VII dorsalis, V posterior, V principalis, IV posterior, IV principalis; embryo 27 cm. Magnif. 20 : 1.

Fig. 14. The same projection, embryo 14 cm. In figs 13 and 14 only the sagittal distances are exact.

v = ventralis. *d* = dorsalis. *p* = posterior. *pr* = principalis. *de* = dexter. *si* = sinister. *o.s.* = oliva superior. *ne* = nervus. *atr.* = atrophicus.

[1]) In a rabbit I saw the same nucleus occurring only in the right brainstem half. WESTPHAL described (A. f. Psych. Bd. 18, p. 846) a group of little cells, lying dorsocaudally to the trochlearis nucleus. The cells of the nu. trochl. post. mihi are neither little nor do they lie more dorsally than the nu. trochl. principalis.

Fig. 1.

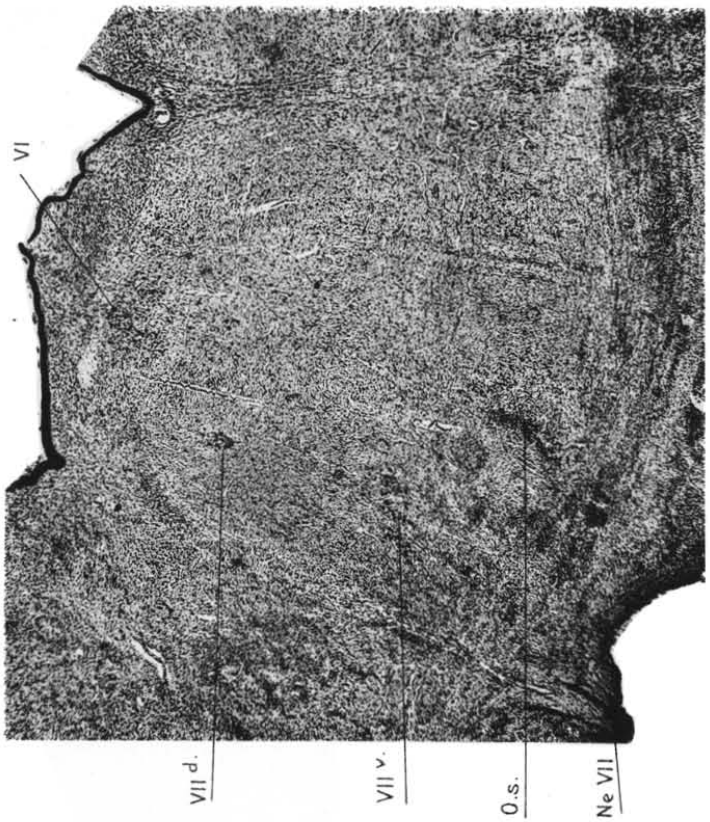


Fig. 2

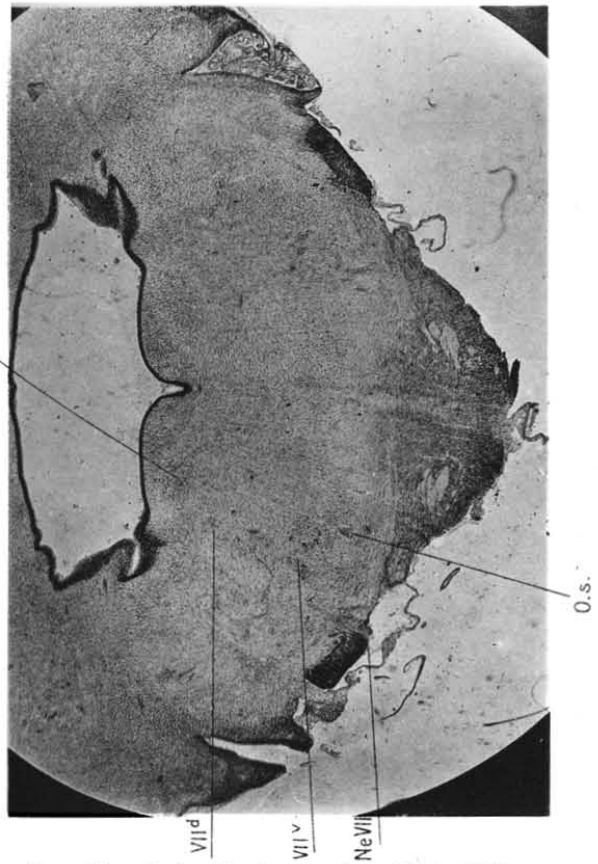


Fig. 3.

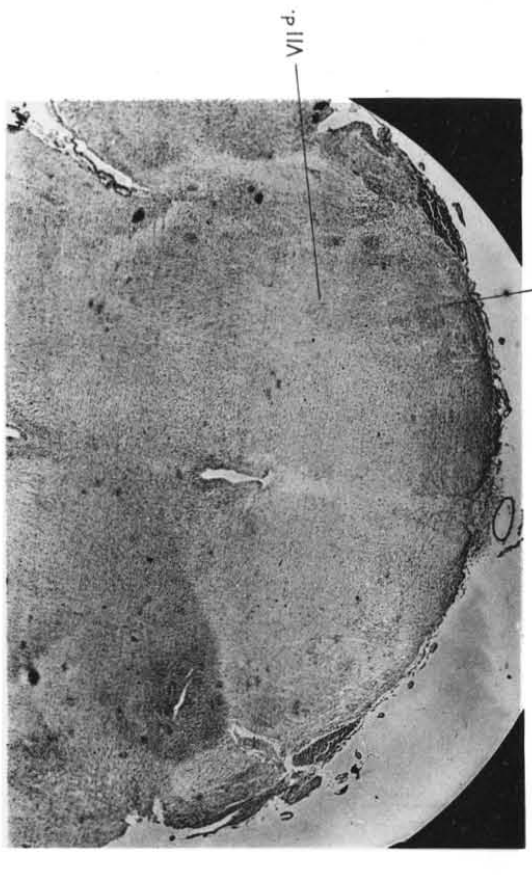


Fig. 4.

Heliotypie, Van Leer, Amsterdam

Fig. 5.

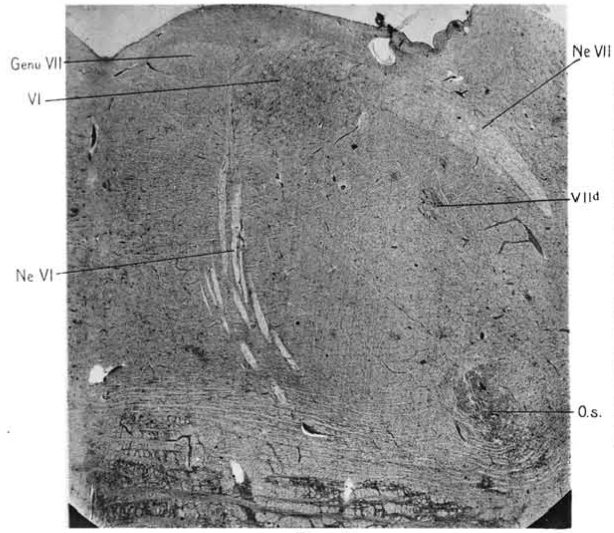


Fig. 6.

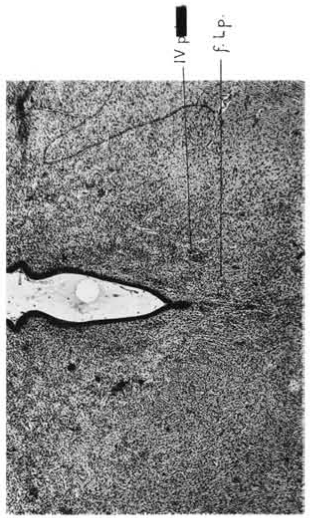


Fig. 9.

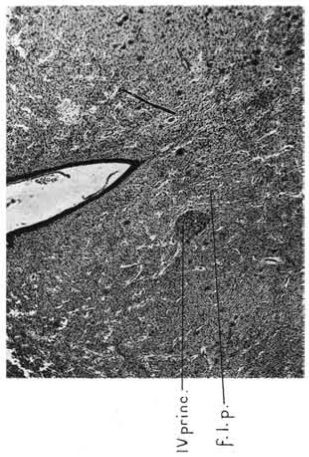


Fig. 10.

Fig. 7.

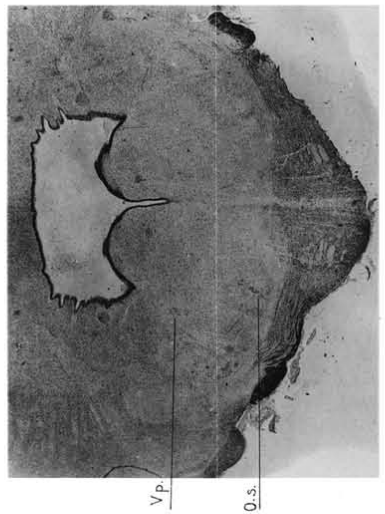
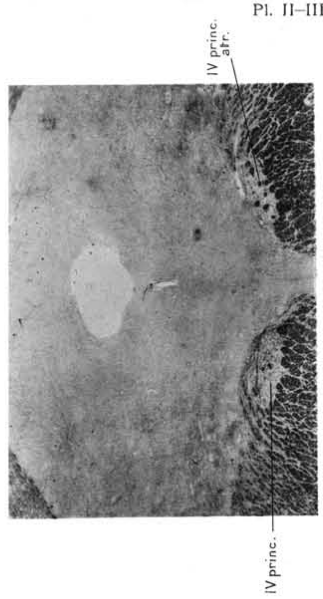


Fig. 8.



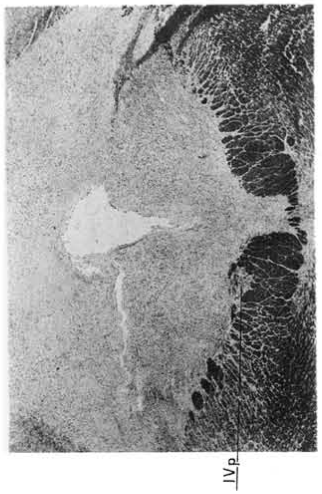


Fig. 11

Heliotypie, Van Leer, Amsterdam.

C. T. VAN VALKENBURG. "Nucleus facialis dorsalis, nucleus trigemini posterior, nucleus trochlearis posterior."

Plate IV.

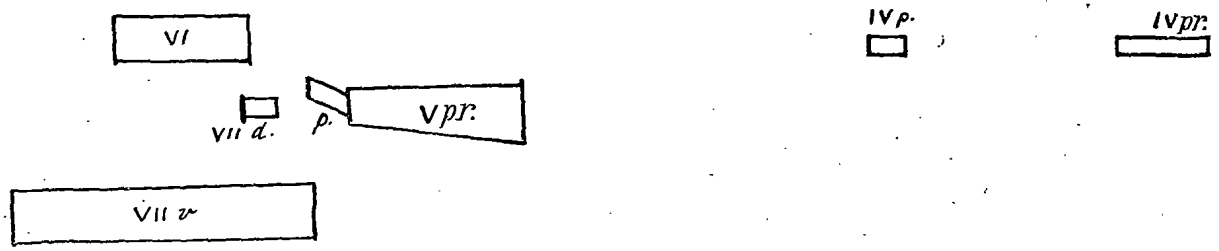


Fig. 13.

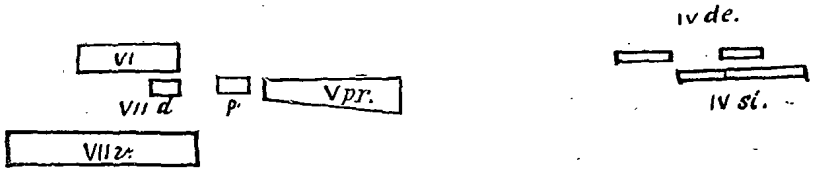


Fig. 14.