An example taken at random may serve to illustrate this mistake.

We wish to determine the effect of an addition of some water, for instance, on the interchange of the component parts of blood-corpuscles and serum

For this purpose we took a certain volume of blood. Let us for the reader's convenience assume that this volume amounted te 100 c.c Let us suppose these to contain 40 c.c. of red blood-corpuscles, and 60 c.c. of serum From these 60 c.c. of serum we take 20 c.c, and dilute them with $7^1/_2$ c.c. of water, but now we do *not* add these $27^1/_2$ c.c. of fluid to the rest of the blood, but only 20 c.c., so that the volume of the blood becomes 100 c.c. again. Now it is obvious that it cannot be expected, as Mr. GRYNS does, that the blood treated, will contain the same absolute amount of substances as the original blood, since serum has been kept back. *This* GRYNS *overlooked,* and a similar mistake he made in the calculation of the experiments, in which the serum was made hyperisotonic by the addition op NaCl.

If Mr. GRYNS, avoiding the mistake made by him, repeats the calculation, he will no longer arrive at the conclusion that "the mistakes in our analyses are much greater than the differences upon which our conclusions are based", nor will these calculations afford him grounds for opposing our views as to the permeability of blood-corpuscles.

**Physiology.** — "*A tumour in the pulvinar thalami optici. A contribution to the knowledge of the vision of forms.*" By Prof. C. WINKLER.

(Communicated in the meeting of 28 January 1911).

The case, which supplied the material for this paper was the following:

F. t. B, aged 22, who entered the hospital on February 25th 1909, was born from healthy parents and did not suffer from any illness before, neither traumata, nor venereal infection. He partook of alcohol and tobacco in a moderate way.

Since Dec. 1908 there was a stiffness of the right leg, followed afterwards by unsteadiness in the movements of the right hand. The commissure of the lips on the right side began to drop. By and by the patient became aware of a peculiar sensation in the right half of the body, a certain numbness, and he commenced to stammer. All these symptoms gradually grew worse without any aching of head or limbs, without dizziness, without disturbances of vision or hearing, as far as the patient knows. Only his memory was impaired.

During March and April notes have been taken about the case. The patient, a very intelligent individual, takes an interest in his surroundings and has right notions as to space and time; the pulse is feeble, 92 per minute, and regular.

Respirations 22 per minute. Nothing abnormal in the organs of the thoracal and ventral region. In the urine neither albumen nor glucose.

Speech is slow, monotonous, stammering and scanned. No disturbances from aphasia or faults of articulation. The patient is able to read and to understand what he reads. Writing is bad (ataxy of the right hand). The pressure on the paper is irregular. The pencil cannot be maintained in the right direction. Still the writing is not illegible, each letter and each word being taken separately. No vestige of agraphy. The head, measuring 53 c.M. in circumference, nowhere aches under pressure.

The sense of smelling is intact. That of hearing is disturbed slightly on both sides, to the right a whisper is heard at 1 M. distance, to the left at 2 M. The sense of taste is impaired.

The pupils of the eyes, unequal, a little more dilated to the right than to the left, are reacting well on light and in converging. The movements of the eyes, except for nystagmus, expecially when looking to the right, can be performed completely. The convergency is not disturbed. The commissure of the lips to the right is drooping, the orbital fissure on that side is wider than to the left. On the right half of the face hardly any folds are to be seen. By active movements, the muscles around the right angle of the mouth are hardly moved at all. The facial muscles react normally on electric stimuli.

The tongue is put out tremulously, pointing to the right. The patient holds his head inclined to the right. The right shoulder droops. The right arm is oedematous, without rigidity or hypotony. All active movements can be made, but they are performed unsteadily. It is impossible to the patient to make both indexes meet. Unsteadiest of all are the movements of the fingers. Fastening or unfastening buttons, taking matches from a box etc., — all this is done in a very clumsy way.

The reflex actions in the right arm are exaggerated. When walking, the right leg is training. To hop on it is impossible. There is neither rigidity nor hypotony. Paresis and ataxia are more marked in the nether portion of leg and foot than in their upper region. With his right foot the patient is not able to put on a slipper, nor to perform the heel-knee test.

To the right the skin-reflexes of abdomen and cremaster are suspended. The reflexes of the knee and the tendon of Achilles are exaggerated, without cloni, A stimulus of the foot-sole to the right is answered by flexion of the small toes and extension of the large one.

Sensibility is disturbed over the whole of the right half of the body.

The sense of touch is only slightly disturbed. Coarse touches are perceived everywhere, subtler ones remain sometimes unperceived.

The sense of pain has suffered much more important alteration. To the right a pin-point is not perceived to be sharp. This hypalgesia passes the diameter of the body for nearly 1 c.M. The subjective statement of the patient is, that the sensations of touches and of painful stimuli are entirely different on the right and on the left. Cold and heat are perceived less clearly on the right than on the left.

What is most disturbed to the right is the deep-seated feeling, and distally still more than proximally. Passive movements of the fingers and toes are not perceived at all. The tactile circles of Weber are much larger on the right than on the left. The patient localizes badly on the right half of the body.

To the right he is astereognostic, e. g. a key given in the right hand is called after long hesitation "a small hammer", a matchbox is called a cork, a ring a six-penny piece. To the left all these objects are recognized immediately.

The patient himself states that he is able to see well. Yet, if a key is held up before him, the left eye being closed, whilst the right eye is kept fixed on a definite point, the object is immediately recognized for what it is, in the left half of the field of vision, but not in the right half. In the same way, if the right eye is closed, a key is not recognized in the right half of the field of vision to the left.

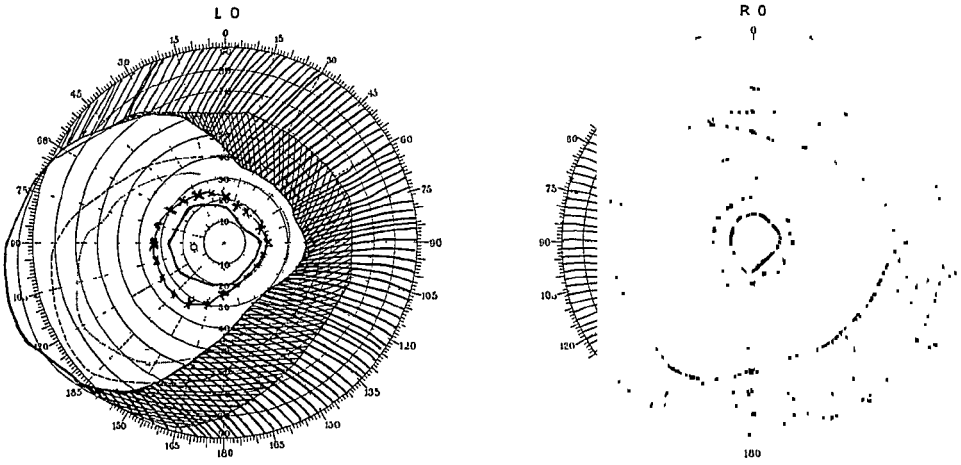
As there is therefore a presumption of hemiopia the patient is examined by the ophthalmologist (Dr. SCHMIDT), who gives the following statement:

Visus O. D $^6/_8$, Visus O. S. $^6/_8$, for both eyes $^6/_8$.

A slight restriction of the field of vision for both eyes, but no hemiopia, not for moving objects and not for colours. The fundus presents no aberrations.

This difference led to a more thorough examination, and to the making of different schemes of the fields of vision. The one reproduced here, was taken on April 20th 1909 by Dr. SCHMIDT, the exterior circle indicating the field of vision for movement, the one marked with crossed lines that for blue, and the inner circle that for red.

Date 20, 4. 1910.




*Field of vision* for movement, for blue and red on 20. 4. 1910.

At the same time however several figures, measuring 2 c.M. in diameter, were cut out from white cartoon, hearts, circles, diamonds, triangles etc.

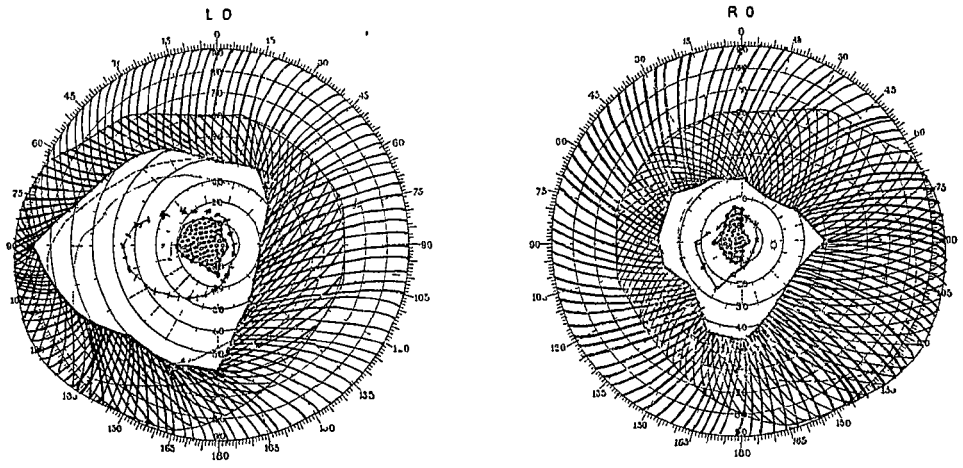
Whenever these different figures were introduced from the left, into the left halves of the fields of vision, they were regularly rightly recognized by the patient at 30°—15° from the fixed point.

But if they were presented to vision from the right, in the right halves of the fields of vision, they never, although the patient saw them approaching, were rightly recognized by him, before they reached the fixed point, or before they had passed the vertical diameter.

The scheme made from this latter experiment, on April 20th 1909, is likewise reproduced here.

The exterior boundary indicates the field of vision for movements, the intercrossed lines mark that for blue. *The area filled with circles is the field of vision, within which the shapes of 2 c.M. diameter are perceived. It follows*

Date 20, 4, 1910.




*Field of vision* for movement, for blue and for shapes of 2 c.M. diameter. The field, within which shapes are recognized, is filled with circles.

*from this scheme that only in the left halves of the fields of vision the shapes are recognized, not in the right halves.*

Gradually the state of the patient grew worse.

Especially the ataxia of the right hand suffered aggravation. With voluntary movements most violent accessory movements were shown When in rest, the hand assumed a peculiar position. The disturbance in the deep-seated feeling aggravated quickly. The patient was no longer able to localize rightly, his knowledge about the position of the hand was lost and the astereognosy became complete.

Speech too became more difficult.

Still, neuritis optica was not to be stated, and the visual symptoms remained stationary, until on May 15th death occurred suddenly.

At the autopsy, in the left half of the brain was found a tumour, which was yielded in toto to me, thanks to the kindness of Prof. DE VRIES; on examination it proved to be a glioma. There was made a series of frontal sections of the brain. These sections, treated partly with the WEIGERT-PAL method, partly with carmine, gave the following data as to the extension of the tumour.

Section 1. It strikes the left hemisphere through the proximal region of the basal ganglia. At the same time it touches the proximal portion of the tumour, which, being but vaguely defined here, perforates the capsula interna, infiltrating the lenticular nucleus and the commissura anterior.

Section 2. It strikes the left hemisphere through the middle of the thalamus, which is enlarged by the tumour, and the right hemisphere through the distal end of the thalamus. The medial and ventral nuclei of the thalamus are substituted by the tumour. The regio subthalamica, together with the red nucleus and fasciculus retroflexus has been pushed ventralward. The field of WERNICKE and the retrolen-

ticular capsula interna are not touched by the tumor and have been pushed frontalward and downward.

Section 3. It strikes to the right the distal ending of the pulvinar. The left thalamus is enlarged by the tumour in all directions. The tumour has here taken the place of the pulvinar thalami, destroying at the same time its ventral nuclei with the radiations of the lemniscus entering these nuclei at their ventral surface, and the c. geniculatum internum.

The c. gen. laterale is found to be removed sideward, but otherwise intact. The cells are arranged in it in the ordinary manner, and the intact radiations of the triangular field of WERNICKE (section 2) originate in this intact ganglion (as may be seen in sections between 2 and 3).

In the retro-lenticular capsula interna however an extensive degeneration of fibres towards the parietal gyri is found.

The corp. quadr. anticum has been pushed aside, without being destroyed by the tumour. The tumour pushes aside the radiation from the tractus to this ganglion, but, as is made evident by sections between 3 and 4 the c. quadr. anticum is not infiltrated, although a few fibres in its superficial medullar-layer have degenerated.

Section 4. It strikes the left hemisphere a little before the splenium corporis callosi. The enormous pulvinar, entirely substituted by the tumour, has pushed aside the splenium and the lateral ventricle without injuring their tissues. The tumour has grown together with the posterior portion of the Cornu Ammonis, and is lying therefore, covered by the alveus. within the wall of the ventricle.

Section 5. It strikes the distal end of the tumor. Grown together with the Cornu Ammonis the tumour compresses the ventricle, without injuring its wall.

Section 6. It strikes the occipital lobe circa 1 c.M. distalward from the tumour.

After comparing these different sections, we are justified in assuming *that a tumour, originating in the left pulvinar thalami, growing is distalward, has compressed the posterior horn of the lateral ventricle, is destroying frontalward the ventral and medial nuclei of the thalamus, and is threatening finally the capsula interna, situated more frontally.*

*The corpus geniculatum laterale and the fibres passing through the triangular area of* WERNICKE, *however are almost completely intact, as is likewise the corp. quadrigeminum anticum.*

In the retro-lenticular region of the capsula interna there are degenerate fibres, part of which pass thence into the strata sagittalia, whilst another part goes directly in the corona radiata of the lower parietal brain, towards the gyrus supra-marginalis (fig. 3, 4, 5).

In the stratum sagittale internum a mass of degenerate fibres is lying laterally from the ventricle and passing gradually through the stratum sagittale externum they enter into the medullary cones of the gyrus angularis and of the basal occipital convolutions.

Remarkable is the aspect of the medullary cones (see section 6) of the circonvolutions around the fissura calcarina. They appear as solid black fascicles.

Nevertheless in both, as well in that of the gyrus cuneus as in that of the gyrus lingualis, there is a stria of degeneration.

In the medullary cone of the g. cuneus this stria is lying dorsally, in the direction of the dorsal portion of the cuneus. The part of the cone situated beneath the cortex in the f. calcarina, is wholly free from degeneration.

In the medullary cone of the g. lingualis the degenerate stria is situated ventrally, directed towards its ventral portion and connected with the degenerate layer of the medullary cones of the occipital gyri. In the g. lingualis too, there is no degeneration in that part of the medullary conus, confining the cortex in the f. calcarina.

Both lips of this fissura, are in WEIGERT-PAL preparations surrounded by black coloured medullary cones.

The tumour found in the left thalamus may aid us to understand the general view of the symptoms of disease.

The present state of our knowledge enables us to conclude that the hypalgesy of the right half of the body, the loss of the deep-seated feeling and the false localisation on that side, the accessory movements and the ataxia of the right hand, and likewise *the astereognosy in the right hand* are dependent on the destruction of the ventral and medial nuclei of the thalamus.

The growing weakness of the right half of the body, the monotonous, stammering speech present indications of the tumour developing frontalward, and perforating the capsula interna.

The destruction of the left corpus geniculatum internum may perhaps be held responsible for the disturbance of hearing on both sides.

Most remarkable however is the disturbance of vision in the patient, as the fundus does not present any abnormal condition. A superficial examination led to a presumption of hemiopia, but after a more careful investigation it became evident that, apart from a slight restriction to the right of both fields of vision, the patient was able to perceive movement and colour in both halves of the field of vision. *On the contrary, shapes are not perceived at all in the right halves of the field of vision.* They are recognised however in the point of fixation and in the left halves of the fields of vision until far towards the periphery.

It ensues that these disturbances are dependent on *a tumour, originating in the left pulvinar, which has destroyed this ganglion together with its medial and ventral nuclei, whilst the corpus geniculatum laterale,* WERNICKE'S *field and the corpus quadrigeminum anticum were left intact by it.*

The shape of an object is recognized best by a normal persons, near and in the point of fixation. Small shapes, comprising many details, the letters and words we read, are even exclusively perceived there and consequently seen with the fovea centralis. Everybody however may ascertain for himself that shapes, measuring 2 c.m. in diameter, will be recognized temporalward unto 40° in the periphery, if they are presented at a distance, equal to the distance of our point of distinct vision.

When the light is bad, the recognizing of shapes in the periphery decreases very quickly in normal persons. Such is likewise the case, when through disease of the N. opticus, there is an important restriction of the field of vision.

Our patient, presenting no abnormal fundus, no disturbance in the perception of light, no blindness for letters or words (no alexia), no optical aphasy, and no other impediment for localizing with the eyes, than nystagmus when the eyes are fixed to the right, does not recognize shapes to the right, however large these shapes may be. This disturbance which incommodes him only very little, is first brought to his knowledge by the doctor. Then he ascertains its existence from the beginning of his disease.

In order to understand this disturbance, it will be necessary to take notice of the studies on alexia, made by NIESSL VON MAYENDORFF [1]).

As the point of departure for his researches this investigator took two facts.

1. Letters and words are recognized only in the neighbourhood of the fovea centralis.

2. Whenever bilateral occipital foci (tumour, softening) determine bilateral hemiopia, there remains a central field of vision, by means of which the patient is able to recognise small forms and colours and to read. On the basis of anatomical arguments, he then proceeds to construct these two propositions:

1. .the fovea centralis, projected on the cortex by a special bundle of fibres in the dorso-lateral strata sagittalia *a*, is localized in a separate cortical area.

2. The destruction of these fovea-fibres or of this cortical area will determine alexia (blindness for letters and writing) either subcortical or cortical.

The first part of this argumentation is not new, but the second part to a certain extent is.

[1]) ERWIN NIESSL VON MAYENDORFF, Das Rindencentrum der optischen Wortbilder Arch. für Psychiatrie. Bd. 43 S. 633. 1908 and other communications e. g. Ueber eine directe Leitung etc. Wien Kl. Wochenschrift Nov. 1906.

All independent investigators agree on this point, that the fovea centralis must be represented in a special manner on the cortex. They are forced to acknowledge this by the fact, that the hemianopsy determined by occipital foci is always incomplete, i. e. there is still a remnant of the field of vision that has not become blind, and to this remnant belongs the fovea.

Therefore this latter must be represented in a particular way in the cortex.

But there is a great divergence of opinions about the manner in which this particular representation is effected.

Some investigators claim for the fovea a separate cortical area (situated e g. at the bottom of the fissura calcarina, HENSCHEN, SACHS, WILBRANDT).

Others believe the fovea centralis to be localized in a diffuse manner in a very extensive cortical area (to which should belong not only the environs of the fissura calcarina, but also at least the occipital gyri, VON MONAKOW).

This divergence of opinions may easily be understood. After it has been proved (FORSTER, among others) that the patient with bilateral hemianopsia still possesses a central remnant of the field of vision, there remain only two possibilities.

Either in these cases, there remains intact on both sides a cortical area of the fovea, — or the diffuse dispersing of the fibres conducting the fovea-impulses towards an extensive optical cortical field, allows the possibility that even after a relative extensive destruction of cortex and fibres, a certain number of these fibres may have been left intact, and consequently central vision unimpaired.

As however, until now, there were known no well ascertained cases of central hemianoptic scotoma, dependent on accurately demonstrated occipital foci, the partisans of a diffuse localization of the fibres of the fovea have a decided advantage over those, who defend the especial cortex-area of the fovea.

The second, new proposition of NIESSL, interferes in a peculiar way in this dispute.

The field of the fovea of NIESSL is no longer the fovea-field in the fiss. calcarina, as it has been conceived by HENSCHEN among others. The fovea-fascicle of NIESSL irradiates into the dorso-lateral mass of the strata sagittalia, towards the basal occipital gyri and even in the cuneus, not into the calcarina-field but around it.

This fascicle being interrupted (e.g. by a softering focus in the g. angularis or by the destruction of its cortical field), the ensuing symptom will be, no longer a central hemianoptic scotoma, but,

if the interruption takes place to the left, the non-recognizing of those forms perceived with both fovea. which are connected with the left fascicle.

As the left hemisphere serves especially to the recognition of words that are heard and to speech, subcortical or cortical loss of recognition of the forms used for speech will be the consequence, or in other terms, subcortical or cortical alexia will originate.

In NIESSL's conception the calcarina-region has become a pure optic zone, the light-perceiving zone of the cortex. Here he agrees with CAMPBELL, BRODMANN and others. The surrounding convolutions form the fovea-area. They serve in connection with the optic zone to recognize shapes.

In my opinion this really most ingenious conception of NIESSL VON MAYENDORFF is not affected at all by the dispute, whether or not there exists a special fovea-fascicle situated within the strata sagittalia. But the case described in the foregoing concerns the greater question put forward by NIESSL, if there exists a loss of vision of forms, without a sufficient loss of light-perception.

Shapes are recognized not only with the eye, but also with the hand. More than once there have been stated cases of so called astereognosis, the impossibility to recognize shapes with the hand, though the tactile perception has suffered relatively only a slight disturbance.

Foci within the inferior parietal lobe, (WERNICKE), in the ventral thalamus-nucleus or in its radiation towards this parietal lobe, determine the loss of recognition of forms, without the loss of tactile perception.

In the described case too there was astereognosis of the right hand, corresponding to the destruction of the ventro-medial thalamus-nuclei and to the degeneration of their radiation towards the parietal gyri of the left brain.

It lies near to seek for an analogy between the astereognosis and the above described disturbance in recognizing optical shapes.

If in the ventral nuclei of the thalamus, impulses from the general sensibility (the deep-seated parts of the body) and from the tactile region meet, if there a new entity is composed of those different impulses, which after further activity of the cortex, enters into consciousness as a tactile shape-image, we may assume a similar proceeding to take place for the optical impulses.

For into the pulvinar radiates a fascicle from the tractus opticus. Optical impulses are brought into immediate connection with the

kinaesthetic impulses, which are elaborated in the ventral unclei. The cortical radiation from the posterior regions of the thalamus however lies more backward, it is directed towards the gyrus angularis, the basal occipital convolutions and the cuneus. In this radiation an important degree of degeneration could be demonstrated, but the degenerated fibres do not penetrate into the borders the convolutions, surrounding the fissura calcarina. They are found in the field of the fovea, indicated by NIESSL.

Consequently, although still sufficient optical impulses join the cortex along the corpus geniculatum laterale and the cortical radiation originating from it, yet the cortex, receiving no communication as to the result of the elaboration of several other impulses that should have been prepared in the thalamus, no longer recognizes shapes in the crossed fields of vision.

This analogy holds good only, in as far as the optical sense together with the sense of touch and the kinaesthesia renders the conception of shapes possible.

The eye may also, independently of the sense of touch, recognize shapes, perceive a third dimension etc.

Some time ago, the studies about disturbances in the perception of a third-dimension (Tiefen-Wahrnehmung), which are only sparsely scattered in literature, have been augmented with one by Dr. VAN VALKENBURG. Bilateral foci in the gyrus angularis had determined this disturbance, together with other symptoms, among which alexia.

Although the perception of a third dimension has some relation with the recognizing of shapes in two dimensions, yet it is distinguished from it, as it is likewise from stereoscopic vision.

After the demonstration of VAN VALKENBURG I think it needless to argue this point,

Necessary it is however to recall to mind an interchange of thought, that occurred about this subject between Dr. NIESSL and Dr. VAN VALKENBURG [1]) viz. whether the dorso-lateral region of the strata sagittalia may contain a special fascicle of fovea-fibre. I have stated already that in my opinion, this is not the principal question. The chief point appears to me the question, whether there may be made a division between a light-perceiving field around the f. calcarina and another field enclosing the former, within which, occasionally with the aid of the first field, shapes are recognized.

[1]) C. T. VAN VALKENBURG. Zur Kenntnis der gestörten Tiefen-Wahrnehmung. Deutsche Ztschr. für Nervenh. Bd. 34. S. 322.
NIESSL VON MAYENDORFF. Einige Bemerkungen zu dem Aufsatze des Herrn Valkenburg. Ibidem Bd. 35. S. 165.
VAN VALKENBURG. Kurze Erwiderung auf die Bemerkungen etc. Ibidem Bd. 35. S. 472.

If I am right in my conception, that the degenerated fibres in this case (the borders of the calcarina are intact) are dependent on the destruction of the thalamus and not on the pressure of the enormous tumour on the dorso-lateral portion of the strata sagittalia, there are at any rate strong grounds in favour of it. For the patient showed no symptoms of alexia and there is a continous connection between the tumour in the thalamus and the degenerations having their origin there.

But if this conception be true, this case would apparently aid to support the opinion that in NIESSL's fovea-zone, there entered likewise fibres from the periphery of the retina. For in the case, as described above, the shapes were recognized in the fovea.

If the conditions presented in this case, allow the conclusions that whilst *the perception of light was retained*, shapes could not be recognized hemianoptically, then it must be conceded likewise that NIESSL's fovea-zone contributes also to the vision of shapes with the periphery of the retina.

And this being so, it must be conceded further, that the light-impulses in themselves are insufficient for the recognizing of shapes, that it is only in their connection with other impulses, *a connection prepared within the thalamus*, that they become able to communicate to definite portions of the cortex the data, enabling this latter to recognize shapes.

LEGENDA OF FIGURES.

*a.l.* = ansa lenticularis. *AM* = cornu Ammonis. *aq* = Aquaeductus Sylvii. *ANG* = gyrus angularis. *br.c.* = bracchium conjunctivum cerebelli. *c.* = sulcus centralis. *c.a.* = commissura anterior. *C.A.* = gyrus centralis anterior. *c.a.f.* = columna ascendens fornicis. *calc.* = fissura calcarina. *c.c.* = corpus callosum. *c.ext.* = capsula externa. *c.extr.* = capsula extrema. *c.g.e.* of *c.g.l.* = corpus geniculatum externum sive laterale. *c.i.* = capsula interna. *cl.* = claustrum. *c.m.* = sulcus calloso-marginalis. *C.M.* = gyrus calloso-marginalis. *C.P.* = gyrus centralis posterior. *c.q.a.* = corpus quadrigeminum anticum. *C.R.* = corona radiata. *C.U.N.* = gyrus cuneus. *f.* = fornix. $f_1$ = sulcus frontalis primus. *F*I = gyrus frontalis superior. $f_2$ = sulcus frontalis secundus. *F*II = gyrus frontalis secundus. *F*III = gyrus frontalis inferior. *f.o.* = fasciculus fronto-occipitalis. *f.r.* = fasciculus retroflexus. *FUS* = gyrus fusiformis. *h* = sulcus Hippocampi. *H* = gyrus Hippocampi. *hab.* = habenula. *INS.* = insula *Reylii*. *i.p.* = sulcus interparietalis. *l* = lemniscus $L_1$ = globus pallidus nuclei lentiformis. $L_2$, $L_3$ = putamen nuclei lentiformis. *LI* = gyrus Lingualis. *n.c.* = nucleus caudatus. *n. ant* = nucleus anterior thalami. *n.l.* = nucleus lentiformis. *n. lat.* = nucleus lateralis thalami. *n. med.* = nucleus medialis thalami. *n. ventr.* = nucleus ventralis thalami. *n. ret.* = nucleus reticularis (Gitterschicht) thalami. *n.r.* = nucleus ruber. $o_1$ = sulcus occipitalis primus. $O_1$ = gyrus occipitalis primus. $o_2$ = sulcus occipitalis secundus. *O*II = gyrus occipitalis secundus. $o_3$ = sulcus occipitalis tertius. *O*III = gyrus occipitalis tertius. *o.p.* = sulcus occipito-parietalis. *ot* = sulcus occipito-temporalis. *OT* = gyrus occipito-temporalis. *P*I = gyrus parietalis superior. *PAR* = gyrus paracentralis. *p.c.* = sulcus post-centralis. *p.P.* = pes pedunculi *p.o.* = sulcus parieto-occipitalis. *p.r.* = sulcus praecentralis. *PRC.* = gyrus praecuneus. *p.s.* = sulcus parietalis superior. *S* = fissura Sylvii. *S.M.* = gyrus

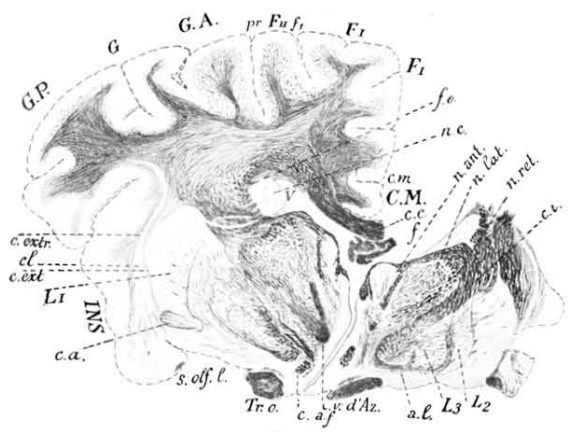



Fig. 1.

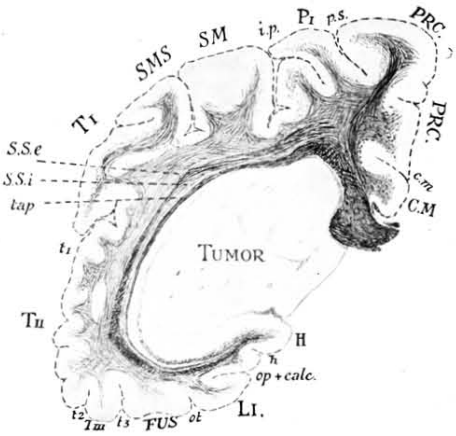
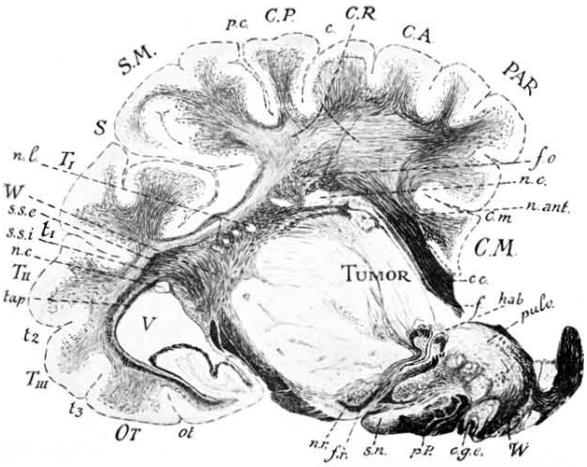



Fig. 4.



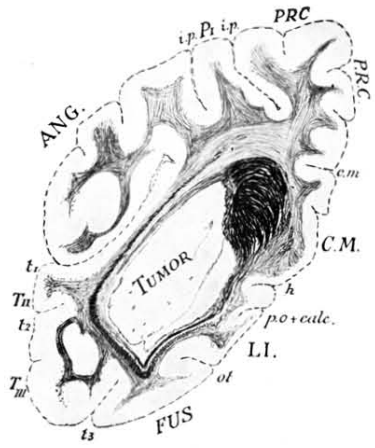




Fig. 5.

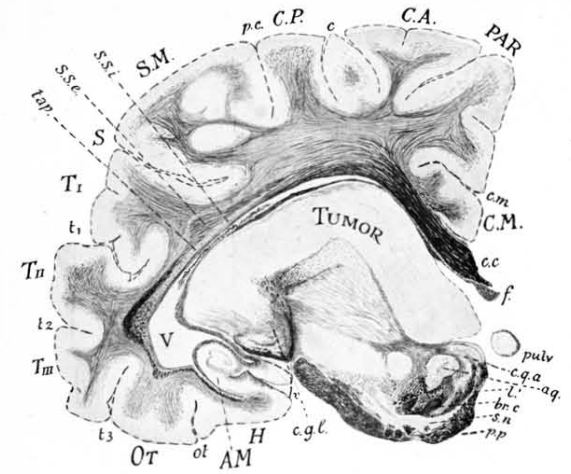



Fig. 3.

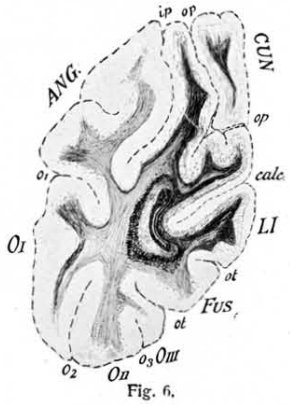



Fig. 6.

supramarginalis. *s.n.* = substantia nigra. *s.olf.l.* = stria olfactoria lateralis. *s.s.i.* = stratum sagittale internum. *s.s.e.* = stratum sagittale externum. $t_1$ = sulcus temporalis superior. $T_1$ = gyrus temporalis superior. $t_2$ = sulcus temporalis secundus. $T_{II}$ = gyrus temporalis secundus. $t_3$ = sulcus temporalis tertius. $T_{III}$ = gyrus temporalis tertius. *tap.* = tapetum. *tr.o.* = tractus opticus *V* = ventriculis lateralis. *v. d'Az.* = fasciculus *Vicq-d'Azyr*. *W* = Wernicke's field.

**Physics.** — "*The Rectilinear Diameter for Oxygen*". By E. MATHIAS and H. KAMERLINGH ONNES. Communication No. 117 from the Physical Laboratory of Leiden.

(Communicated in the meeting of June 25, 1910 and January 28, 1911) [1].

§ 1. *Introduction.* As far back as Dec. 1894 the comparison of the equation of state for the permanent gases (particularly that for hydrogen) with the equation for ordinary normal substances was mentioned in Comm. N°. 14 dealing with the Leiden cryogenic Laboratory as being one of the first objects for which efforts were made to develop the methods now used for obtaining accurate measurements at very low temperatures. While the law of corresponding states was assumed to be approximately correct for the group of substances of very low critical temperature as well as for the other normal substances, there were still reasons for suspecting that their reduced equations of state would show deviations on comparison with those of other substances greater than are found between various groups of ordinary normal substances. In fact, the reduced empirical equation of state for ordinary bodies differs considerably from the original reduced equation of VAN DER WAALS; nor does this difference disappear when the equation is modified by making a calculation of the influence on the kinetic pressure of the finite dimensions of the molecules stricter than that developed by ascribing a constant value to *b*. At that time the hope could be cherished that substances such as oxygen, nitrogen, and hydrogen would, on account of the simpler constitution of their molecules, show a better correspondence with the assumptions upon which VAN DER WAALS based his calculations, and that their reduced equations would approximate to the theoretical VAN DER WAALS equation, showing at the same time deviations from the reduced equations for the other substances.

Operations intended to throw light upon this subject made but slow progress [2]). Cryostats had to be constructed that put a range of

[1]) An excerpt from this paper appeared in the C.R. July and Aug. 1910. The Académie des Sciences at Paris has shown its great interest in the study of the rectilinear diameter of liquids which exist at very low temperatures only, in granting one of us a subvention from the Bonaparte Fund so as to be able to come to Leiden. It is an agreeable duty to record our cordial thanks for this.

[2]) See introduction to Comm. No. 97*a* (March 1907).