close to regions enjoying an immunity. These latter are generally in dry localities and some distance from streams. In these cancer regions one of two conditions prevail—either they are closely populated, or if the houses be spread about at some distance from each other a rivulet or stream connects them."

Having alluded to the disputed question of "heredity," I cannot close my paper without recording one series of cases, the occurrence of which can hardly be explained without that factor. In one family of two generations numbering 16 individuals reaching adult years 10 have died; of these 10, 3 have died of carcinoma of uterus, 2 of carcinoma of the stomach, and 1 of carcinoma of the liver, while of the 6 yet living 1 has a large tumour of the neck, and 1 a tumour of the arm, which has recurred after removal.

The facts which this investigation has brought out, and which may readily be confirmed by anyone who will take the trouble to tabulate all the cases of malignant disease occurring in his own neighbourhood, seem to me to be of considerable importance. The explanation I have suggested may not be the correct one, but of the facts there can be no doubt.

NOTE.

¹ From inquiries recently made it seems probable that malignant disease in cattle is influenced by locality in a precisely similar way and is much more frequently met with in those pastures which are low lying or bordering on sluggish streams than it is in the upland pastures. It is also more common among shorthorns than among other breeds.

ON THE STRUCTURE OF THE NEUROGLIA.

By JAMES R. WHITWELL, M.B.,

Medical Superintendent, Suffolk County Asylum.

Of late years a considerable amount of attention has been directed towards the neuroglia and sustentacular apparatus of the nervous system, more particularly since the introduction of Golgi's epoch-making method, and still later the surprising results achieved by Weigert in his more recent work on this subject. It is unnecessary to enter in any way into an historical survey of the various transition stages which have resulted in our present state of knowledge; it will be sufficient to indicate the two opposing camps into which neurologists and histologists have divided themselves on the subject.

1. The neuroglia is composed entirely of greatly ramified cells (glia cells), the branches of which pass everywhere in the interstices of the proper nervous elements.¹ Various kinds of these cells have been described,² and some writers consider that the glia cells form the distal portion of the lymphatic system (Meynert,³ Lewis⁴). Other functions have been attributed to them.

2. The neuroglia consists of a series of unbranching fibrils in the meshes of which certain cells lie, but not in organic continuity with the fibres, the so-called branching glia cells being an optical effect, the product of unsuitable methods (Weigert).⁵

It is undoubtedly true that the great bulk of authors believe the former theory to be true, and the examination year after year of preparations made by the Bevan Lewis or Golgi methods makes it difficult at once to believe that one could have been deluded by appearance to the extent that Weigert would have us believe, in spite of the fact that Ranvier's specimens prepared by maceration in dilute alcohol offer suggestions in the same direction.

On the one hand, then, neuroglia cells with processes can be clearly shown by more than one entirely distinct method, and, on the other, a method has been devised which resolves the previously obtained picture into component parts; it is, therefore, essential that some other method or methods must arise to add their weight to one or other side before any definite conclusion can be arrived at.

I would venture the suggestion that perhaps our conception of the neuroglia and sustentacular apparatus generally is somewhat narrowed owing to the difficulty of obtaining a comprehensive survey of it as a coherent system having an individuality of its own, and this is doubtless largely due to the methods commonly employed in demonstrating it, and I would here propose a method which is exceedingly simple

and yet gives a clear, though at first sight somewhat bewildering, view of its arrangement as a whole, a view which, like Weigert's nerve-fibre stain and his new neuroglia stain, displays one whole system to the necessary exclusion, or rather optical detraction, of the others. If any properly hardened (chrome, alcohol, picric formol) section of the central nervous system be placed on a slide and allowed to dry in the air, the more delicate nerve cells and their processes become optically obliterated in favour of the less hydrated and more highly refractile connective elements; these, however, form such a highly complicated and dense mass that comprehension of their arrangement is impossible, and it is necessary, in order to evolve the picture, previously to apply some reagent that will produce slight expansion of the section equally and in all directions. Many chemical bodies will do this with more or less success, such as glacial acetic acid, lactic acid, and rodinal, but probably the best for all purposes is hot concentrated caustic potash. The section then is dropped into a relatively large quantity of hot caustic potash, and allowed to remain for a few seconds only, when it is caught up on a slide and transferred to warm water to wash for a few seconds, and again taken up on a slide and desiccated in the air, the most correct picture being probably obtained from sections where on the slide the sectional area most nearly corresponds to that of the piece of brain from which it was removed, previous to its original treatment with the hardening agent. When sufficiently dry a cover glass may or may not be put on, the edges only, however, should be merely sealed with Canada balsam.

Fig. 1.— $\times 800$. Section of upper portion of cortex (asc. parietal), showing arrangement of fibrils of neuroglia. (These fibrils should all appear of the same diameter or nearly so).

On microscopic examination of this preparation with ordinary magnification but careful illumination, a more or less dense felted network of fibres is revealed, which may be seen to form a series of nests for the nerve cells, blood vessels, etc., and these can be readily seen *in situ* during the desiccation process. If this section be stained with any cell-staining reagent and mounted in Canada balsam, then the cell elements become visible, but the connective elements, being embedded in a substance so nearly their own refractive index, disappear.

The view presented by sections prepared this way is very striking, and shows clearly the vast sponge-like arrangement produced by a felted mass of neuroglia fibres, in the interstices of which the nervous and other elements lie. The arrangement of these fibres is at first difficult to follow on

account of the fact that, even in the thinnest sections, different layers are partly in focus and confuse the eye. The "astroid" arrangement of these fibres, however, which gives rise to the appearance of branching neuroglia cells, can readily be seen, and by the physical differentiation as readily analysed into a series of fibres which cross, pass under, over, and round the central cell, but show no sign of springing from it as processes. Conditions similar to those represented by Ranvier, and also the recurved fibres of Weigert, occur in abundance; at the peripheral layer of the cortex of the brain the horizontal series of fibres forming a limiting layer can readily be seen, and fibres can be seen passing up into it and helping to form it, and from it long fibres frequently pass down deeply into the grey matter; many of these are perhaps better seen in sections from frozen tissue desiccated either with gentle heat or in the air without previous treatment with either potash or osmic acid.

The nerve cells and blood vessels each have their own highly complex basket-work nest, and in the case of the nerve cells the glia fibres, when in the neighbourhood of an "astroid," may readily simulate the so-called "scavenger cell" appearance. The blood vessels have a series of fibres running parallel to the vessel wall, and others crossing it at a variety of angles, while fibres may be seen passing from "astroids" to the vessel sheath (simulating spider cells), some apparently blending with it, but in reality most of them can be seen to pass under or over or enter into the series of parallel fibres.

Fig. 2.— $\times 800$. From section of cortex showing an "astroid" in relation to a blood vessel.

This expansion-desiccation method may be applied to Golgi sections, and I think by its use some key to the Golgi method may ultimately be obtained; there is, however, much difficulty in examining and blending the dead black picture obtained by the chrome silver method with the brilliant focussing picture of the highly refractile neuroglia fibres of the desiccation method; there is therefore much opportunity for error in interpretation. The felt network of glia fibres forming a sponge-like reticulum (as seen by the desiccation method) must apparently be regarded as constituting the peripheral channels and spaces of the lymphatic system of the brain (continuous with the perivascular lymphatics) and in the interstices of this each individual cell and fibre lies, bathed in its lymph. There are many reasons for believing that in all probability the Golgi reaction is brought about, not by a stain or deposit of or in the cells and fibres, but by a fluid element. The reasons for this belief have been most clearly shown in Dr. Hill's masterly address to the Neurological Society, and the application of this method to Golgi specimens, showing spider cells, appears to offer some evidence in favour of this view, since there may certainly be seen in some specimens, the appearance of the silver salt deposited on the outside of these glia fibres, either running along one side or surrounding the whole fibre, and perhaps it is owing to this occurrence that by Golgi's method there may be observed such great variations in the appearance of thickness of the spider cell processes.

The relationships of the neuroglial fibrils, with their arrangement in "astroids," to the so-called spider cells may be seen, not only in Golgi specimens, but also in some fresh sections of brain (Bevan Lewis) fixed with osmic acid or permanganate of potash (probably better with the latter), subsequently stained with aniline blue-black, if careful illumination and focussing be attended to. In this case also the whole fibril seems sometimes to be stained, and at other times only one side of it; the exact relationship is, however, difficult to ascertain. The appearance of a much larger number of processes is probably due to the fact that in one case the microscopic view is obtained by dead staining, and is a colour picture, which notoriously obliterates slight differences of level, while in the other case the picture is due to difference in refraction rather than colour. It is a noticeable fact that the neuroglial fibrils are of practically the same diameter throughout, while many fibrils appearing as processes of cells by staining and other methods appear to taper.

The fibrils of the neuroglia seen by this method are about 1.5μ in diameter, of varying length, fine cylindrical, smooth, translucent, and non-tapering, curved sinuous, and sometimes beaded (probably the result of preparation). They do not appear on careful examination to branch, though their arrangement frequently simulates branching, and lying in certain meshes formed by these fibrils are cells which apparently belong to the neuroglial network, though these do not appear to branch, are chemically different to the fibrils,

Fig. 3.— $\times 800$. "Spider cell" from Golgi specimen subsequently treated by expansion-desiccation method, showing relationship to fibrils.

and these latter do not appear in any case to come off as processes of the cells. The neuroglia cells may, however, be the parent cells of the fibrils, and stand in something the relationship to them that the cells do in connective tissue or retiform tissue.

They may be separated by dissociation methods and examined in the desiccated condition in a more or less isolated state, showing sometimes exceedingly long fibrils, though dissociation by tearing and pressure appears frequently to break them up into shorter rods and even beads. In dissociated specimens it is frequently possible to see clearly the detailed basket-work surrounding the nerve cells, especially if the latter be stained; and the view thus obtained certainly sometimes suggests the idea that some of the crossing and interlacing fibrils may account for some of the peculiarities seen in Golgi specimens—for example, certain "thorns," and the appearance described under the name "fibres grimpantes" by Ramon y Cajal from Golgi specimens, sympathetic staining by contiguity being a well-known difficulty in the chrome-silver method. Chemically these fibrils do not correspond in their reactions to neurokeratin nor elastin, and are very refractory to staining agents.

There seems therefore some evidence to justify the following conclusions:

1. The sustentacular apparatus of the nervous system con-

sists of an interlacing network of fibrils, in the meshes of which lie cells both neuroglial and nervous.

2. These fibrils show no evidence of being direct processes of cells, and do not appear to branch.

3. The sponge-like reticulum thus formed is to be regarded as the peripheral portion of the lymphatic system, consisting of lymphatic spaces and channels.

4. The fibrils form a complete basket-work for each element in the nervous tissue, including the blood vessels.

5. The fibrils consist of a highly refractile substance (refractive index about 1.5) with a considerable degree of elasticity, as is shown by their curvature on release.

6. Chemically the fibrils appear to be composed of a substance which is neither neurokeratin nor elastin.

REFERENCES.

¹Schäfer *Quatin's Anatomy*, 1895. ²Andriezen, *BRITISH MEDICAL JOURNAL*, 1893. ³Stricker's *Handbook of Histology*, Syd. Soc. ⁴Bevan Lewis, *Textbook of Mental Diseases*. ⁵Weigert, *Beiträge zur Kenntniss der normalen menschlichen Neuroglia*, 1895. ⁶De la Névroglie, 1892. ⁷Bratn, 1896.

ISOLATION IN INFLUENZA.

By ERNEST W. WHITE, M.B.LOND., M.R.C.P.,

Resident Physician and Superintendent, City of London Asylum;
Professor of Psychological Medicine, King's College,
London.

THE recent epidemic of influenza in the City of London Asylum having been successfully cut short by isolation, and the former epidemics in the institution since 1889 having been similarly treated, with equal success, I am prompted to give a brief account of these visitations, and the means adopted to arrest the extension of the disease.

We will commence with the latest outbreak; on February 10th I find a note in my Superintendent's Journal as follows: "Influenza has broken out in the female division (main block); four patients and a nurse were removed to the cottage hospital to-day." This hospital is usually tenanted (to guard against dampness) by 20 farm patients, who can be removed at an hour's notice. Our wards and dormitories in the main divisions of the asylum are only separated by glass screens, but the dining hall, chapel, and kitchen intervene between the male and female sides. The laundry block is attached to the female division by a covered way, as is the workshop block on the male side. The cottage hospital is distant 120 yards from the main building. Our resident community consists of 540 persons (250 female patients; 215 of these in main block, 35 in laundry), with 35 nurses, laundry maids, and servants, and 230 male patients with 25 attendants and resident artisans. On February 11th 6 patients and a nurse were removed to the cottage hospital with the disease, and the chief nurse was under treatment in her rooms away from the wards. On the 12th, 5 more patients were transferred to the cottage hospital with it. On the 13th, 11 patients and a nurse were removed to the cottage hospital, and 3 patients and a nurse were under treatment in the main building, but isolated, and with sheets saturated with carbolic acid solution over the doors of their rooms. On the 14th, 2 patients and a laundry maid were removed to the cottage hospital with it. The chaplain (non-resident) was also confined to bed at his home. On the 15th 1 patient was sent to the cottage hospital, and 1 old patient was placed under treatment in a small dormitory off the female infirmary. On the 16th there were 2 deaths of patients from influenza, ages 72 and 81; 1 other old lady, aged 90, was placed under treatment in the small dormitory off the female infirmary. On the 17th there was 1 death from it, age of patient 76. On the 18th 1 patient was removed to the cottage hospital, 3 old ladies (over 75) were placed under treatment in the small ward off the infirmary. On the 19th 1 patient was sent to the cottage hospital, and 1 old patient placed under treatment in the dormitory off the infirmary. There was also 1 death from it, age of patient 81. On the 24th there was 1 death from it, age of patient 82. On the 25th 1 of the 2 male attendants who carried the female patients to the hospital went down with influenza, and was isolated in the male end of the hospital: and on the 28th the other male attendant who helped to carry the pa-

tients to the hospital also developed it, and was isolated in male end of hospital.

The male division has throughout been free, with the 2 exceptions named, and accountable for. The laundry block has also been free, although only 30 yards from the main building, with the exception of the 1 laundry maid, who was the person who carried the linen from the laundry to the female division and entered the wards. She felt ill, her temperature was taken, and she was sent to the hospital at once.

The following are extracts from my annual reports since 1889 under the heading "General Health," and refer only to the influenza epidemics.

1890.
Epidemic influenza visited us at the beginning of the year. The first cases occurred on January 4th, and we were not free until March 10th. In all, 23 members of the staff, including all the officers and 20 patients, suffered. The disease was in some cases of a severe type, and relapses occurred, but we escaped without a death. Several patients had acute tonsillitis as a sequela. It was apparently brought into the building by the attendants and nurses, as it was prevalent in the neighbourhood, and six of the staff were first attacked. I therefore had the cases isolated in the detached hospital, and as a result a very small percentage of patients fell ill with it. Our resources were severely taxed during the epidemic, but we were able to tide over the crisis without obtaining outside assistance, thanks to the self-sacrifice of the nursing staff, which it affords me no small amount of pleasure to record. During the remainder of the year the general health was in every way satisfactory.

1891.
Epidemic influenza visited us for a second time on May 20th. The first case was that of one of the housemaids; then, on the 28th, six male patients in No. 5 ward contracted it, probably through one of their number who is employed in the carpenters' shop. On June 8th a male charge attendant and one of his patients fell ill with it. On the 15th we had three more cases, all members of the staff, and on the 20th two male patients took it. We have since been free until the commencement of the present year.

1892.
During January, February, and March we had a third epidemic of influenza of a severe type. At its outset, 3 male attendants of fine physique contracted it; then 2 nurses and a female patient; then the head male attendant and 2 other attendants, all strong healthy men; then I went down with it; next the chief male night attendant; then in succession a laundry maid, 3 nurses, 14 patients, the chief night nurse, and two other patients. It was of the broncho-pneumonic type, leaving its victims extremely debilitated for many weeks. This outbreak is accountable, directly or indirectly, for 7 of the deaths of 1892.

On July 11th, a fourth epidemic of influenza appeared, fortunately of a comparatively mild, though definite type. It was confined to 1 male and 8 female patients, who all, save one, who was suffering from pulmonary phthisis, made good recoveries. During every epidemic we have isolated our cases in the cottage hospital, believing, as I do, the disease to be distinctly infectious.

1893.
About the close of the month of February there were several mild cases of influenza affecting both staff and patients.

1894.
Early in the year, several cases of influenza were recorded, none of a severe type, and all made good recoveries.

1895.
Influenza of a comparatively mild type visited us towards the close of February, and remained with intervals of freedom until the end of April. Thirteen members of the staff and 6 patients had it, and all excepting 2 were isolated in the cottage hospital. The relatively large proportion of staff to patients is a further proof of the infectious nature of the disease and of its having been introduced from without.

1896.
Early in March, 2 attendants and several male patients had influenza, and were isolated in the cottage hospital.

1897.
For the first time since 1889 I have no epidemic of influenza to record.

MEANS OF ISOLATION ADOPTED.

As regards the recent epidemic, on February 10th I recognised that we had a definite outbreak. I therefore gave orders that the female division (main block) was to be isolated as far as possible; that the male and female patients were not to meet at chapel or the dining hall; that the meals were to be in the wards, the dining hall to be kept master locked; and the chapel service on Sundays to be attended by male patients only; the female service being held in a ward. All association of the sexes thus came to an end. The laundry residents were also to be kept away from the main division. The charge nurses were instructed to take the temperatures of all their patients who appeared to be at all out of sorts, and if the thermometer registered a temperature above 100°, the patient was at once to be wrapped up, and taken over to the cottage hospital. Patients over 70 years of age were to be treated in