haemorrhages are into the dilated perivascular sheaths (see Figs. 2 and 3). In the corpus callosum the networks of capillaries and small vessels show fractures and escape of corpuscles into the tissues. The microscopic changes in the brain confirm in every way the opinion expressed by Captain Stokes when he made the *post-mortem* examination that he was dealing with a case of shell shock.

In Case II the extensive haemorrhage on to the under surface of the orbital lobe without visible external injury is of interest. The force of the explosion must have been enormous. What happened to the man when it occurred we do not know. The cortical, arterial and capillary vessels were empty, the perivascular sheaths were in many places dilated and filled presumably with cerebrospinal fluid (see Fig. 9). The cortical neurones are swollen up, the nuclei are large and clear; the basophil substance is diminished in amount, a condition very like that observed in the cells of the cortex of an animal in which experimental cerebral anaemia had been effected. Owing to the brief clinical and *post-mortem* notes this case is of much less interest than Case I.

I am unable to find in the literature at my disposal any description of the microscopic changes in the brain of soldiers dying from commotio cerebri without visible external injury.

Mairet and Durante have exposed animals to the compressive and decompressive forces generated by detonation of high explosives. They found scattered through the brain and spinal cord minute haemorrhages caused by the rupture of small vessels. The blood is found in the lymphatic sheaths. The vessels most commonly ruptured are those which have the least support by solid tissue; in fact the description of their findings closely corresponds with that in the above cases.

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PRELIMINARY REPORT ON THE PATHOLOGICAL FINDINGS IN NERVES FOLLOWING WAR INJURIES.

[WITH SPECIAL PLATE.]

BY

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THE incentive to the work I am doing on nerve pathology comes from Colonel Sir Robert Jones, who has placed the extensive material from the Alder Hey Military Orthopaedic Hospital in my hands. The University of Liverpool and Professor Ernest Glynn, Captain R.A.M.C.(T.), have given me every facility and aid in prosecuting my studies, and I am greatly indebted to them.

This is only a preliminary report of work covering three months' service at the hospital, and is produced principally because I feel I can give some material assistance to other workers along these lines by presenting the staining reagent which, after three months' work, I finally found to be most satisfactory. Without a good stain for axis cylinder and medullary sheath one cannot do nerve

work in the laboratory. Many of the stains require unusual experience before they can be used satisfactorily. I tried Stroebe's stain without success. In order to make use of it Kennedy had to use the aniline blue for twenty-four hours. Bielschowsky's axis cylinder stain required several days and did no contrast staining; maybe it had to be done over again. It was most useful early in my work, as was also a modification of Howell and Huber's picric acid haematoxylin method. The stain I have to give workers in nerve pathology is one based on a technique I used in Heidelberg when working on nerve degeneration in Kühne's laboratory in 1895. It brings out the axis cylinders in distinct relief as pink covered by a thin line of purple-black—the medullary sheath "neurokeratin framework" faintly tinged purple-black—the red blood cells brown, the nuclei pink, muscle deep red, connective tissue unstained, or a very faint pink.

Where the axis cylinders are just formed they always have a purple appearance. Not infrequently fine lucules 1 to 2 μ in width are seen among the wider fibrils, the finer ones appearing deeper stained than the wider ones because of the pink centres of the fuller-grown fibres. These forming axis cylinders may be easily picked out in adhesions as purple lines against a very faint pink connective tissue background. There are modifications in the structure of the axis cylinders and nerve fibres in denser connective tissue, but the staining reaction remains unmodified. In one specimen of unusually dense connective tissue formation in the proximal end of an excised nerve the axis cylinders were very irregular, varicose, and of a rough outline by turns,

yet the purple border about the pink central tendril was present. Some of the larger fibres showed a vacuolated appearance, in which case the vacuoles were outlined by a fine blue-black stain. Tinel refers to this in "stump neuromas" as a *gonflement* of myelin. As a rule, the fully developed nerve shows the axis cylinder "capped" at regular intervals by a pyramidal purple material deeply stained against the axis cylinder, and fading away gradually. Tinel speaks of this appearance as "bearded" or "prickled with thorns," and refers it to deeper silver impregnation at these points—the incisures of Lantermann.

Technique.

The specimens are hardened in 10 per cent. (or, according to some laboratories' computation, 4 per cent.) formalin and then carried through the alcohols to ether and absolute alcohol and celloidin. Although thin sections are preferable, good results are obtained with 20 μ thick sections.

The section is washed in water, placed in carbol-fuchsin fifteen minutes, momentarily in water, 1 per cent. osmic acid five minutes, water two minutes, watery safranin 50 per cent. one minute, acid alcohol 1 per cent. two minutes, 95 per cent. alcohol five minutes. Absolute alcohol and oil of cloves are now used alternately until the section appears deep pink but translucent; it is then placed in xylol for two minutes and mounted in Canada balsam.

Advantages.

The great value of seeing the nerve fibres distinctly outlined against connective tissue, cell proliferation, and blood vessels will be appreciated at once by those who examine tissue from the great number of excised "nerve callus" masses of war surgery.

In our experience we have had so far more than one hundred cases to examine. We have sectioned the excised nerves at proximal end, distal end, middle, and adhesions, including muscle and fat. We have had old operations to go over in some of which Cargile membrane, fascia wrapping, or veins had been used. In one case a rabbit's nerve had been used as a graft. This material was stained in about twenty-five different ways before the above-described method was adopted. The only method that approached satisfaction was that of Bielschowsky.

Method of Examination.

Some of the notable observations in my work have been the irregularity of growth of new fasciculi of nerves in the proximal end of the nerve about the old parallel running fibres, as far as the bulbous enlargement at the wound. There is invariable infiltration of the nerves with blood, new formed capillaries within and about the nerve, and little evidence of round-cell infiltration (most of our nerves were injured over eight months earlier). Connective tissue formation of varying density both within and about the fibres is the rule. The peripheral end always shows a great cellular proliferation with elongated spindle-shaped nuclei, usually arranged in little clumps and interlacing, running in various directions, resembling the arrangement of nerve fibrils in the bulbous enlargements in the stumps we have examined. In some of these we found axis cylinders well stained; in others repeated staining failed to show fully formed nerves.

The method of operating on these old torn nerves has been pretty definitely outlined, and is done in the same way at most of the base hospitals where the paralysed are treated some months after the original wound has healed.

The nerve is exposed with careful regard to all anatomical relations—adhesions relieved by sharp dissection in a line parallel to the fibres. Blunt dissectors are used when adhesions are pretty well localized to the immediate seat of nerve tear or cut, where a bulbous enlargement is usually seen. The work on the denser adhesions about this point is facilitated by raising on the dissecting elevators the freed portion of the nerve at the proximal and distal side of the bulbous mass included in adhesions. When the nerve in its continuity can be raised free of adhesions so much of it is excised as will leave greyish-pink moderately soft nerve ends. Here it is cut through and sutured with chromicized catgut. These sutures, about four in number, pass through the outer sheath. It may be necessary to stretch the ends, transplant the nerve, and use an approximation suture which passes through the entire thickness of the nerve. The limb is placed in a position giving greatest relaxation to the nerve and muscles. Occasionally one meets with a case where relief of adhesions alone is deemed sufficient. There are cases where longitudinal incisions through the swollen injured part have been made. Cargile membrane, fascia, or muscle covering are used to protect the area of suture from future adhesions.

Observations and Results.

The material removed at these operations has been placed at my disposal since June 14th, 1917. I have used formalin as a rule as hardening agent, but picric and osmic acid have also been employed. Material from both ends, mid-portion (this is usually the bulbous part), and adhesions were examined in various ways and by different stains. Glycerin mounts were made of teased specimens, in which case the picric acid hardening and carbol-fuchsin-haematoxylin staining were most satisfactory. Howell and Huber recommended the picric acid-haematoxylin (Boehmer's) method. In fact, I find this haematoxylin most useful in the study of the cell proliferation. We invariably found good old nerve fibres in the proximal end, but very often these were intertwined by a mass of new young tendrils in small fasciculi and many young capillary blood vessels coursing in various directions about them.

In some cases no fibres at all were seen at the bulbous enlargement, but this was very rarely the case. As a rule old connective tissue, sometimes sclerotic in character, was found here, but even in this well-stained axis cylinders, single and in fasciculi, were detected (Tinel).

Wherever young fibrils were found there was a great cell proliferation. The distal end was always quite cellular, the nuclei of the cells, as a rule, were elongated and staff-shaped. In fact, the cellular areas here and in the bulbous portions frequently gave the appearance of a leiomyoma such as we so frequently find in the body of the uterus. Tinel calls such cellular areas gliomas. In a number of our cases we found quite a great many fasciculi of well-formed young nerves with axis cylinders in the distal end.

The adhesions invariably contained cellular young nerves, some with a faint line of myelin covering the axis cylinder,

others grown to adult age and well protected by medullary sheath and sheath of Schwann.

My examinations of nerve bulbs from stumps corroborate Thomson and Kennedy's findings. I find more good fully formed nerves than connective tissue and an unusual proliferation of the cells of the sheath of Schwann, called by Tinel, von Bungner, and others, neuroblasts.

For those who wish to read the best that has been written on the subject of regeneration and degeneration of peripheral nerves, I would refer to the bibliography in articles written by Howell and Huber, von Bungner, Alexis Thomson, Kennedy, Stroebe, and Luciani's *Human Physiology*, vol. iii, translated by Welby.

The very recent book by J. Tinel, *Les Blessures des Nerfs*, published by Masson et Cie., 1916, gives a brief but comprehensive surgical pathology of injured nerves. My findings are in accord with his regarding the contents of the bulbous injured parts. He names the swelling a neuroma when it is made up of regenerated nerve-fibres, such being usually found in the proximal (central) end. It is a pseudo-neuroma when it is made up of a thickening of the enveloping tissue by haemorrhage, fibrous tissue and proliferation of the neurological elements. This is usually found on the swelling of the peripheral end. He names these proliferating cells from the sheath of Schwann neuroblasts, with von Bungner, S. Meyer, and Kennedy.

Gluck thinks that there are real large protoplasmic ganglion cells among the sheath of Schwann cells, which are responsible for the formation of the new fibril.

I find great numbers of these neuroblasts in adhesions and at both ends, but particularly in the distal end—so numerous, in fact, that I can well understand why Tinel should use the term glioma for such cellular areas of the "pseudo-neuroma."

Tinel definitely states that the regenerating nerve always proceeds from the central end, using the old sheaths for a pathway and attracted by the "neurotropismus" of the proliferating cells of the sheath of Schwann. This neurotropismus or chemiotropic influence referred to by Langley and Anderson, and admirably worked out experimentally by Forssman, is not an uncommon explanation of the influence and only part played by the distal end.

Some say that the distal end produces good nerves autogenetically, others believe that they grow up to a certain stage and only form well-developed axis cylinders when brought in communication in some way with nerve centres; and here we have another use of the cells as expressed by Tinel. Mott, Halliburton, and Edmunds consider the activity of these neurilemma cells to be nutritional in nerve repair.

I will go quite fully into the various views about new nerve growth, as borne out by my pathological material, in a later, fuller communication.

ADDENDUM.

I wish to add to the above a description of some interesting microscopic findings which are of assistance in interpreting conditions as seen in the stumps of nerves, adhesions, and the nerve callus. In staining the specimens, the safranin used as described above is omitted; it is not an essential part of the staining method.

Ranvier described what he called "renflements biconiques"; Tinel writes of nerves "barbelé" or "hérissée d'épines"; von Bungner, Stroebe, and others have disputed about the incisures of Lantermann. Stroebe even denied that neurokeratin is in the medullary sheath. Arndt, with Kuelne, Kuhnt, Joseph, and Tuckett, arrive closer to our pictures when they speak of a neurokeratin sheath and myelin framework, "a sheath-like element stained with acid fuchsin" which surrounds the axis cylinder. Ranvier was not very far away when he wrote of a colloid material about the axis cylinder at the constricting node. However they look upon the axis cylinder in its relationships to the medullary sheath, there is no question but that most histologists have kept them distinctly separate. The above-named physiologists, through the neurokeratin material, worked to varying degrees by the different men into the framework of the medullary sheath and immediate surroundings of the axis cylinder, blended them into a more harmonious connexion.

It is to demonstrate this connexion that my stain is especially adapted. I have referred above to the fine single and double lines of purple (more accurately called

mauve) about even the smallest axis cylinders. This is due to the neurokeratin contents of the youngest fibre.

Two histological points are to be noted even in the youngest fibrils of adults or embryo; one is the cones, barbs, *renflements biconiques*, or whatever they be called, and the other is the so-called vacuoles, *gonflements* of myelin moniliform appearance of the fibrils, due to the neurokeratin framework. They show so clearly with my neurokeratin stain that the photographs I am preparing will speak better than words.

There is one fact that should be noted, however—that is, that stretching or compressing a nerve draws out this neurokeratin support into cone-shaped form, leaving the point finely drawn out along the axis cylinder, which it ensheaths, and the base toward the sheath of Schwann, each cone being from 10 to 40 μ long, depending on the amount of stretch. The base appears more deeply stained—not so; it is merely that, being at the wider attachment, there is a greater amount of it stained at the point viewed; this masses the pigment.

There are a number of interesting points that one can explain, and work is now in progress to put a correct interpretation on many long and acrimoniously discussed questions.

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THREE CASES OF MELAENA NEONATORUM SUCCESSFULLY TREATED BY THE INJECTION OF WHOLE BLOOD OR BLOOD SERUM.

By ROBERT HUTCHISON, M.D., F.R.C.P.

THERE is, of course, nothing new in the treatment of the haemorrhagic disease of the newly born by the injection of human blood or blood serum. It was introduced, I believe, by J. E. Welch in the year 1910, and many successful cases have been recorded since, especially in America. In this country, however, it does not appear to be very generally known yet, so it seems worth while to put on record the three cases described below, which occurred consecutively.

CASE I.

A female child, aged 2 days. The day after birth began to pass blood from the bowel; no haematemesis nor bleeding elsewhere.

On admission the child was blanched and profuse melaena was present. The same evening 5 c.cm. of human serum obtained from the blood of a patient with erythraemia was injected *sub cutem*. Next day there was a small attack of epistaxis but no further bleeding from the bowel, and the child was discharged a week later apparently well.

CASE II.

A male child, aged 4 days. Two days after birth several haemorrhages from the bowel took place, the last just before admission. The child was well nourished but pale and slightly icteric. Two hours after admission 5 c.cm. of serum, obtained from the same patient with erythraemia as in the first case, was injected under the skin of the back. Six hours later the

child looked much better and only one further slight attack of bleeding had occurred. Next day the stools were normal and three days later the child was discharged.

CASE III.

A male child, aged 30 hours; a healthy-looking well-developed child of normal colour. Blood was noticed in the first action of the bowels after birth and four tarry stools had been passed since. There had been no haematemesis. The napkins showed typical melaena of considerable amount. On the afternoon of admission 8 c.cm. of whole blood furnished by the ward sister were injected into the subscapular region. In the next twenty-four hours there were four more small tarry stools, after which the haemorrhage ceased, and the child was sent home well three days later.

How the serum acts it is impossible to say with certainty; but it seems probable that it supplies some constituent which is lacking in the infant's blood and which is essential for clotting. I used human blood or blood serum in all the cases described, but normal horse serum or antidiphtheritic serum would probably do as well.

Memoranda:

MEDICAL, SURGICAL, OBSTETRICAL.

THE TECHNIQUE OF NERVE SUTURE.

THE device here described may be strongly recommended for revivifying the neuromatous ends of divided nerves. It is simple, cheap, and effective. The essential point is the use of a safety razor blade, held in a pair of Halsted artery forceps, for division of the nerve. The blade—as supplied for a Gillette or other brand of safety razor—must be gripped quite firmly by the forceps, when it will be found more satisfactory than the sharpest scalpel. This device is used extensively at the orthopaedic centre, Blackrock, by Colonel Wheeler, who now prefers it to any other type of instrument for this purpose. The technique is as follows: The neuromatous end to be freshened is grasped by its fibrous sheath by two artery forceps clipped directly opposite one another, and the end of the nerve is divided by the razor blade until the brush-like ends of the healthy funiculi appear. A catgut suture is then inserted, and the two ends are approximated. The second suture is then inserted, and the first is cut. In like manner the other sutures are inserted, and the nerve ends are brought together accurately, and, if possible, the funiculi themselves are placed in apposition. The advantages of the razor blade are: (1) A sharp edge can always be obtained; (2) the nerve fibres can be cut horizontally with the least bruising of the structures. This device, therefore, seems worthy of bringing to the notice of neurological surgeons in other stations. Incidentally, I might add that the employment of tissue, such as Cargile membrane, etc., has been given up, for, as far as can be judged, it increases rather than diminishes the subsequent fibrosis near the sutured nerve.

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PARAFFIN AND BISMUTH FOR GASTRIC ULCER.

I HAVE found a mixture of bismuth subnitrate and liquid paraffin of use in the treatment of gastric ulcer. The bismuth salt may be rubbed up with ordinary liquid paraffin to form a smooth cream. It is taken thus without producing much nausea, and with increasing tolerance.

The liquid paraffin is a good vehicle for bismuth, undoing its constipating effect. The patient is more comfortable, and less flatulent than when taking bismuth alone.

The action of the combination may be supposed to resemble that of bipp in the treatment of external wounds. The special electrical effects of paraffin on wounds, mentioned in your issue of October 20th, are unfamiliar ground to me. Apart from that, the combination deserves a trial.

Holmes Chapel, Cheshire.

LIONEL JAS. PICTON.

AN official statement has been published denouncing the bad treatment of Italian prisoners by the Austrians. Their food is altogether insufficient for the maintenance of health. The conditions in concentration camps with regard to the accumulation of prisoners and the exhausting labour demanded are extremely bad, and the amount of sickness and the mortality extremely high.