substance of Schwann presented, in the larger fibres, the same concentrically arranged appearance as we had observed in the sciatic nerve, as is illustrated by figs. 6 and 7, of which fig. 6 is one of the largest met with, being $\frac{3}{8}$ of an inch in diameter, while fig. 7 is as small as $\frac{1}{6}$ of an inch in transverse measurement. In the very minute fibres no appearance of concentric lines could be detected, yet, wherever the existence of an axial cylinder was indicated by a carmine point, a ring of medullary sheath was always visible, presenting the same proportion to the axial cylinder as in fibres of larger size. This may be gathered from figs. 8, 9, and 10, of which fig. 8 measures $\frac{7}{16}$ of an inch across, fig. 9 $\frac{3}{8}$, and fig. 10 only $\frac{1}{6}$.

At the margins of longitudinal sections of the cord, the contrast, both in structure and in tint, between the axial cylinder and the medullary sheath showed itself very beautifully. It often happened that a projecting isolated fibre was, near its extremity, more or less divested of the white substance of Schwann, so that the delicate, carmine-tinted axial cylinder was exposed, though presenting here and there colourless flakes of the medullary sheath adhering to its surface; while in parts where the nerve was still entire, the pink colour of the central fibre could be distinctly discerned through the intervening white substance. Fig. 11 represents a large fibre under such circumstances, and fig. 12 one of considerably smaller size; and these sketches also display the remarkable fibroid arrangement which we find the white substance of Schwann invariably assumes under the influence of chromic acid.

In conclusion, we may remark that the successive employment of chromic acid and carmine seems likely to afford valuable aid in discriminating nerve-fibres among other structures; there being, so far as we are aware, no other form of tissue which, after the use of these means, exhibits fibres having a central carmine axis, and peripheral uncoloured sheath.

Supplementary Observations by Mr. Lister.

The fibroid arrangement of the white substance of Schwann in nerves hardened by chromic acid has been minutely described by Stilling, in his elaborate treatise on the 'Nerve-fibre and Nerve-cell,'* a work which we had not seen when

* 'Ueber den Bau der Nerven-Primitivfaser und der Nervenzelle.' Von Dr. B. Stilling. 1856.
the foregoing communication was written, but a copy of which was kindly lent me by Professor Goodsir, soon after Mr. Turner had left Edinburgh for the vacation. According to Stilling, the medullary sheath is, even in perfectly fresh nerves, composed of a network of fibres, which are continuous with others in the axial cylinder and in the proper investing membrane; so that, in his opinion, these three constituents of the nerve-fibre differ from each other only in the manner in which their elements are disposed.* This view is not only quite novel anatomically, but is opposed to the generally received physiological opinion, that the axial cylinder is the essential part of the nerve-fibre, and the medullary sheath an insulating investment. Considering the high estimation in which the writings of Stilling on the anatomy of the nervous centres are deservedly held, and the influence which therefore attaches to his opinions, it seems fortunate that we have been able to present so clear a demonstration that the axial cylinder is chemically as well as morphologically totally distinct from the medullary sheath.

With regard to the cause of the fibroid arrangement of the medullary sheath, an observation which I happened to make several years ago, regarding the aggregation of fatty matter, may perhaps tend to throw light upon the subject. I submitted to microscopic examination some of the pultaceous slough of a sore affected with hospital gangrene, thinking it possible that I might discover in it some fungus which might account for the peculiar specific character of that disease; and found in it numerous bodies, each composed of branching fibres radiating from a common centre, and looking, at first sight, like some sort of vegetable growth, so that I made careful sketches of them, one of which is reproduced in fig. 13. But seeing afterwards, in the same object, some bundles of acicular crystals of margarine, having a distant resemblance to the bodies I had drawn, I added ether to the specimen, and found that it dissolved the latter equally with the former. This showed that what first attracted my attention was merely an arborescent form of aggregation of some fat, probably margarine; and it seems not unlikely that the fluid fat which exists in the medullary sheath of a perfectly fresh nerve, may tend to a similar arrangement of its particles when passing into the solid form, and so give rise to the appearance in question. It is to be remarked that the fibroid character is not peculiar to specimens treated with chromic acid, but also shows itself, though in a less perfect manner, in nerves which have been subjected to other modes

of preparation—for example, after exposure for a few seconds to a temperature of 212° F.

There is another important statement made by Stilling, which the use of the method of examination above described enables me to correct. He speaks of the fibres which connect one nerve-fibre with another as similar in every respect to those seen in the medullary sheath.* I find, however, that both in the sciatic nerve and in the spinal cord of the cat, the connective tissue between the nerve-fibres, like the neurilemma and pia mater, with which it is continuous, becomes coloured by the carmine; whereas, the medullary sheath, as before stated, is quite unaffected by it, proving that the two structures are chemically distinct from one another. In both these situations, too, the fibres of the connective tissue are much more delicate than the constituents of the medullary sheath, which are often comparatively coarse, as may be seen from fig. 11. In the columnar regions of the cord, the former require a high magnifying power to be applied to very thin sections, in order to distinguish them, and are often present in such extremely small quantity that, without very careful examination, the nerve-fibres appear actually in contact with one another. In the sciatic nerve I have observed occasional elongated nuclei in the connective tissue.

I may add that glycerine has proved very useful, not only for permanently preserving the preparations in the moist state, but also as an aid to investigation; for it renders the sections much more transparent, without making the white substance of Schwann invisible, as turpentine does; and hence the course of the nerve-fibres through the cord can be traced much more easily, and, at the same time, the proportion between the medullary sheath and axial cylinder can be readily ascertained. Thus, by examining transverse sections of the cord in this way, I find that while Kölliker is quite correct in his statement that the fibres of the roots of the nerves diminish in size in passing inwards through the columnar regions,† yet the diminution affects only the white substance; the axial cylinder often retaining its full dimensions even in the middle of the gray matter, while the medullary sheath is reduced to a very thin crust, so that the nerve-fibre assumes a character differing but little from that of an offset of a nerve-cell.

† Kölliker's 'Handbuch der Gewebelohre,' 3d edit., p. 235.