nation of the kind as to make it a matter of much interest that a larger number of meteoric irons from various localities should be subjected to careful examination in the same direction, thus supplementing our knowledge of the fixed constituents of these curious bodies by a study of their gaseous contents.

III. "On the Structure and Function of the Rods of the Cochlea in Man and other Mammals." By URBAN PRITCHARD, M.D. Communicated by Prof. LIONEL BEALE, M.D. Received April 18, 1872.

(Abstract.)

The ear is, it is well known, one of the most complicated organs of the body, consisting of the external, middle, and internal sections, the two former being concerned in collecting and conducting sounds or vibrations, while the duty of the internal portion consists in receiving, localizing, and clearly distinguishing them. It is simply with this last function of the organ that I purpose to deal, my aim being to describe the true construction and use of the cochlea, so far as its task of distinguishing the various sounds is concerned. This cochlea, it must be borne in mind, consists of a spiral canal, in form and shape very similar to the inside of a snail-shell. From the axis of this spiral, there proceeds horizontally a plate of bone, the lamina spiralis, almost dividing this canal into two; from this plate, again, there extend two membranes, the membrane of Reissner and the lamina spiralis membranacea, as far as the walls of the canal, thus separating it into three minor canals.

Between the layers of the membranous spiral lamina are situated the so-called Rods of Corti. These were first discovered and described by the Marquis de Corti; and although since then many observers have studied the subject, yet scarcely two investigators are agreed as to their exact form.

Deiters has published the results of two investigations, in which the form of the rods is differently described; Kölliker, Henle, and others appear to agree with Deiters's later view, and most of our text-books have copied their drawings. Recent writers, such as Dr. A. Böttcher, Waldeyer, &c., give varying drawings, some of which are nearer the true form of the rods than that of Deiters, while others exhibit them in all kinds of extraordinary shapes.

In a general view of the rods from above, they appear similar to two rows of pianoforte-hammers, rather than like the keys of that instrument, to which they have been likened. In a lateral view, these two rows of rods are seen sloping towards each other, like the rafters of a gabled roof. The rods consist of a shaft and two enlarged extremities, but the two rows differ considerably in form; the inner rods are attached by their

lower extremities to the membrana basilaris at its junction with the lower lip of the limbus, and just external to the spot where the nerve-filaments emerge; they are directed outwards and upwards, with a slight undulation to meet the outer rods. The lower extremity is enlarged and rounded, gradually tapering to the shaft, which is cylindrical; the upper extremity is somewhat cuboid in form, but the outer surface is deeply concave, and the upper lip of the concavity is prolonged into a process.

The outer rods are attached to the membrana basilaris by a broad base, which also gradually tapers to a cylindrical shaft. Their upper extremity is less cuboid in form, and presents a convex internal surface, which articulates with the corresponding concavity in the inner rods just mentioned; from the outer and upper part there extends outwards a slender process.

One of the most important features with regard to these rods is their relative length. Most authors state that there is very little difference in the length of the two rods; in this, however, they are much mistaken; for not only do the two sets of rods differ in this respect, but the length of each varies according to its position on the cochlea. Thus, at the base, the outer rods are as nearly as possible equal in length to the inner; but proceeding upwards, both rows increase in length with great regularity, although not in the same ratio, the outer increasing with much greater rapidity, so that near the apex they are twice the length of the inner.

It was generally supposed, *à priori*, that these rods were graduated so as to distinguish the most minute variation of tone, but no one until now has been able to demonstrate this.

The rods, therefore, vary in length from about $\frac{1}{500}$ to $\frac{1}{200}$ of an inch. The number of rods in each row is not the same, there being about three of the inner to two of the outer; and, according to calculation, there are about 5200 inner rods and 3500 outer in the whole cochlea.

Most authors, with the exception of Deiters, describe nuclei situated in various parts of these rods, principally in the lower extremities; but although seen from above this appears to be the case, on closer observation these so-called nuclei of the rods are found to be nothing more than the nuclei of cells surrounding them.

The arrangement of the nerves.—The cochlear nerve-fibres from the portio mollis pass up the modiolus, and turn off at the lamina spiralis. Just at this junction we find in the bone itself a ganglion, from which the fibres proceed outward. Immediately before the end of the lower lip of the limbus, the nerve-filaments pierce its upper surface, and appear close to the base of the inner row of rods; concerning the termination of these nerve-filaments little is really known.

Corti and most other authors considered this system of rods to be the essential portion of the cochlea; they supposed that the rods received the vibrations conducted to them, and being set in motion, so affected the nerves as to cause the brain to appreciate the various sounds. Later German writers have attributed the appreciation of the various vibrations

to certain delicate cells which are attached to the under surface of the membrana reticularis. From this circumstance alone it appears very evident that these investigators had not suspected, much less discovered, the fact that the rods are most exquisitely graduated, for otherwise they could surely never have doubted that so beautiful and suitable an apparatus could have any other ostensible purpose than that of appreciating the various sounds. I consider, indeed, that the cochlea represents a musical instrument, similar in nature to a harp or musical box, the strings of the one and the teeth of the other being represented by the rods of Corti. The spiral bony lamina is simply a sounding-board; around the rods are placed the various nerve-cells and nerve-fibres, and from these cells the impressions are conveyed by the fibres to the brain itself.

It is possible, therefore, to trace very completely the course of sounds or vibrations from a musical instrument or any other source to the brain, through the medium of the ear. First the vibrations are caught and collected by the auricle, and transmitted through the external meatus to the drum of the ear, next across the middle to the internal ear. Here the sound is appreciated, merely as a sound, by the vestibule; the direction is discovered by means of the semicircular canals; but to distinguish the note of the sound, it must pass on to the cochlea. The vibration therefore passes through the fluid of the cochlea and strikes the lamina spiralis, which intensifies and transmits the vibration to the system of rods. There is doubtless a rod not only for each tone or semitone, but even for much more minute subdivisions of the same; so that every sound causes its own particular rod to vibrate, and this rod vibrating, causes the nerve-cells in connexion with it to send a nerve-current to the brain.

In conclusion, I feel it my duty to mention that I am greatly indebted to Professor Rutherford, of King's College, for suggesting the investigations which led to these results, as also for much valuable advice while prosecuting them in his laboratory at King's College.

Addition to Lieut.-Col. A. Strange's paper "On a new Great Theodolite to be used on the Great Trigonometrical Survey of India, with a short Note on the performance of a Zenith-Sector employed on the same work." (See p. 317.)

(Received June 15, 1872.)

Since my paper with the above title was read, it has occurred to me that some particulars as to the weight of the instrument might interest those engaged practically in Geodesical work. The following are the weights of the main parts as separated for carriage:—