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 :—

		lbs.
(1)	*Stand*, with Levelling-apparatus complete	108
(2)	*Iron Circle of Stand* with 3 Centering-Screws	156
(3)	*Tribrach*, with Horizontal Circle, Guard ditto, Vertical Axis, and Relieving-apparatus	180
(4)	*Vertical-Axis Socket*, with 5 Horizontal-Microscope arms, Elliptical Table, Pillars, 2 Azimuthal Levels, 2 Vertical ditto, 2 Vertical Microscopes, 2 Pointer ditto, Horizontal Tangent-Screw plates	235
(5)	*Telescope*, with Vertical Circle	64
(6)	Miscellaneous appliances and spare parts (about)	130
	Weight of Instrument....................	873
(7)	Aggregate weight of field packing-cases, assumed at $\frac{2}{3}$ the weight of contents	582
	Total weight of Instrument in field-cases	1455

The heaviest package (4) packed in field order will be,—instrument 235 lbs. + case ($\frac{2}{3}$) 157 lbs.: total 392 lbs. This is less by about 100 lbs., according to my recollection, than the heaviest package of Troughton's Great Theodolite, long in use with the Indian Survey, and with which I myself worked for five years in a country parts of which were extremely rugged and mountainous. Expense apart, the portability of an instrument is of course defined by the weight of its heaviest portion.

Nevertheless the instrument is considerably heavier than I should wish. There are three ways of diminishing this inconvenience:—first, by diminished dimensions; second, by mode of construction; third, by choice of materials. I will say a few words on each.

When the designing of this instrument was placed in my hands by Sir Andrew Waugh, the late Surveyor-General of India, he left the question to my decision whether the Horizontal Circle (which governs the whole) should be 30 or 36 inches in diameter. With my five years' experience of the larger size, and with ample experience of smaller ones, I deliberately preferred and adopted the larger, and am responsible for that decision. I believe myself to be in the minority on this question; but can only say that, if I had to use the instrument myself, I should still prefer the larger size, attaching, as I do, great importance to the greater optical power and the superior stability which are secured by it: for these I would myself willingly sacrifice convenience to a great extent.

By "mode of construction," I mean particularly the degree in which the main parts are cast in single masses. That principle, when the design was commenced, had been notably illustrated by the present Astronomer Royal and President of this Society, in the new instruments designed by him for the Royal Observatory and now in use there. Like many others, I was at the time fascinated by it; but I am now disposed to think that this principle has been carried too far in my own design under notice. Discretion is requisite in applying even an unquestionable principle. And I now think that it is not judicious to apply the same method to a portable as to a fixed instrument; to do so introduces the difficulty of carriage, and this must result in curtailing size, and with it power. Casting in masses professes to diminish or eliminate the strains and tensions supposed to be incident to building up the structure with separate pieces. Whatever may have been the case some years ago, I am disposed to believe that this superiority is now much less marked than it used to be, if, indeed, it exists at all at present. Self-acting shaping-tools have been brought to such perfection, that the fitting of contiguous surfaces to each other can now be made practically absolute, to the exclusion of those strains which imperfect fitting must of course formerly have introduced. Nor must it be forgotten that even casting in masses does not exclude irregular strains, and that the more unequal in thickness the different parts of a mass are, the more such strains are to be apprehended. Let any one cast even so symmetrical a thing as a ring, say 3 feet in diameter and 3 inches thick, divide it into two halves, and afterwards attempt to fix these halves together; he will find them infallibly distorted. Every one who has turned large irregularly shaped masses of metal in a very accurate lathe, knows that every cut of the tool alters the *general* form of the mass. In the instrument under discussion, the principle in question has, I now believe, been carried too far; it has greatly increased weight, whilst I doubt whether it has diminished unequal tensions.

As to choice of materials, I have already mentioned that the use of aluminium bronze has tended materially to diminish weight. I am of opinion, however, that steel can now be employed for such a purpose almost exclusively, since at the present day it can be cast and worked as readily as brass, though of course at rather greater expense, owing to its hardness. The various shaping-machines and drill-slotting machines give almost unlimited control over the forms that may be given to the solid masses, while sheet-steel is now an article of ordinary commerce available for the tubular parts. The nickelyzing process, now extensively employed in America, and becoming every day better known and appreciated here, effectually preserves steel from oxidation.

Practical surveyors are alive to the question of facility in dismantling, packing, and setting up so large an instrument as this. I am able to give some data on this head. After exhibiting the instrument to the Society at Burlington House, Piccadilly, it had to be removed to my Observatory in Belvedere Road, Lambeth; it was taken to pieces, packed, loaded on a van, conveyed to its destination, and again set up in the Observatory ready for adjustment and use in three hours. I should mention that the passages through which the various parts had to be carried from the Meeting-room to the cases in the outer hall are tortuous, narrow, and dim, that the distance from Burlington House, about $1\frac{3}{4}$ mile, was traversed at a foot's pace, in order that the men might be at hand in case of accidents, and that ten ordinary labourers of the India Store Department, with my assistant and myself, were employed in the operation.