

work than elaborately fitted laboratories. Desk work must be dethroned to a large extent and the pupils be given more time in the open air.

The exhibition of home-made apparatus was not so good as usual this year. Judging from the remarks of many teachers present at the conference, this exhibition has in previous years been regarded as one of the most helpful of the items on the programme of events, and Dr. Kimmins, to whose energy the success of the conferences is due, should develop this side of the annual meetings as largely as possible in future.

A. T. SIMMONS.

A NEW RANGE-FINDER.¹

THE instrument designed by Prof. Forbes is intended only for use with rifle fire. It is not suitable for long-range artillery, or for the Navy. This infantry type is by far the most difficult to produce, because, in addition to accuracy, extreme portability is an essential feature. At the same time, the infantry are more in need of some addition to their present resources than any one else, and the urgent need of such an instrument has been proclaimed and re-echoed by all our officers who have returned from the war in South Africa.

All methods of optically measuring the distance of an inaccessible object depend on using a base of known length, which must be measured on the ground, or else be part of the instrument. In the latter case the instrument can usually be worked by one man, who can find the distance without changing his position. This class of instrument is sometimes spoken of as short-base range-finders. Numerous patents for such instruments have been applied for; but the difficulties in the way of ensuring accuracy are so great that only one type has ever been perfect^{ed} and generally used. The Barr and Stroud range-finder has been adopted by the Navy with most satisfactory results, and this has proved the fact that a short base (4½ feet) is not inconsistent with accuracy. For the use of infantry, however, where extreme probability, and accuracy, and suitability for ill-defined objects, such as men, bushes, rocks, &c., are essentials, this is an unsuitable instrument.

In the Barr and Stroud instrument the two images of a distant object are seen with one eye, hence the object appears to be double until the micrometer arrangement has been so moved as to make a coincidence of the two images, when the scale reading of the micrometer gives the distance directly. Now in naval work, for which this instrument is made, a ship, or its mast or funnel, is very sharp against the sky, and the coincidence can easily be made; but this method is almost valueless in the field. A bush, or a rock, or a man is an object so ill-defined, especially against certain backgrounds, that in attempting to make a coincidence you may move one picture in the telescope over the other for a considerable angle before you are sure that it is double. The difficulty has been got over by Messrs. Carl Zeiss and Prof. Forbes, who make use of stereoscopic vision in the new range-finder.

The instrument consists of a folding aluminium base, 6 feet in length, and a field glass. The base is a square tube hinged at its middle, and folds up to 3 feet 6 inches. Each half has at each end a doubly reflecting prism. The rays of light from a distant object strike the outer pair of these four prisms, are reflected at right angles along each tube, and are then reflected at the two middle prisms into the two telescopes of the binocular fixed to the base, in directions parallel to the original rays intercepted by the outer prisms. It is the measurement of the angle between these rays that tells the distance of the object looked at. This angle is measured by two vertical wires, one in each telescope, seen by the two eyes. One of the wires is fixed, the other is moved by a micrometer-screw until the two

¹ Abstract of a paper read before the Society of Arts on December 18, 1901, by Prof. George Forbes, F.R.S.

wires appear as one, while the object is seen distinctly. This gives the distance accurately to 2 per cent. even at 3000 yards. But now stereoscopic vision comes in and gives far greater accuracy. The wire seems to stand out solid in space, and the slightest turn of the micrometer screw causes the wire to appear to be nearer or farther than the object looked at, and when the wire appears to be at exactly the same distance the micrometer reading gives the distance with an accuracy far greater than that attainable by observing the duplication of images on the retina.

This range-finder can be used in a variety of positions. The more steadily it is held the more accurate the result. A standing position is the least steady. When kneeling, using only half the base, the other half may be bent down at right angles, and so form a leg which serves as a rest on the ground. The most easy position is sitting with the elbows resting on the knees. Another steady position is lying flat on the ground facing the object (Fig. 1). In every one of these positions you can take advantage of cover. Since the eyes are virtually at the extremities of the base, the observer may stand, sit, kneel, or lie behind a tree, bush, rock, ant-hill, horse, comrade, or waggon, and will not only be more able to work without sensation of danger, but without drawing the fire of the enemy on his comrades.

Lord Kitchener having expressed a desire to see the range-

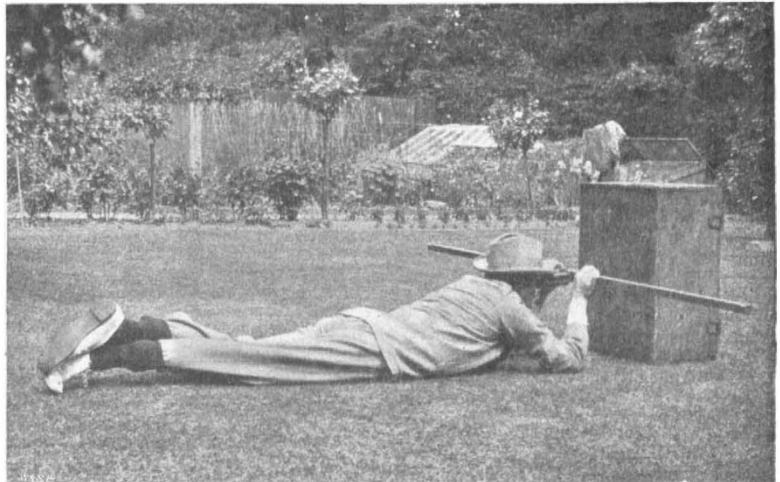


FIG. 1.—Range-Finder in use behind cover.

finder tested in the field, Prof. Forbes has proceeded to South Africa with his instrument, and a thorough examination of its efficiency will be made under practical conditions.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

THE Prince of Wales having consented to be nominated as Chancellor of the University of Wales, has been elected to that office in succession to His Majesty the King, who has assumed the title of Protector of the University.

THE executive committee of the Carnegie Trust met at Edinburgh on Monday. The secretary and treasurer submitted their reports for the period ended December 31, 1901, showing that fees have been paid by the Trust to 2441 students, amounting to the sum of 22,941*l.* 16*s.* 6*d.* It was arranged to hold the annual meeting of the trustees in London, at which the first report of the executive will be submitted.

AT a special meeting of the Governors of University College Dundee, on January 8, Sir W. O. Dalglish intimated that he would provide a sum of 5000*l.* for the building of the new medical school, and an additional sum of 5000*l.* towards the extinction of the debt on the College. This latter sum will be payable only if within a certain reasonable time sufficient money is subscribed to make up the remaining sum, the balance of