

have made it possible to take the three negatives necessary for their method of colour photography in three seconds, including the time required for changing the plates and light filters, when the light is only moderate and the lens aperture  $f/16$ . In the central court, besides a great deal of apparatus and several demonstrations of processes, the Adhesive Dry Mounting Co. shows its method of mounting by warm pressure. The Ozotype Co. shows in the north room several examples of "ozobrome" prints. These are quite a new departure, a carbon print being produced by means of a bromide print without exposure to light, the silver image in the bromide print reducing the bichromate in the carbon tissue by mere contact. The original bromide prints and the carbon copies are shown side by side.

C. J.

### GEODETIC OPERATIONS IN SOUTH AFRICA.

IT will be admitted that the Administration of Southern Rhodesia acted wisely in accepting the timely counsel which Sir David Gill brought under its consideration. Some ten years ago His Majesty's Astronomer at the Cape pointed out to Lord Grey, who then administered the government of the colony, the desirability of basing the land tenure on a properly established system of survey. The adoption of such a course would not only afford the means of supplying a sound and incontrovertible evidence of title to the possessor, but would protect the Government against the perpetration of fraud and tend to diminish future litigation. Sir David Gill does not hesitate to say that in Cape Colony large tracts of land have been stolen from the Government, either through the wilful shifting of beacon marks or from carelessness due to inadequate surveying. Sir David Gill did not lay any great stress upon the scientific value that necessarily attaches to accurate measurement conducted on a large scale; but this point was not neglected, and the work was planned so as to give the greatest assistance to economic requirements, and at the same time to forward scientific interests. The one purpose was effected by carrying a chain of triangles eastwards from Bulawayo, covering the most thickly populated and important parts of the country, the other by extending the chain north and south along the thirtieth meridian, so that it might form part of the great arc of meridian which it is proposed to extend from the south of Natal to the Mediterranean. The actual district surveyed extends from about  $16^{\circ}$  to  $20^{\circ}$  south latitude and from  $28^{\circ}$  to  $31^{\circ}$  east longitude.

Sir David Gill sketches the history of the work accomplished in successive years, from which can be gathered something of the difficulties which Mr. Simms and his assistants encountered and overcame. Abnormally wet seasons, illness among the staff, the necessary burning of the grass and the rising of the smoke preventing the measurement of horizontal angles, loss of cattle, and in one instance the destruction of the theodolite, are a few of the troubles that beset those who attempted geodetic operations in an unsettled country; but, notwithstanding these drawbacks, there remained only three stations south of the Zambezi which were not fully connected with the scheme of triangulation proposed. As the work is extended northwards these stations will be occupied, and thus form a useful link in the two systems.

A matter of great interest in the report from a scientific point of view consists in the critical examination of the Jäderin wires used in the measurement of the base lines. This apparently convenient form of measurement was, it is believed, adopted by the Russian geodesists in the work connected with the Spitsbergen base, but in this country the apparatus has not been submitted to any very thorough test, and figures for the first time on a large scale in the geodetic survey of South Africa. Two wires, one of steel and the other of brass, constitute a "pair," and, as a rule, were used in this form. Each wire is about 1.65 mm. in diameter, and is stretched by an accurate spring balance with a tension of 10 kilograms. The length of three pairs

<sup>1</sup> Report of the Geodetic Survey of part of Southern Rhodesia executed by Mr. Alexander Simms, Government Surveyor, under the direction of Sir David Gill, K.C.B., F.R.S., His Majesty's Astronomer at the Cape. Pp. xiv+146. (Cape Town, 1905.)

was each 80 feet, but two others of 160 feet and 320 feet respectively were used in crossing streams and gulleys. Another form of the same apparatus, occasionally used, consisted of a wire of "invar" nickel-steel and a wire of another alloy having a coefficient of expansion about the same as that of brass. The absolute length of each of these pairs was determined by repeated comparisons with a base line 80 feet in length, measured with a standard bar apparatus; but even the length of this base could not be assumed to be constant. The partially decomposed quartzose slate beneath the piers which carried the fiducial marks appeared to change slightly in position, especially after rain, and the length of this base as measured in the wet and dry seasons differed by half a millimetre. Constant measurement with the bars removed any source of error from this cause, since the change of length between the beginning and end of a set of wire comparisons was practically insensible.

But the real source of error in the use of the Jäderin wires lies in the fact that the ordinary steel and brass wires are liable to change of length, due to re-arrangement of the molecules of the constituent metals which takes place independent of temperature after these molecules have been violently disturbed. The tendency in all new drawn wires is to shorten, very markedly at first, and to diminish in amount as a more stable arrangement of the molecules is established. In a postscript, however, it is stated that, as the result of experiments conducted at the International Bureau of Weights and Measures, it is found possible by careful annealing and special mechanical treatment to render the arrangement of the constituent molecules of "invar" wires practically stable, and that such wires can be used as standards. Such wires, however, are not examined here. As an evidence of the change of length in the wires actually used, we may quote the following:—The length of a standard pair, at a temperature when both components were of equal length, was found to be in

April and May, 1898 ... .. 24382.07 mm.

October and November, 1898 ... .. 24381.84 "

Two base lines were measured in the course of the work, one of  $11\frac{1}{2}$  miles and the other of  $13\frac{1}{2}$  miles. The first, known as the Inseza base, was measured in three sections, the second in seven, each section being measured in opposite directions. As an indication of the accuracy attained we give the repeated measures in the shorter base:—

	Direct	Reverse	Discordance
	mm.	mm.	
Length of Section I.	4,509,571.88	4,509,554.47	1 in 259,000
" " II.	6,200,765.86	6,200,732.18	1 " 184,000
" " III.	8,196,927.19	8,196,928.28	1 " 4,746,000
TOTAL ...	18,907,264.93	18,907,214.93	1 in 378,000

We have not space to quote the results in the case of the Gwibi or longer base, but the results there are even more accordant, the average discrepancy amounting to only one in a million and a half.

W. E. P.

### UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

THE celebration of the four hundredth anniversary of the foundation of the University of Aberdeen began on Tuesday, and will continue for several days. The commemoration has been planned on a magnificent scale, and the arrangements have been perfectly organised. The formal proceedings opened on Tuesday morning with a service at King's College in commemoration of the founding of the University by Bishop Elphinstone. In the afternoon, at a reception given by the Chancellor (Lord Strathcona) and other high officers of the University, the delegates of the British, colonial, and foreign universities were presented to the Chancellor and delivered their addresses. In the evening a banquet was given by the Lord Provost and the corporation. Among the distinguished foreigners who are taking part in the celebrations are:—Prof. H. Becquerel, Prof. Behring, Dr. C. De