

present of peculiar interest; and (3) the middle and southern area, found in France, Spain, and Sardinia, almost wholly Lower and Mid-Silurian.

Under this head of geographical distribution we have to deal with some curious phenomena—such as concern birthplace or first appearance, generic and specific, the duration of life, tolerance of conditions, mineral habitats. Migration possesses great interest, with its marks, causes, and modes, with its power, direction, and rate of progress, &c.

The transport or removal of dead organic matter from place to place, the “*remaniement*” of French geologists, is an important agency under several aspects, especially in the formation of extensive sheets of rock.

It now has become proper to bring to a close these few observations, or rather this enumeration of heads of Natural-History subjects, by expressing a confident hope that this compilation will find many and well qualified interpreters, and will be useful to geologists in general.

*February 28, 1867.*

Lieut.-General SABINE, President, in the Chair.

The following communications were read:—

- I. “On a Transit-Instrument and a Zenith Sector, to be used on the Great Trigonometrical Survey of India for the determination, respectively, of Longitude and Latitude.” By Lieut.-Colonel A. STRANGE, F.R.S. Received February 16, 1867.

In 1862 the Secretary of State for India in Council sanctioned the provision of an extensive equipment of geodesical and astronomical instruments of the first order for the use of the Great Trigonometrical Survey of India; and he did me the honour to entrust to me the task of designing and superintending their construction. After several modifications, the following list was adopted:—

One GREAT THEODOLITE, with a 3-foot Horizontal Circle. By Messrs. Troughton and Simms.

Two ZENITH SECTORS. By Messrs. Troughton and Simms.

Two 5-FOOT TRANSIT-INSTRUMENTS. By Messrs. T. Cooke and Sons, York.

Two SMALLER TRANSIT-INSTRUMENTS (*German form*). By Messrs. T. Cooke and Sons, York.

Two 12-INCH VERTICAL CIRCLES (*German form*). By Messrs. Repsold, Hamburg.

Two GALVANIC CHRONOGRAPHS for registering Transit-Observations. By MM. Secretan and Hardy, Paris.

Three ASTRONOMICAL CLOCKS. By Mr. Charles Frodsham.

The whole of these are nearly ready, and I take the opportunity of now submitting two of them (a 5-foot transit-instrument by Messrs. Cooke, and

a zenith sector by Messrs. Troughton and Simms) to the inspection of the Royal Society. Both instruments present peculiarities.

*The 5-feet Transit-Instrument.*—This has a very powerful telescope of 5 inches clear aperture (a large diameter in proportion to its focal length). The axis is of aluminium bronze, cast in one piece, hollow, and turned both inside and out. The two halves of the telescope are easily separable from the axis for portability.

It is provided with four levels for rendering the axis horizontal; these are mounted on a plan suggested and devised by Mr. Cooke. He remarks that the ordinary striding level usually applied to such instruments watches the pivots only, whereas the observer wishes to be informed whether or not the telescope itself describes a true plane. This it will not do if the flexure of the axis differs, as it may do, in different altitudes. Mr. Cooke therefore attaches the levels to the telescope. His mode of doing this, and of providing for their due adjustment, will, in the absence of drawings, be best understood by inspecting the instrument.

The means of adjusting the axis vertically and azimuthally are also peculiar. The bearings on which the pivots turn are carried by strong three-armed pieces, similar in form to the tribrach of an ordinary theodolite. On one side the tribrach is raised or lowered by means of the three vertical screws which form its feet, and the axis is thus made horizontal; on the other side the tribrach is pushed laterally by two horizontal screws, and the telescope is thus brought into the meridian. Three principal objects are sought in these arrangements—to exclude shake, to obviate strain, and to cause the expansions to take place from the centre outwards. I have been well satisfied with the trials I have made of them. I find these adjustments to be exceedingly delicate in their action, and very stable.

*The Zenith Sector.*—This is quite unlike any instrument of the same denomination. My endeavour in designing it was to combine maximum power with minimum weight.

A solid steel vertical axis revolves within a hollow wide-based conical cast-iron pillar. Across the vertical axis is placed a frame, in which are formed bearings for the reception of a transverse horizontal axis. This axis carries outside the frame a telescope of 4 feet focal length and 4 inches clear aperture, and a portion of a circle comprising two opposite sectors, each containing about 45°. The telescope being vertical for the observation of stars near the zenith, the sectors are horizontal—that is, transverse to the telescope. The frame which supports the horizontal axis carries also four micrometer-microscopes for reading the sectors. These microscopes are arranged conically, so that all four are illuminated by a single light, in the manner adopted by the Astronomer Royal for the Great Greenwich Transit-Circle. The telescope and sectors revolve together, the microscopes being fixed. When packed for carriage, the telescope and sectors can be made to lie in the same direction, and so take up much less room

than if they retained their transversal positions. Two levels are fixed to the horizontal-axis frame. The instrument is duly counterpoised.

The general arrangement of the instrument may be best conceived by supposing an equatoreal of the German form to be adjusted as it would be at the pole, when its polar axis would represent the vertical axis of the zenith sector, and its declination axis the horizontal axis.

The instrument has been too short a time in my hands to admit of my forming an opinion as to its probable success. I anticipate some advantage from the arrangement of the sectors, which, being in identical circumstances, should be liable to no inequalities of either flexure or temperature.

Both of the principal axes of the instruments are provided with independent adjustments, the action of which appears to be very satisfactory.

In concluding this brief and imperfect notice, I beg to state that I hope to draw up hereafter a full and detailed description of all the instruments given in the foregoing list. At present my time is absorbed by the trials and experiments to which it is necessary that I should subject them before their despatch to India; and I trust the Royal Society will accept this explanation as an excuse for the meagreness of the present account.

## II. "On the Orders and Genera of Ternary Quadratic Forms."

By HENRY J. STEPHEN SMITH, M.A., F.R.S., Savilian Professor of Geometry in the University of Oxford. Received February 21, 1867.

(Abstract.)

The object of this Paper is to supply demonstrations of the undemonstrated results, relating to Ternary Quadratic Forms, which are contained in an important memoir of Eisenstein's ("Neue Theoreme der höheren Arithmetik," Crelle's Journal, vol. xxxv. p. 117),—and, at the same time, to extend those results to the cases not considered by him in that Memoir. The following are the principal points in which the theory of Eisenstein has been thus further developed:—

1. In Eisenstein's Memoir forms of an even discriminant only are considered. Such forms, and their contravariants, are always properly primitive; they have particular generic characters with respect to uneven primes dividing the discriminant, but have no supplementary characters (*i. e.* characters with respect to 4 or 8). The case of forms of an even discriminant is more complicated. Besides the properly primitive order, there may exist, in this case, an improperly primitive order, in which the forms themselves are improperly primitive, and their contravariants properly primitive,—or, again, an improperly primitive order, in which the forms themselves are properly primitive, and their contravariants improperly primitive. Further, forms of an even discriminant may have characters with respect to 4 or 8; and a complete enumeration of these supplementary characters requires a careful distinction of cases. To facilitate this enu-