345, Strand, the magnetic disturbances and interference with transmitted signals from auroræ and earth-currents were first observed and the observations tabulated, which have since proved useful, notwithstanding the then defective construction of the recording apparatus; here also the earliest lines of railway telegraph were inaugurated; the long five-inch astatic combination of the double needle and single needle instruments was employed, taking the place of less perfect apparatus. It must be remembered that, previous to the introduction of the double and single needle instruments, very cumbersome apparatus had been employed. There was the five-needle instrument, requiring five wires for the five needles, and a sixth wire for the return current (Cooke and Wheatstone's patent, 1837);

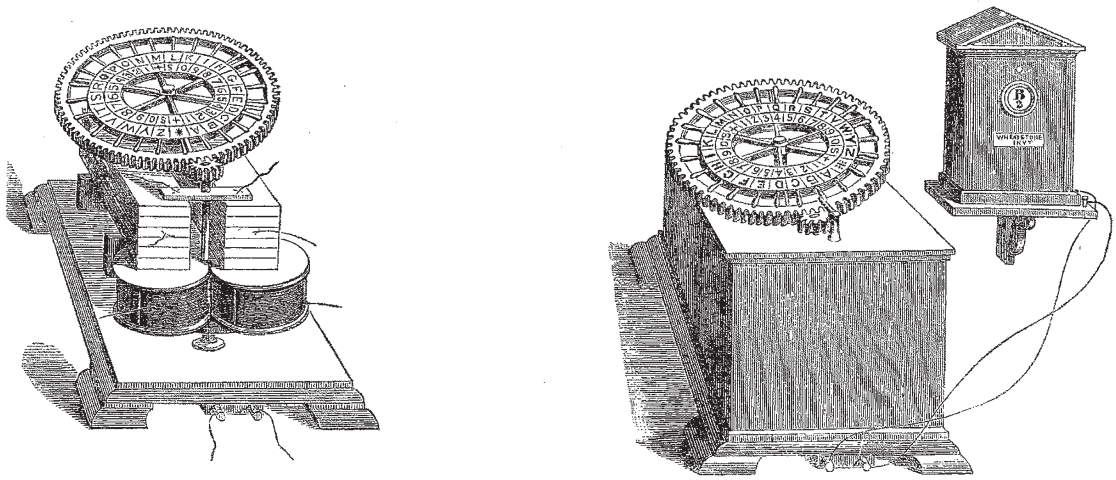

FIG. 27.—Wheatstone's letter-showing dial telegraph, 1840.

the respective letter or signal being indicated by the concurrent deflection of two pointers. Obviously, this instrument became useless for extended circuits, the capital cost of outlay for the six wires restricting its use. The old letter-showing apparatus of Cooke and Wheatstone (1840), in which the letters of the alphabet composing the word are severally presented to view at an opening in a dial-plate by means of an electro-magnet acting upon the pallets of an escapement, put in motion by independent clockwork. The communicator of the instrument is furnished with a dial-plate similar to that of the indicator, so that on the rotation of the dial of the communicator by the operator, the necessary succession of make and break currents of electricity are sent through the wire and controlled so as to actuate the motion of the index-pointer of the indicator at the distant station.

(*To be continued.*)

*THE INDIAN TRIGONOMETRICAL SURVEY**

ONE does not usually expect to find much of general interest in the Report of a Trigonometrical Survey. Col. Walker's admirably drawn-up Report, however, includes some matter of more than special value; indeed, many of the details connected with the immediate work of the Survey are calculated to interest the general reader, they are concerned to such a large extent with the peculiar difficulties to be overcome by the various parties, difficulties which make ordinary survey work look like mere child's play.

The Index Chart prefixed to the Report enables one to form a very full idea of the work which has already been done, and of how much there is yet to do. From Cape Comorin to Peshawur and all along the Himalayan frontier, and from Kurrachee on the west to Burmah on the east, the country is covered with an intricate net-work of triangulation, including, however, many gaps which will take many years to fill up. Shooting out from the northern border of the system of triangulation are numerous aurora-like lines indicating the secondary triangulation to fix the peaks of the Himalayan and Sooliman ranges. We cannot go into the details of the work of the Survey, and must content ourselves with a brief summary of the out-turn of work during the year under review, and with a reference to a few of the more interesting side topics.

Of Principal Triangulation, with the great theodolites of the Survey, seventy triangles, embracing an area of 7,190 square miles, and disposed in chains which, if united, would extend over a direct distance of 302 miles, and in connection with which three astronomical azimuths of verification have been measured. Of Secondary Triangulation, with vernier theodolites of various sizes, an area of 5,212 square miles has been closely covered with points for the topographical operations, an area of 3,650 square miles has been operated in *pari passu* with the principal triangulation but exterior thereto, and in an area of 12,000 square miles—in the ranges of mountains to the north of the Assam Valley which are inhabited by independent tribes—a large number of peaks have been fixed, many of which have already been found serviceable in the geographical operations now being carried on with the military expedition against the Dufflas. Of Topographical Surveying, an area of 534 square miles has been completed in British portions of the Himalayas, on the scale of one inch to the mile, an area of 2,366 square miles in Kattywar on the two-inch scale, and areas of 690 and 63 square miles respectively, in Guzerat and in the Dehra Dún, on the scale of four inches to the mile. Of Geographical Exploration much valuable work has been done in Kashgharia and on the Pamir Steppes, in connection with Sir Douglas Forsyth's mission to the Court of the Atalik Ghazi, and several additions to the geography of portions of Great Thibet and of Nepaul have been obtained through the agency of native explorers.

In the course of the operations of the year under review the northern section of the Brahmaputra Meridional Series has been completed, whereby two important circuits of triangulation formed by it with the Assam and East Calcutta Longitudinal Series to the north and south, the Calcutta Meridional and the Eastern Frontier Series to

* General Report of the Operations of the Great Trigonometrical Survey of India, during 1873-74, by Col. J. T. Walker, R.E., F.R.S., Superintendent of the Survey (Dehra Dun; Office of the Superintendent, G. T. Survey, M. J. O'Connor, 1874.)

the west and east, have been closed. The Straits of the Gulf of Manaar have been reconnoitred, with a view to connecting the triangulation of India with that of Ceylon, which has been found to be feasible.

Probably the most important features in the operations of the principal triangulation of the year are the resumption of the chain of triangles in Burmah, and the completion of the Bangalore Meridional Series for the revision of the southern section of the Great Arc.

Referring to the revision of certain important triangulations which were originally executed at the commencement of the present century with very inferior instruments, Colonel Walker expresses his conviction that no portion of the principal triangulation remains which will ever require to be revised, and that the last of the old links in all the great chains of triangles which might with any reason have been objected to as weak and faulty, have now been made strong and put on a par with the best modern triangulation.

The pendulum observations have been completed, and the final results are now being computed and prepared for publication.

Considerable assistance was, moreover, rendered to Col. Tennant in the operations connected with the observation of the Transit of Venus; the Appendix contains Mr. Hennessey's account of his observations at Mussooree, the details of which have already appeared in NATURE.

The reports of the various district superintendents are very full, and contain a good deal that is of general interest; the accompanying district sketch-maps are of great use in enabling one to read these reports with understanding. We shall briefly refer to some of the points of more general interest.

In Major Branfill's report on the Bangalore Meridional Series, a very interesting phenomenon is noticed in connection with the Cape Comorin base-line. The operations of 1873–74 were intended to close in a side of the polygon around the base-line which had been completed in 1868-69; but it was found that one of the two stations on the side of junction had disappeared. This station was situated on a remarkable group of Red Sand Hills, where, in 1808, Col. Lambton had constructed a station by driving long pickets into the drift sand; in 1869 Major Branfill, finding no trace of these pickets, had caused a masonry well to be sunk to a depth of ten feet, where it reached what was believed to be firm soil below; but during the interval of four years this well had been undermined, and nothing remained thereof but some scattered *débris*. It would appear that the sand hills travel progressively in the direction from west-north-west to east-south-east, which is that of the prevailing winds in this locality; if Col. Lambton's station was situated on the highest point of the hills and in a similar position relatively to the general mass as Major Branfill's, then the hills must have travelled a distance of about 1,060 yards to the E.S.E., for the results of the triangulation show that this is the distance between the positions of the two stations; thus the rate of progression would be about seventeen yards per annum. From Major Branfill's Notes on the Tinnevelly district, which are appended to the General Report for 1868-69, it appears that certain measurements of the eastward drift had made it as much as 440 yards in the four years 1845-48; but the distance between the trigonometrical stations of 1808 and 1869 probably affords the most accurate measure which has hitherto been obtained of the rate of progress of this remarkable sand-wave, which gradually overwhelms the villages and fields it meets with in its course, and has never yet been effectually arrested; numerous attempts have been made, by growing grass and creepers and planting trees on the sands, to prevent the onward drift, but they have hitherto been unsuccessful.

Mr. Bond, one of Major Branfill's staff, managed to procure an interview with a couple of the wild folk who live in the hill jungles of the western Ghâts, to the south-west of the Palanei hills. A strange dwarfish people had often been heard of as frequenting the jungles near the station of Pémalei, in the north-west corner of the Tinnevelly district, but until Mr. Bond caught these two specimens no trace of them had been seen by the members of the Survey. These two people, a man and a woman, believed themselves to be 100 years old, but Mr. Bond supposes the man to be about twenty-five, and the woman eighteen years of age. "The man," Mr. Bond states, "is 4 feet 6½ inches in height, 26¼ inches round the chest, and 18½ inches horizontally round the head over the eyebrows. He has a round head, coarse black, woolly hair, and a dark brown skin. The forehead is low and slightly retreating; the lower part of the face projects like the muzzle of a monkey, and the mouth, which is small and oval, with thick lips, protrudes about an inch beyond his nose; he has short bandy legs, a comparatively long body, and arms that extend almost to his knees: the back just above the buttock is concave, making the stern appear to be much protruded. The hands and fingers are dumpy and always contracted, so that they cannot be made to stretch out quite straight and flat; the palms and fingers are covered with thick skin (more particularly so the tips of the fingers), and the nails are small and imperfect; the feet are broad and thick skinned all over; the hairs of his moustache are of a greyish white, scanty and coarse like bristles, and he has no beard.

"The woman is 4 feet 6½ inches in height, 27 inches round the chest (above the breasts), and 19½ horizontally round the head above the brows; the colour of the skin is sallow, or of a nearly yellow tint; the hair is black, long, and straight, and the features well formed. There is no difference between her appearance and that of the common women of that part of the country. She is pleasant to look at, well developed, and modest." Their only dress is a loose cloth, and they eat flesh, but feed chiefly on roots and honey.

"They have no fixed dwelling places, but sleep on any convenient spot, generally between two rocks or in caves near which they happen to be benighted. They make a fire and cook what they have collected during the day, and keep the fire burning all night for warmth and to keep away wild animals. They worship certain local divinities of the forest—Rákas or Rákári, and Pé (after whom the hill is named, Pé-malei)."

The woman cooks for and waits on the man, eating only after he is satisfied.

The means taken for tidal observations in the Gulf of Kutch promise to lead to valuable results. The object of these observations is to ascertain whether secular changes are taking place in the relative level of the land and sea at the head of the gulf. Very great difficulties were found in selecting suitable stations for fixing the tide-gauges, as the foreshores of the gulf consist mainly of long mud-banks, which often stretch miles into the sea, and are left bare at low water, when they are intersected by innumerable tortuous and shallow creeks, whose shifting channels would be very unfavourable positions for tide-gauges. Only three points suitable for tidal stations were met with on the coasts of the gulf: at Hanstal Point, near the head of the gulf; at Nowanár Point, half-way up, on the Northern or Kutch coast; and at Okha Point, on the southern coast, opposite the island of Beyt. None of these points, however, are situated in ports or harbours, where piers, jetties, landing-stages, or docks might have been utilised; on the contrary, they are all situated at some distance from the nearest inhabited localities, and present no facilities whatever. The operations had thus to be of the very simplest nature. The only practicable plan was to have the tide-gauges set up on shore, over wells sunk near the high-water line, and connected with the sea by piping. The wells are iron cylinders, with an internal diameter of twenty-two inches, which slightly

exceeds the diameter of the float; the cylinders were made up in sections of fifty inches in length, the lowest of which is closed below with an iron plate, and the whole, when bolted together, forms a water-tight well, into which water can only enter through the piping for effecting the connection with the sea. The piping is of an internal diameter of two inches, which has been computed to be sufficient to permit of the transmission of the tidal wave to the well without sensible retardation. Iron piping is laid from the well to the line of low water; it is brought vertically up from the bottom of the well nearly to the surface of the ground, and is then carried down to the sea, where flexible gutta-percha piping is attached, and carried into the deep water. The outer piping terminates in a "rose," which is suspended a few feet above the bed of the sea by a buoy, in order to prevent the entrance of silt as much as possible, and it can be readily detached from the iron piping whenever it has to be cleaned.

After many difficulties, and even dangers to life, Capt. Baird's party managed to get the gauges erected and set to work, and what with the tidal observations, observations of the barometric pressure, the velocity and direction of the wind, and the amount of rainfall—for each station has been provided with means for making such observations—very valuable results may be expected.

Lieut. Gibbs's notes on the portion of the Dang Forests, in the Guzerat district, visited by him in 1874, are of great interest, and we regret that space forbids us referring to them in detail. His observations on the inhabitants of this region are of special value; he also seems to have paid considerable attention to the fauna, flora, and geology of the district.

Capt. Heaviside's lively narrative of the pendulum work in India, of his journey home, and of the operations at Kew, will also be read with interest.

Two narratives of somewhat unusual interest are given in the Appendix. One of these, by Lieut.-Col. Montgomerie, gives an account of a journey to the Namcho or Tengri Núr Lake, in Great Thibet, about ninety miles north of the Brahmaputra, by a native explorer, during 1871-72. The explorer was a semi-Thibetan, a young man who had been thoroughly trained for the work, and who was accompanied by four assistants. The party set out from Kumaon in November, and crossed the Brahmaputra at Shigatze, and amid considerable hardships made their way northwards, reaching the lake about the end of January, when they found it completely frozen over, although the water is so salt as to be unfit for drinking. The party intended to travel all round the lake, which is 15,200 feet above the sea, fifty miles long and from sixteen to twenty-five miles broad, and intended to proceed further to the northward and take complete surveys, but were robbed of nearly all they had, and were thus compelled to beat a rapid retreat, which they did by way of Lhásá.

During the great part of his journey to the Namcho Lake the explorer found the streams all hard frozen, and he was consequently much struck by the number of hot springs that he met with, and more especially by the great heat of the water coming from them, his thermometer showing it to vary from 130° to 183° Fahrenheit, being generally over 150°, and often within a few degrees of the boiling point, being in one case 183° when the boiling point was 183¾°. The water generally had a sulphurous smell, and in many cases was ejected with great noise and violence; in one place the force was sufficient to throw the water up from forty to sixty feet. These springs in some respects seem to resemble the geysers of Iceland.

To the south the lake is bounded by a splendid range of snowy peaks, flanked with large glaciers, culminating in the magnificent peak "Jáng Ninjinthanglá," which is probably more than 25,000 feet above the sea. The range was traced for nearly 150 miles, running in a north-easterly direction. To the north of the lake the mountains were not, comparatively speaking, high, nor were there any high peaks visible further north as far as the explorer could see from a commanding point which he climbed up to. He only saw a succession of rounded hills with moderately flat ground in between them. Immediately north he saw a lake of about six miles in length, which he was told was called Bul Cho, from the borax (bul) which is produced there in large quantities, supplying both Lhásá and Shigatze with most of the borax that they require.

The Tengri Núr or "Namcho" Lake is considered to be a sacred place, and although at such a very great distance from habitations and so high above the sea, it boasts of several permanent monasteries and is visited by large numbers of pilgrims. There are several islands in the lake, two of them large enough for monasteries: at the time the explorer was there the Lámas on the islands kept up their communication with the shore by means of the ice, but he did not hear as to what was done in summer. Fish are said to be abundant, and modern lake shells were found on the shore as well as fossil shells, which were very numerous and of all sizes.

The narrative contains many other valuable observations made on the people and the country through which he travelled; there is a good map of the route.

The other narrative is quite equal in interest to that just referred to. It consists of extracts from a native explorer's narrative of his journey from Pítorágarh in Kumaon *viâ* Jumla to Tadum, and then down through Nepaul, along the Gandak River, to British territory. The explorer, who had to exercise much determination and ingenuity, took minute notes by the way of all he saw, and has added much to our knowledge of the geography, the people, and the products of a region comparatively unknown. He had to cross many rivers by the way, which was generally done by means of ropes suspended between the banks. The explorer wished to proceed much further than Tadum, which is a little beyond the Brahmaputra, in Great Thibet, but was prevented by the head man of the village. He started on July 1, 1873, and reached British territory again about the end of November, after having travelled nearly 500 miles. We have space to notice only one interesting phenomenon which he observed. At Muktináth, near Kágbeni, about 11,280 feet above the sea, in N. lat. 29° and E. long. 83° 45′, about 600 feet south of the temple, is a small mound with a little still water at its base, having a sulphurous smell. From a crevice in this mound, at the water's edge, rises a flame about a span above the surface. The people of the place told the explorer that the water sometimes increases in quantity sufficiently to flow into the crevice; the flames then disappear for a while, and there is a gurgling noise, a report, and the flames burst up and show again. This spot is called Chume Giarsa by the Bhots.

Our readers will see, from the cursory glance we have been able to take at this Report, that it contains much valuable matter apart from the immediate work of the Survey, the members of which are doing good service to India and to science.

THE BIOLOGICAL DEPARTMENT OF THE BRITISH MUSEUM

THE newly-issued Report of the condition and development of the British Museum has, so far as biologists are concerned, a special interest. Its results may be considered as an index of the public feeling on the importance of the study of Natural History. Looked at in this light, we think that specialists in all the departments may feel hopeful. The acquisitions to the Zoological Department have been numerous (30,699 in all), over 6,000 being Vertebrata, "the majority being either entir