THE YERKES OBSERVATORY.—From the University of Chicago we have received a brochure in which Prof. E. B. Frost gives a brief, detailed account of the establishment, equipment, and work of the Yerkes Observatory. Fourteen excellent reproductions of photographs of instruments, spectroheliograms, nebulæ, &c., illustrate the twenty-four pages of the booklet, and give the reader a very fair idea of the enormous activities and possibilities of the institution. One point which attracts our attention is Prof. Frost's emphasis of the necessity for having, in a modern astronomical observatory, well-equipped workshops wherein repairs and modifications of existing instruments may be executed, and new instruments constructed.

PROMINENCE OBSERVATIONS.—No. 6, vol. xxxviii., of the *Memorie della Società degli Spettroscopisti Italiani* contains Prof. Ricco's periodical summary of the Catania prominence observations, dealing with the first six months of 1908. Prominences were observed on ninety-three days during the six months, and 170 in the northern, and 247 in the southern, hemisphere were measured. The mean latitude for the two hemispheres was 27·5°, but, dividing the latitude, N. and S., into 10° steps, there were two maxima (lat. 10°–20° and 50°–60°) in the northern hemisphere and only one (20°–30°) in the southern.

SCIENTIFIC WORK IN INDIA.

THE annual report of the Board of Scientific Advice for India for the year 1907–8 has lately been issued by the Superintendent of Government Printing, Calcutta. The Board was constituted in 1902, and consisted originally of the heads of the meteorological, geological, botanical, forest, survey, agricultural, and veterinary departments, but the Government of India invites from time to time to serve upon it other men of science in the service of the imperial and provincial Governments. The Board is a central authority for the coordination of official scientific inquiry, intended to ensure that the work of research is distributed to the best advantage and the prevention of useless duplication of inquiries and lack of interdepartmental cooperation. The advice of the Board is given with the view of aiding the Government of India in prosecuting practical research into questions of economic and applied science on the solution of which the progressive prosperity of the country depends. The Board discusses annually the proposals of the head of each of the great departments in regard to the programme of investigation in his department, and submits each year a general programme of research to the Government. Its reports and programmes are communicated through the Secretary of State for India to the Royal Society, which has appointed an advisory committee to consider them.

The present report opens with a summary of the proceedings at the three meetings held during 1908, two at Calcutta and one at Simla. As indicative of the scope of the labours of the Board, some of the subjects discussed at the first meeting may be mentioned. The Board had under consideration the remarks of the Royal Society committee on the Board's report for 1905–6 and its programme for 1907–8. The subjects discussed included, among many others, the preparation of a hand-list of the species of the flora of India, economic and industrial chemistry, and the limits of the imperial mycologist's research work, the relations of the zoological section of the Indian Museum to other departments engaged in zoological research, and proposals for a special report on the progress of the Geological Survey.

The conclusions arrived at by the Board in these matters were as follows:—that, as regards the preparation of a hand-list of the flora of India, although its importance was recognised, lack of staff and the existence of more immediately necessary work precluded its preparation forthwith; that the consideration of economic and industrial chemistry and the work of the imperial mycologist should await the results of the discussion of the subjects by the Board of Agriculture for India; that reference should be made, so far as possible, to the zoological section of the Indian Museum by other departments engaged in zoological research; and that no officer was available for the increase of work that the preparation of a special report on the progress of the Geological Survey of India would necessitate.

Very full reports upon the work of the various scientific departments during the year 1907–8 then follow. Dr. J. W. Leather and Mr. D. Hooper deal with the work on industrial and agricultural chemistry, and Mr. Puran Singh with forest chemistry; Dr. G. T. Walker, F.R.S., with solar physics, meteorology, and terrestrial magnetism; Sir Thomas H. Holland, F.R.S., with geology; Colonel S. G. Burrard, F.R.S., with geodosy and geography; Messrs. W. W. Smith, A. Howard, E. J. Butler, and R. S. Hole with various branches of botany; Mr. A. M. F. Caccia and A. J. Gibson with forestry; Dr. N. Annandale and Messrs. H. Maxwell-Lefroy and E. P. Stebbing with zoological subjects; and Colonel H. T. Pease with veterinary science.

The programmes of work of the various scientific departments for the year 1908–9, as approved by the Board, constitute the next section of the volume, which concludes with an appendix by Dr. W. R. Dunstan, F.R.S., director of the Imperial Institute, describing the economic investigations conducted for India at the Imperial Institute during the year ended September 30, 1908.

The detailed programmes of work teem with particulars of investigations of great interest, but since the bare enumeration of the researches to be undertaken runs to twenty-seven large pages, it is possible here only to give an example or two. In meteorological work, a special endeavour is being made this year to secure meteorograph records of temperature and humidity up to great heights by means of small balloons. At four nearly equidistant periods between April and December batches of registering balloons have been, and are to be, liberated at some place in the west of the Punjab, and organised efforts made to recover as many as possible on descent. Each batch was to comprise, perhaps, ten complete units, the adjustment and liberation of which takes between a week and ten days. It was hoped to reach heights of 25,000 feet in the earlier experiments, and later in the year it is hoped to increase the heights at which the balloons are caused to descend until 50,000 feet has been reached. It is important to reach this height in order to see whether the isothermal zone, which has been almost invariably found at or near that level by sounding balloons in Europe, is to be encountered over India.

The new work to be undertaken by the Geological Survey provides another typical instance of the activity of scientific workers in India. The mapping of previously unsurveyed areas in the Amherst district of Lower Burma is being proceeded with, the geological map of the Raniganj coalfield is being revised in conjunction with a committee appointed by the Mining and Geological Institute of India, and the following pieces of work are in hand:—a survey of the ossiferous deposits of the Siwaliks and the Salt Range; an examination of copper-ore and associated sulphide-ore deposits in Sikkim; a survey of certain glaciers in Sikkim; and a study of the palæontology of (*a*) the Cretaceous rocks of Tibet, (*b*) the fossil fishes of the East Coast Gondwanas.

POSITION FINDING WITHOUT AN HORIZON.

WHEN about three years ago the first Gordon-Bennett balloon race was held, and several of the aëronauts descended precipitately on the north coast of France, believing they were approaching the Bay of Biscay, it seemed to me worth while to consider the possibility of designing an instrument by the aid of which observations could be taken so as to obtain even a rough idea of position. For this purpose the observation of the altitude and azimuth at any moment of a single star or of the sun will be sufficient to establish the locality, or the altitudes of two stars not in the same vertical plane with the observer will do as well.

If the observation is such that the error is as great as the diameter of the sun or moon, the resulting uncertainty of position will be a little more than thirty miles, and so in proportion. The observer will be, of course, on a circle on the earth described round the point where the star is in the zenith, the radius of which in nautical miles is equal to the zenith distance of the star expressed in minutes.

A search at the Patent Office library showed that a large number of inventors had for nautical purposes, rather than for use in balloons, imagined instruments which, for various reasons, would be impracticable. In some an attempt has been made to combine a sextant and a pendulum, but even if the observer were not expected to watch the star and the pendulum at the same time, the pendulum was made so short and of such quick period that the inevitable trembling of the hand would give rise to angular relative movement of the pendulum represented by several diameters of the sun. The beauty of the sextant is the property it possesses of gluing the two objects, *e.g.* the sun and horizon or moon and star, which are being observed together, so that with all the spasmodic movements which the magnification of the telescope and the unsteadiness of the hand make inevitable, the eye, nevertheless, can follow them and see if there is continuous close contact or not, whereas if the apparent position of one of the objects only depended upon the steadiness of the hand, no observation worthy of the name would be possible. It is therefore essential, if any approach to accuracy is required, that the star or sun should be seen in the same field with, and glued to, the mark, whatever form that may take, which determines the altitude, and also that the angular variation in the position of this mark should hardly be affected by the trembling of the hand. I tried at the time to interest one or two instrument makers, but unsuccessfully; now, however, that the subject is attracting attention in Germany, as shown by Dr. Lockyer's (vol. lxxx., p. 29) article in a recent number of NATURE, perhaps my design may be worth bringing forward. I would only remark that an instrument of the kind would be useful on board ship when the sun or stars may be visible while the sea horizon is obscured, provided only that, as is usual in fog, the ship is not rolling seriously. These worse conditions can only be met by the more complicated gyroscopic horizon perfected by Admiral Fleuriais.

The instrument depends essentially upon the use of a vertical collimator suspended on gimbals, and top-weighted like a metronome, so as to have a period of swing either way of as much as one second. The collimator has at its focus a scale of, say, tenths of a degree in transparent divisions upon an opaque ground, and above its lens a clear or half-silvered glass mirror set at 45° with the axis of the collimator. The collimator is suspended in a tube, which is the handle of the instrument, and which carries also the parts of a small sextant.

Figs. 1 and 2 are vertical sections through the axis of the instrument, the latter partly in elevation. *a* is a box frame to which are attached the tubular handle *b*, the telescope *c*, and other sextant parts. The telescope is carried by means of a slide *d* and pin *e*, so that it may be moved sideways or be hinged downwards when not in use. Inside the handle is mounted a gimbal ring *f*, on which the collimator *g* is supported on knife-edges *h*; *i* is the scale already described; *k* is the unsilvered mirror attached to the collimator, by means of which the scale *i*, illuminated by the mirror 7, may be seen in the telescope; *l* and *n* are the horizon and index glasses respectively of the sextant, but made as prisms for convenience, though, of course, the usual mirrors might be used; *r* is the top weight of the collimator; and *t* a correcting weight running on a screw to bring the zero of the scale *i* apparently on to the true horizon. A conical damper *u*, lined with velvet, is made to slide within the handle, being pressed upwards by a spring *v* so as to steady or even to lift the collimator off its *v*'s and against the pins 1, and capable of being moved downwards by the thumb-lever *x* and fork *y*. An exterior sleeve 5 carries a cap 8, which serves as a protector to the translucent window at the base of the handle, and as a holder also for the illuminating mirror 7; 3 is a quadrant carrying three dark or tinted glasses.

When the telescope is directly opposite the mirror *k* and the reflectors *l*, *m* of the sextant, the star will be seen by double reflection projected upon the scale, of which one half is marked + and the other −. The arm of the sextant being therefore set to any position to bring the star on to the scale, a series of scale readings may then be made, which, added to or subtracted from the vernier reading, give the series of altitudes. If the telescope is slid sideways so that half its field is to the right of the mirror *k*, it may be made to look into the object-glass end of a surveyor's level or even at the sea horizon with a known dip, and the zero of the scale tested and so adjusted by means of the moving weight *z*. At any time when a sea or artificial horizon is available, observations may be made as with an ordinary sextant with the telescope laterally displaced, and by this means also the index-glass may be adjusted.

I have experimented with a collimator and telescope mounted as described, and found that, without the top weight, the angular movement due to unsteadiness of the hand is far too great for accurate observation, but that when the period is increased to about one second by top-weighting, the angular movement is so far reduced that, when sitting at a table and holding the instrument in the hand, an accuracy of 1′ is possible. Of course, with the trembling of the hand the collimator turns about its centre of oscillation, and so with the period named a sudden movement of 1/100 inch will correspond to 1′ about, while if the period is two seconds the angular accuracy will be four times as great.

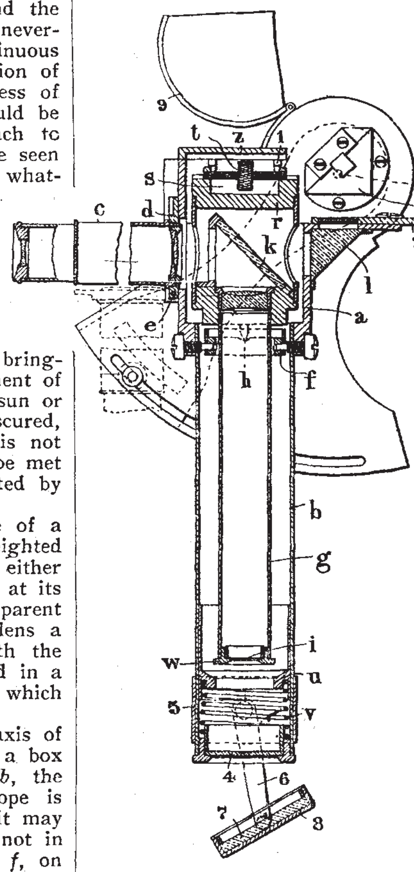

FIG. 1.

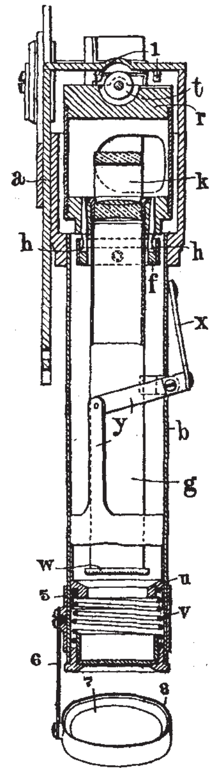

FIG. 2.

If used on a ship with any appreciable rolling it would be best to get down to the neutral axis, and observe zenith stars through a hatchway, so as to avoid the horizontal acceleration which is so pronounced on the bridge, for, of course, the collimator will hang, not in the true vertical, but at an angle equal to $\tan^{-1}\frac{\text{horizontal acceleration}}{g}$. If this is small the star may be observed to move a corresponding degree upon the scale in time with the rolling of the ship, and the successive elongations may be read off.

In a balloon, owing to the extreme quiet, I believe useful observations could be taken, more especially at those times at which it is not turning. I do not think it would be of any use on a flying machine in motion.

C. V. BOYS.

THE POSITION OF HIGHER EDUCATION.

THE higher education subcommittee of the education committee of the London County Council has had under consideration the relations which it is desirable should subsist between the University of London and other institutions of university rank in the metropolitan area and the London County Council. The subcommittee's report was presented to the education committee towards the end of May, and contains, not only a valuable *résumé* of the various steps taken by the late London Technical Education Board and by the Council itself to improve the supply of higher education in London, but also an important collection of statistics concerning the financial aid given by municipal and other authorities in the great provincial centres of population.

The subcommittee's report includes tables of grants made by other local education authorities to university education, the grants made by the Treasury in London and the provinces, and those provided by the London County Council. In London the grant from the Council is 48·6 per cent. of the Treasury grant, and in other towns the grant from the local authorities is 75 per cent. of the Treasury grant.

Grants made by Provincial Local Authorities to Universities and University Colleges.

	Treasury grant	Grants from Local Authority
Universities:	£	£
Birmingham	11,000	7,010
Leeds	11,0C0	14,456
Liverpool	13,050	14,650
Manchester	15,200	5,950
Sheffield	5,700	11,744
University Colleges:		
Bristol	4,750	532
Newcastle-upon-Tyne	6,750	2,890
Nottingham	5,800	4,340
Reading	3,950	1,800
Southampton	3,250	2,113
Aberystwyth	4,000	—
Bangor	4,000	—
Cardiff	4,000	4,712
Dundee	1,000	80
Total	£93,450	£70,277

London County Council Grants to University Education.

	Treasury grant	Council grant
	£	£
Bedford College	4,000	800
King's College	8,700	2,000
University College	10,000	1,500
London School of Economics	1,150	1,2C0
East London College	—	1,000
Imperial College of Science and Technology	20,000	5,C00
University of London	8,000	10,000
Extra Grants	—	3,720
Total	£51,850	£25,220

It is pointed out in the report that the various universities and university colleges have been successful in obtaining great assistance from generous donors, and that in such cases the receipt of State aid and financial help from the local authority does not seem to affect the flow of private benevolence. Thus Birmingham has received more than 256,000*l.* in this way; Leeds 380,000*l.*; Liverpool more than 188,000*l.*; Manchester more than 192,000*l.*; and Sheffield more than 229,000*l.*; while, in London, University College had received up to the date of the latest Government report 453,000*l.*; King's College 206,000*l.*; and Bedford College more than 29,000*l.* from private benefactions.

The subcommittee has given careful and sympathetic consideration to the applications received from certain London institutions of university rank for grants during the present year, and has come to the conclusion that more might be done in London for university education in consideration of the amount of the grant received from the Treasury and having regard to the rateable value of the county of London. In this connection the following table, abbreviated from one included in the report, is instructive:—

Town	Rate in £ necessary to raise grant to local University or University College	Amount obtainable from a similar rate in London
		£
Birmingham	0·498	92,672
Leeds	0·638	118,724
Liverpool	0·6027	112,162
Manchester	0·227	42,203
Sheffield	0·646	120,228
Bristol [1]	0·070	12,946
Newcastle-upon-Tyne	0·173	32,129
Nottingham	0·851	158,360
Reading	0·6033	112,288
Southampton	1·00	186,111
Aberystwyth	—	—
Bangor	—	—
Cardiff	0·977	181,840
Dundee	0·019	3,604
London	0·135	25,220

The table shows very clearly that if London made the same proportional provision for higher education that Cardiff does, the annual grant would be 181,840*l.* instead of 25,220*l.*; or 158,360*l.* if it applied the same fraction of the rate as Nottingham does for higher education.

It is of interest to pass from the comparison of rate-aid and State-aid for higher education in England and Wales made in this and the preceding tables to some facts relating to the position of the subject in other countries. By a fortunate circumstance, an exhaustive article by Prof. Guido H. Marx in the issue of *Science* for May 14 shows remarkable growth and spread of interest in higher education, and the consequent great increase in the number of young men and women pursuing advanced studies, and receiving higher scientific and other training, in various countries.

It is natural to look to Germany for significant educational movements, and Prof. Marx, dealing with the combined attendance at the twenty-two German universities, shows that prior to 1870 this attendance was fairly uniform, keeping regular pace with the population. Immediately after 1870 the increase of attendance grew much more rapidly than the population, and there is not the slightest tendency for the increase to fall off. At the beginning of the period of rapid development in 1870 there was in Germany one student in the institutions of higher education for every two thousand inhabitants, while in 1907 there was one such student to every thousand inhabitants.

In the case of the United States of America, the combined attendance at all the colleges, universities, scientific, technical, and professional schools—omitting preparatory departments—up to the year 1885 showed a condition of practical stability, but beginning with that year the ratio of these students to the population increased year by year, and at present indicates no signs of falling off. In 1885 there was one such student for every seven hundred inhabitants, and twenty years later one for every four hundred of population.

Several important deductions can be made from the following table, drawn up by Prof. Marx:—

[1] The Bristol Town Council has decided to devote the produce of 1*d.* rate (about 7 000*l.* a year) to university education.