the Future. Science will certainly go on, and scholarship and poetry will go on at its side and beneath its ægis. The "scientific use of the imagination" on which Tyndall, that most poetic man of science, discoursed so finely forty years ago will be balanced more and more by the imaginative use of science.

The famous epigram by Ptolemy, the author of the Ptolemaic system, with the Professor's version of it, may conclude the address:—

ΠΤΟΛΕΜΑΙΟΥ.

Οἶδ' ὅτι θνατὸς ἐγὼ καὶ ἐφάμερος· ἀλλ' ὅταν ἄστρων
μαστεύω πυκινὰς ἀμφιδρόμους ἕλικας
οὐκέτ' ἐπιψαύω γαίης ποσίν, ἀλλὰ παρ' αὐτῷ
Ζανὶ θεοτρεφέος πίμπλαμαι ἀμβροσίης.

I know that I am mortal, and doomed to fleeting days,
But when I track the circling stars in myriad-orbèd maze,
I tread the earth no more, but sit beside the Lord of Heaven,
And taste the ambrosial food whereby the life of Gods is given.

CIVIL SERVICE ESTIMATES FOR SCIENCE AND EDUCATION.

THE Estimates for Civil Services for the year ending March 31, 1913, are being issued as a series of Parliamentary Papers. The following particulars referring to the money under this vote to be devoted to scientific work and to higher education are taken from the paper entitled "Class IV. Education, Science, and Art."

Under the heading "Scientific Investigation, &c.," we find that the amount of the grants in aid for 1912–13 is 125,523*l.*, which represents a net increase over the total for 1911–12 of 61,920*l.* This considerable advance is explained largely by the increase of 29,500*l.* in the grant to the National Library of Wales and of 31,000*l.* to the National Museum of Wales.

The grants in aid enumerated under the heading of the Royal Society, and voted for scientific investigations and scientific publications, for the expenses of the Magnetic Observatory at Eskdalemuir, and for salaries and other general expenses of the National Physical Laboratory, remain as in 1911–12; the grant in aid of the expenses of the aëronautical section of the National Physical Laboratory, however, has been increased from 4885*l.* to 5775*l.* The total grants in aid under all these headings reach 23,775*l.*

The grant to the Meteorological Office has been increased from 16,850*l.* to 17,000*l.*, and that of the Royal Geographical Society from 500*l.* to 1250*l.* The Edinburgh University will receive 1728*l.*, as compared with 1508*l.* in 1911–12, and the International Seismic Association 370*l.*, as compared with 210*l.*

The Estimate for Universities and Colleges, Great Britain, and Intermediate Education, Wales, amounts to 314,200*l.*, an increase of 10,400*l.* over that for 1911–12. The total for universities and colleges is 287,000*l.*, an increase of 10,500*l.*, which all goes to Scottish universities.

The vote for Science and Art in Ireland reaches 138,591*l.*, as compared with 117,883*l.* in 1911–12, 30,600*l.* of the increase being accounted for by larger annual grants to schools and classes of science, art, and technical instruction. The estimate of the amount required for grants under the Irish Universities Act, 1908, is 130,000*l.*, or a decrease of 56,256*l.* on 1911–12.

The estimate of the amount required to pay the salaries and expenses of the Board of Education and of the establishments connected therewith is 14,504,765*l.*, allocated, so far as the chief items are concerned, as follows:—administration, 202,333*l.*; inspection and examination, 249,633*l.*; elementary schools, 11,832,235*l.*; training of teachers, 603,000*l.*; secondary education, 756,000*l.*; technical institutions, evening schools, &c., 621,800*l.*; universities in respect of technological work, 42,000*l.*; Imperial College of Science and Technology, 20,000*l.*; Science Museum, 18,018*l.*; Geological Museum, 3694*l.*; Geological Survey of Great Britain, 17,644*l.*; and Committee on Solar Physics, 2171*l.*

THE GYROSTATIC COMPASS AND PRACTICAL APPLICATIONS OF GYROSTATS.[1]

THE problem of a *practical* gyrostatic compass has attracted the attention of many, but the credit of being the *first* to produce a practical working instrument belongs to Dr. Anschütz, who, with those associated with him, has devoted some twelve years of patient work and no inconsiderable sum of money in experiments. Since then some important work has been done by Hartmann and Braun in Germany, and Mr. Sperry in America, details of which are not available.

Few people have any idea of the difficulties attending the installation and correct adjustment of a magnetic compass on board a large steel ship, and more particularly on a battleship or cruiser, so as to work surrounded by huge masses of steel, and in order to withstand the terrific shocks caused by the firing of heavy guns, and the problem would to-day be impossible had it not been for the theoretical work of Sir George Airy, the applied genius of Lord Kelvin, and the present practical improvements introduced by the superintendent of compasses at the Admiralty.

A magnetic needle can only point in the direction of the lines of magnetic force at the place where it is set up, and it is well known that there are very few places on the globe where the magnetic needle points true north and south.

Dr. Anschütz attacked the problem of a gyrostatic compass with enthusiasm, and has continued to work at it in the face of many and great disappointments with a thoroughness and patience which is characteristic of his nationality. The construction of the compass meant new designs for everything in connection with its motors, &c. His first experiments were with gyrostats suspended with the gyro free to move about its three principal axes, or, as it is termed, having three degrees of freedom; but it is easy to show how impossible it is to construct such a gyro so as to be sensitive to small movements, and yet really accurate in practice.

To make use of the gravity effect of the earth, Dr. Anschütz mounts his gyrostat in the form of a pendulum; as the earth rotates the gyrostat tends to maintain its plane of rotation parallel to its original plane in space. The earth's gravity acts against this tendency, and a precession results, the only position of equilibrium occurring when the gyro axis has set itself parallel with the axis of rotation of the earth.

In the actual compass the friction of the universal joint carrying the pendulum arrangement must be very small for the gyro to take an ultimate position with accuracy—the length of the pendulum, and hence the effect of gravity, must be small, so as to keep the compass free from disturbances—and therefore the precession is very slow, and the compass would swing to and fro on either side of the meridian indefinitely; its mean position would, it is true, be the true north and south line, but valueless for practical use.

[1] From a Discourse delivered at the Royal Institution on Friday, February 23, 1912, by Mr. G. K. B. Elphinstone.

The sizes, weights, and speeds chosen are such as to result in a compass having many times the directive force of a magnetic compass, and therefore responding to much smaller alterations of direction than can readily be observed with a magnetic compass. The compass itself being quite non-magnetic, can be put down under armour—in a position where a magnetic compass could work only with very special precautions and under grave difficulties. The action of the contact is to control a small electric motor, which moves a plate away from the contact on the card as soon as it touches it, and then the motor stops; the motor drives a transmitting device which controls as many receivers as are wanted in the ship.

The receivers are merely electrical counters, and can be put in any position; the small dials make one complete revolution for only 10° change of course, and these are geared after the manner of clock-hands to the outer dial, one turn of which corresponds to a turn of thirty-two points, or 360°; they are arranged to turn at a quicker rate than any large ship can turn in the water. The movement which the inner card makes, for a very small alteration of course, is considerable, and takes place instantly; and, owing to this fact, enormous improvement is possible in the steering of a large ship when the helmsmen have become used to the appearance of the dials.

Attention must be paid to the necessity of corrections which have to be applied to the readings of the compass.

The first correction is an interesting one, as it is not apparent at first sight; it is common to every form of gyrostatic device which takes the earth's rotation into consideration. If a ship with a gyro compass is steaming due east or due west, the ship's speed is added to the speed of rotation of the earth in space, or deducted from it. Suppose the ship steams due north, then the resultant travel of the ship in space is along the diagonal line, as it is moving from west to east by the earth's rotation, and south to north by its own steam. Therefore it is travelling in space about some axis which it sets its own axle and its N. and S. line on the compass card, parallel to which is not the north and south axis of the earth.

The speed of the ship, the course and the latitude, come into this correction, for which tables are made out, the maximum correction which has to be considered being some 3°; for all manœuvring this correction can be neglected.

The second correction which has to be taken into account is due to the existence of the air blast used in damping, the damping checking the precession whenever this takes place. The precession varies with the cosine of the angle latitude; the air blast is constant in its effects in all latitudes, depending only on the speed of rotation of the gyro—therefore there is a varying cause and a constant retarding force, and in consequence a varying result. The effect is that for every 10° of latitude a correction of about ½° has to be applied—½° in a distance of 600 miles.

The gyro compasses in use in the British navy are adjusted to be correct at 50° north latitude, so that for all cruising in the Channel and say up to the Firth of Forth, this correction does not require consideration.

Both these corrections can be treated arithmetically by adding to or deducting from the reading on the card the same quantity *all the way round*; it does not vary in different parts of the card, as is the case when applying a deviation correction to a magnetic compass reading.

The worst difficulty which the gyro compass is faced with is the effect produced by violent rolling or great vibration in a ship. This has been receiving a great amount of attention from the inventors during the last eighteen months, since practical experience at sea showed the necessity of some improvements in this respect. Fortunately the results of the investigations have led to considerable improvement, and to a complete cure of the trouble experienced in this way, so that it will shortly be possible for gyro compasses to be installed in ships which are quite independent of the rolling motion or vibration of the vessel.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

LONDON.—Two important benefactions were announced last week. The first is an offer of 100,000*l.* from an anonymous friend of the University, made through Lord Haldane as chairman of the Royal Commission on University Education in London, as a contribution towards the cost of acquiring the vacant site north of the British Museum for new University headquarters. This munificent offer, announced last Friday, was followed next day by an offer from the Drapers' Company to erect a Senate House and administrative offices at an approximate cost of 60,000*l.* The offer is not explicitly associated with the site mentioned above, but it is based on the report of the Royal Commission, which suggested a building such as is indicated, together with other buildings appropriate to the site, which is divided into four plots. The Drapers' Company stipulate that the other buildings are to be provided within a reasonable time. In connection with the gift of 100,000*l.*, a board of trustees has been formed, composed of Lord Haldane, representing the Government; Lord Milner, representing the Royal Commission; Lord Rosebery, representing the University; and Sir Francis Trippel. It is stated that the donor has already done a great deal for university education, and holds that the University of London ought to be the chief educational institution of the Empire.

GLASGOW.—The Vice-Chancellor, Sir Donald MacAlister, K.C.B., has been appointed by the University to represent it at the fifth jubilee festival of the Royal Society.

The centenary of the launch of the *Comet* as a passenger steamer on the Clyde is to be celebrated during the summer. Prof. Barr, of the chair of engineering, and Prof. Biles, of the Elder chair of naval architecture, are the University representatives on the centenary committee.

Mr. J. M. F. Drummond, appointed lecturer in botany, is to have special charge of plant physiology.

The fine collection of prehistoric antiquities recently displayed in the Glasgow National Exhibition has been deposited by Mr. Ludovic Mann in the Hunterian Museum.

Proposals are under consideration for the erection within the University of a monument of the famous Glasgow brothers, John and William Hunter, the latter of whom was the founder of the Hunterian Museum.

IT is announced in *Science* that gifts of more than 100,000*l.* to the University of California have just been secured through the will of the late Mrs. Jane K. Sather, of Oakland. Plans have been begun for the Sather Campanile, a lofty bell-tower, for which Mrs. Sather provided some 40,000*l.* Two professorships are endowed, and endowment is provided for three book funds.

DR. H. L. SMITH has accepted a call to the presidency of Washington and Lee University, Lexington, Virginia, and will probably enter upon the duties of