in the subdivision of the Centrechinoida (*olim* Diademoida). Here the characters of the jaws are used as the guiding features in the separation of three suborders.

The final part of the paper gives a complete survey of all Palæozoic Echinoids hitherto described, and, naturally, includes the description of several new genera and species. The completeness of the revision may be gauged from the fact that figures are given of all but four of the known species. The seventy-six plates accompanying the paper are partly photographic and partly diagrammatic, both alike admirably clear. A full bibliography and an adequate index bring to a fitting conclusion a work that must always remain a classic to echinologists, and a model to workers on other groups. H. L. H.

CHEMISTRY OF THE SUGARS.

PROF. EMIL FISCHER'S latest paper in the final part of the Berlin *Berichte* for 1912 brings another chapter in the chemistry of the sugars to a close. His welcome return to the subject has been attended with the same brilliant experimental dexterity which led to his former successes in this remarkable group of compounds, and it is to be hoped that he will yet succeed in conquering the still unsolved problem of the synthesis of the disaccharides. Fischer now describes the conversion of ordinary glucose into a methyl pentose, and is enabled to clear up the constitutional formulæ of the stereoisomeric methyl pentoses and effect their complete synthesis from the elements.

The methyl pentoses are a somewhat remarkable group of compounds; they represent sugars of the type of glucose in which one hydroxyl group is reduced so that $CH_2.OH$ is replaced by CH_3. At first their occurrence was rare and limited to a few coloured glucosides. Many more of these have been described recently, but the group is most widely represented amongst the seaweeds, the investigation of which we owe to Votoček. As a result of his work, several isomerides of rhamnose, the methyl pentose which was first discovered, are known.

Fischer started from a dibromo-derivative of glucose, discovered by Fischer and Armstrong ten years previously. The one bromine atom in this substance is attached to the carbon atom at one end of the chain of carbons which constitutes the skeleton of glucose; it is easily replaced by methoxyl and a glucosidic compound formed. The position of the second bromine was uncertain; there were reasons for considering it as attached to the other end of the chain. This position is now confirmed by the fact that when the bromine atom is reduced the glucoside of a methyl pentose is formed from which the methyl pentose is in turn obtained. The new sugar proves to be identical with a compound described by Votoček, and receives the name isorhamnose. Its configuration formula must be the same as that of glucose, and it is easy to deduce the formula of rhamnose and other members of the group.

A side issue of the research, which, however, possesses the very greatest interest, is the behaviour of the new glucoside of isorhamnose towards enzymes. Like the β-methyl glucoside, from which it is derived, it is hydrolysed by emulsin, though somewhat more slowly. Apparently the substitution of CH_3 for $CH_2.OH$ is not sufficient to put the compound out of harmony with the enzyme; this is what might be expected in view of Irvine's proof that tetramethyl-β-methyl glucoside is likewise hydrolysed by emulsin. It is therefore all the more remarkable that β-methyl xyloside, which differs only in that the CH_3 group is replaced by H, is not acted on by the enzyme in the very least.

A more striking proof of the selective nature of enzyme action could not well be desired, and the moment is opportune to emphasise this fact, since it is fundamental to the interpretation of vital phenomena. E. F. A.

GYROSTATS AND GYROSTATIC ACTION.[1]

WE are accustomed in daily life to handle non-rotating bodies, and their dynamical properties excite little attention, though it cannot be said that they are commonly understood. It is different, however, with rotating bodies. These, when handled, seem to be endowed with paradoxical, almost magical properties. I have here an egg-shaped piece of wood. I place it on the table and it rests, as we expect it to do, with its long axis horizontal. Our experience tells us that this is the natural and correct position of the body. But I set it spinning rapidly on the table, as you see, with the long axis horizontal, and you observe that after an apparently wobbling motion it erects itself so that its long axis is vertical. It was started spinning about a shortest axis, but the body has of itself changed the spin, and it is now turning about the long axis. In taking this position it has actually raised itself against gravity, through a height equal to half the difference between the lengths of the long and short axes. This seems paradoxical, but the man who is in the habit of spinning tops knows that this is the proper position of the body, that it must stand up in this way when spinning rapidly on a rough horizontal plane.

This experiment may be performed at the breakfast table with an egg as the spinning body. But the egg must be solid within—that is, it must be hard-boiled; a raw or soft-boiled egg will not spin. Perhaps this was why Columbus did not adopt this method for his celebrated experiment; there may, of course, have been other reasons.

It is thus made clear that by causing a body to rotate rapidly we endow it with new and strange properties. Between a top when spinning and the same top when not spinning there is a difference which reminds us of that between living and dead matter; and this will strike us still more forcibly when we consider some more complicated cases of rotational motion. The top, the ordinary spinning-top of the schoolboy, stands on its peg and "sleeps" in the upright position, in contempt of all the laws which govern statical equilibrium.

The experimental study of spinning-tops is carried on by very small boys and a few more or less aged people. Somehow, but I think quite wrongly, a top is regarded as a toy suitable only for a child, and that kind of amusement is scarcely encouraged by the benevolent despots who so completely direct the games of boys at school. Among older boys there used to be a regular game in Scotland of "peeries," and some of you may have read Clerk Maxwell's poetical description of the Homeric contests which distinguished the sport.

The top as a plaything is depised; nevertheless it is a most important contrivance. The earth on which we live is a top, and a considerable range of astronomical phenomena are most easily explained by reference to the behaviour of ordinary spinning-tops. It is a top that directs the dirigible torpedo, that controls the monorail car, which may soon rise from the posi-

[1] Discourse delivered at the Royal Institution on Friday, February 14, by Prof. Andrew Gray, F.R.S. The motor-gyrostats described are the invention of Dr. J. G. Gray and Mr. G. B. Burnside. The gyrostatic tops and combinations used in the latter part of the lecture are due to Dr. Gray.

tion of a small model to that of an important affair of practical railway engineering, and that in the gyrostatic compass gives a direction-pointer unaffected by the iron of the ship, or the rolling and pitching of the vessel. Its properties (summed up in what we call gyrostatic action) have to be reckoned with in all swift-running machinery, such as fast-speed turbines, and rotary engines of all kinds, especially if these drive flywheels or propellers. They affect very seriously the stability of aëroplanes, and even of submarines, and I am very doubtful if aviators have yet become in sufficient degree instinctively alive to the dangers of sudden turnings, such as those which are encouraged by the promoters of aviation displays in alighting competitions.

The man who has spun and studied tops and gyrostats appreciates as no one else can the extreme importance of properly balancing rotating machinery, and of avoiding gyrostatic action where such action is likely to interfere with the running of the machine as a whole.

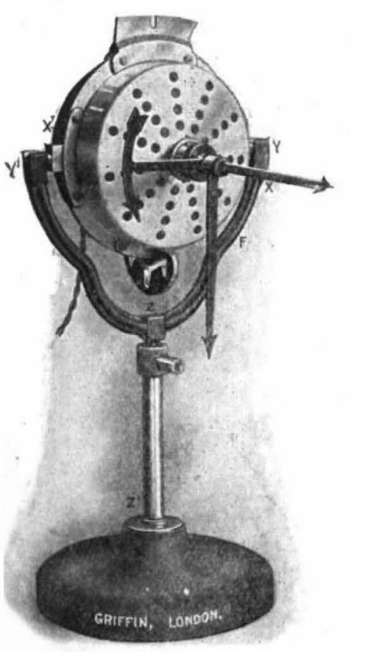

FIG. 1.—Motor-gyrostat in "fork and pedestal" mounting.

The properties of a top are best studied in the gyroscope, or gyrostat, as it is better called. Here is a simple gyrostat, of the ordinary form sold in the toyshops, but with some important modifications to enable it to run for a long time at a high speed. It consists, as you see, of a heavy-rimmed metal disc, or flywheel, capable of rotation with but little friction on pivots held in sockets attached to a metal frame. Thus the flywheel may, by the quick withdrawal of a string wound round its axle, or in some other way, be set into rapid rotation in the frame, which in turn is mounted in various ways to show gyrostatic effects. But this ordinary form, as well as some others of a more pretentious character, suffers from the great disadvantage of having no means of maintaining the spin, and the continual renewal of the spin is a great nuisance.

I have here a gyrostat (Fig. 1) in which this drawback has been overcome by the simple and effective device of making the flywheel itself the rotor of a high-speed continuous-current electric motor. The ordinary gramme-ring armature is well adapted for this. It gives a wheel of great moment of inertia, or, as I call it, "spin inertia" (that is, the matter of the wheel is distributed so as to be on the whole as distant from the axis as possible), which can be run at high speed for a long time without trouble of any kind from bearings or contacts.

For my first experiments the motor gyrostat is set up with the axis of the flywheel horizontal, in this mounting, which consists, as you see, of a fork perched on a pillar. Notice the possible motions, the freedoms, I may call them, of the arrangement. The flywheel can turn about its axle, the case can turn about the line of the pivots which carry it in the fork, and the fork about a vertical axis provided in the pillar. These three axles, which we shall number (1), (2), (3), are mutually at right angles and meet at the centre of gravity of the movable system or gyrostat proper. When thus set up the gyrostat is said to be freely mounted.

With the flywheel at rest I push down on one side of the case, and immediately turning takes place, as we should expect, about the axis (2). Pushing down the other side of the case causes the instrument to turn about the axis (2) in the opposite direction. I grasp the fork in my hands and turn it about the axle (3) in either direction. Nothing unexpected happens; the gyrostat turns with the fork, its axis remaining horizontal throughout. Again, I grasp the pillar in my hands and turn it on the table, and you see that the friction of the axle (3) is sufficient to cause the fork and gyrostat to move round with the pillar. As before, the axis of the flywheel remains horizontal.

My assistant now causes a current of electricity to flow in the coils which form part of the flywheel and in the coils which surround the soft iron core of the magnet which is stationary within the ring. So far you can only tell that the flywheel is turning by the faint hum which its motion sets up. But when I repeat the operations which I have just performed on the non-rotating gyrostat, the behaviour of the instrument is quite startlingly different. I push down on one side of the case as before; a resisting force is experienced, and the gyrostat turns, not visibly about the axle (2), but about (3), the vertical axis. So long as I maintain the tilting force so long does the resistance and this turning about the vertical persist. I withdraw the tilting force, and the turning motion ceases.

Now I would direct attention to these rods with arrow-heads, which are screwed to the gyrostat case. This curved one shows the direction in which the flywheel is spinning. The straight rods are intended to represent the spin-momentum and the tilting action respectively. Both are completely known when their amounts and their planes are known. The spin-momentum is got by multiplying two numbers together, one representing the spin-inertia of the wheel (which is greater the more the mass is placed in the rim), the other the speed of turning. The turning action or "couple" is also got by multiplying the force with which I push by the arm or leverage of the force about the axis. So then we represent these two by lines drawn at right angles to the two planes, making the lines of lengths to represent the two products. Standing on one side of the plane of the flywheel, you see it turning against the hands of a clock; standing on one side of the plane of the turning action I apply you observe that action tending to turn the body also against the hands of a clock. The two lines representing the two products drawn towards you from the two planes represent also the directions of the turning actions of the couples. For example, the direction of rotation of the flywheel being that shown by the curved rod, the line representing the spin-momentum points outwards from the side of the gyrostat to which the rods are attached. I call this the *spin-axis*. The other line representing the turning action which I applied I call the *couple-axis*.

Now observe that I set the couple-axis so as to point toward your left. I push down the side of the gyrostat nearest me, and you see that the spin-axis turns towards the left. Again, I turn the couple-axis so as to point to your right. When so placed it represents a turning action tending to depress the end of the axle of the flywheel that is nearest you. I apply such an action and the spin-axis turns towards your right. In both cases the spin-axis turned towards the instantaneous position of the couple-axis.

Now I set the couple-axis vertical, pointing up. It

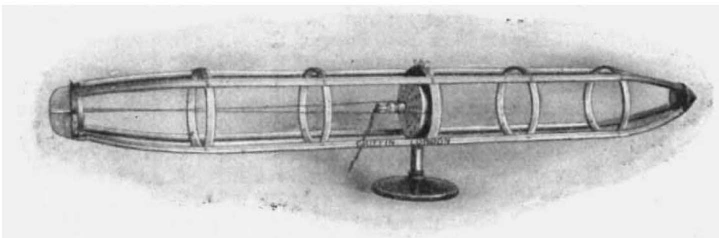

FIG. 2.—Motor-gyrostat mounted to demonstrate the principle of the dirigible torpedo.

represents a turning action tending to produce horizontal turning in the counter-clock direction as seen from above. I apply such an action to the fork, when you see that the gyrostat turns the spin-axis towards the upward direction. Finally, I set the couple-axis vertical but pointing down, as in Fig. 1. It now represents a turning action tending to produce clockwise rotation as viewed from above, counter-clock rotation as seen from below. I apply the action represented and the gyrostat turns the spin-axis towards the downward direction.

These experiments may be summed up as follows:—The flywheel is spinning about axis (1). Any attempt to tilt the gyrostat about axis (2) produces turning about (3); an attempt to tilt it about (3) produces turning about (2). This response of the body seems paradoxical, but in point of fact, and this is the secret of the whole affair, *this turning of the body as a whole amounts to the production of spin-momentum about the couple-axis at exactly the proper rate.* It is quite easy to prove this by the consideration, in the most elementary way, of the accelerations of the different particles composing the wheel.

The turning of the spin-axis towards the couple-axis is called a precessional motion, from a similar motion of the earth which produces the astronomical phenomenon called the precession of the equinoxes. The turning action, or couple, as I shall now call it, may be said to cause the flywheel to "precess" towards the couple-axis. This relation of directions is very important, and should be kept always in mind.

If this turning response of the body, about an axis which we shall call (3), is prevented when turning about an axis (2), at right angles to (3), is changing the direction of the axis of a rotor—an axis (1), say, at right angles to (2) and (3)—a preventing couple, usually called *gyrostatic,* about the axis (3), must be applied by the bearings to the axle of the rotor, and therefore an equal and opposite couple by the axle to the bearings. This couple, it is easy to prove, is equal to the product of the spin-momentum and the angular speed at which the direction of the axis of the rotor is being changed. Thus the greater the moment of inertia of the rotor, or its angular speed, or the angular speed of the change of direction of the axis, the greater is the gyrostatic couple.

For example, the rotor of a dynamo, mounted on one of the decks with its rotor-axis athwart ship, applies, when the ship rolls, a couple to the bearings, the plane of which is parallel to the deck, and which consists of a forward force on one bearing and a sternward force on the other. These forces are reversed with reversal of the direction of rolling, so that an alternating force is applied to each bearing tending to shear it off the deck. Thus if the bearings are at all loose, the axle will knock alternately on the front and back of each bearing.

Similarly the axle of the rotor of a fore-and-aft turbine, when the ship pitches, applies a force to port to the bearing at one end, and a force to starboard at the other end, which forces are reversed when the direction of the pitching motion is reversed. When the course is being changed the forces of the gyrostatic couple are applied to the top of one bearing and the bottom of the other.

Now, returning to the pillar-gyrostat, and putting the flywheel in rapid rotation, I turn the pillar round on the table. I have turned, as you see, the base round through one revolution, and throughout the turning motion the axle of the flywheel has remained pointing in the same direction. The friction at the axle about which I have turned the pillar, which, you will remember, was sufficient to carry the gyrostat round when there was no spin, is now quite insufficient to cause any serious change of position of the gyrostat. Only a very small couple producing precession acted.

This experiment illustrates the principle of permanence of direction of the axis of rotation, in the absence of a couple producing precession, the principle on which depend the gyrostatic compass and the self-directing torpedo. Carried within the body of the torpedo is a fast-spinning gyrostat, and at the instant at which the torpedo leaves the impulse-tube this gyrostat is mounted freely with its axis coincident with that of the torpedo—that is pointed, so to speak, exactly along the "cigar." Any turning of the torpedo body sideways brings about a relative shift between the gyrostat and torpedo axes, and this shift brings into operation a vertical rudder at the stern of the torpedo. If the nose of the torpedo turns to port, the rudder steers the craft to starboard, and *vice versâ.*

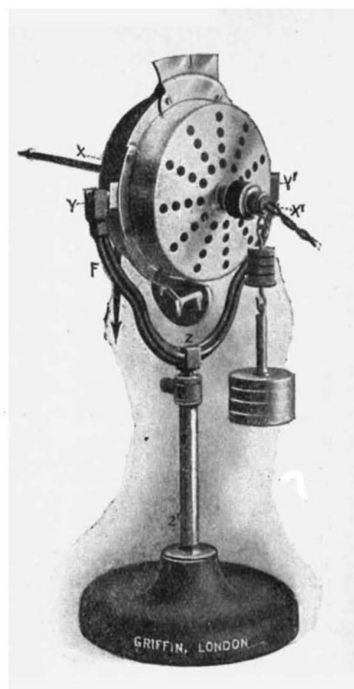

FIG. 3.—Motor-gyrostat in pedestal, with weight attached.

Here (Fig. 2) is a skeleton frame representing a torpedo. It is mounted on a vertical axle, and carried on pivots within the structure is one of our motor-gyrostats. At the stern of the frame is a small rudder, and this is connected by means of cords to the gyrostat. I set the flywheel in rotation. When, as I do now, I turn the nose of the torpedo to port, the rudder steers to starboard; when I turn the nose to starboard the rudder steers the craft to port.

The case of the pedestal gyrostat is provided with a hook at one extremity of the axis (see Fig. 3). The effect of hanging a weight on this hook is to apply a couple tending to cause turning about the axis (2)—that is, which would produce such turning if the fly-wheel were not spinning. But the wheel is spinning, and the visible actual turning is about the axis (3). Observe also that the wheel is rotating comparatively slowly, and that the precessional motion is great. I increase the speed of the flywheel and the gyrostat precesses more slowly. I replace the weight by a larger one, and for the same spin the precessional motion is greatly increased. Thus for a given applied couple the faster the spin the slower the precessional motion, and for a given spin the greater the couple the faster the precessional motion.

Now while the weight is in position and the gyrostat precessing about the axle (3) I attempt to hurry the precessional motion, and immediately the gyrostat turns about the axis (2) so as to *rise* against gravity. I try to delay the precession, and again the gyrostat turns about the axis (2), but now so as to descend under gravity.

Without being aware of it people are constantly meeting with examples of gyrostatic action in daily life. A child expert in trundling a hoop causes it to turn its path to the right or left, by striking it a blow at the top with the hoop stick, the effect of which the ordinary person would suppose, if he thought about it, should be to make the hoop to fall over to the right or the left. A bicyclist riding without holding the handles leans over to the right if he wants to steer the bicycle to the right, and to the left if he wants to steer to the left. And if he feels himself falling over to right or left he turns the handles instinctively so as to turn the bicycle to that side, when the machine resumes the upright position. In the bicycle, however, the spin of the wheels is not the most important action to be taken account of.

The gyrostatic action in the bicycle is much more marked in a motor machine, for in that a massive flywheel rotates in the same direction as the wheels. As the bicycle turns a corner it is constrained to precess, and a couple is needed to produce this precession of the rotating parts quite apart from that required to turn the rest of the machine. This the rider applies by leaning over to the *inside* of the turn, and leans over more than he would have to do if the flywheel were not there or were not rotating.

Good examples of gyrostatic action are given by paddle and turbine steamers. A paddle steamer is steadier in a cross-sea than a screw steamer of the same size. This is due in part to the gyrostatic action of the paddle-wheels, which, but for their comparatively slow speed of rotation, would form a compound gyrostat of considerable power. For this gyrostat the spin-momentum may be conveniently represented by a line drawn from the steamer towards the port-side. A couple tending to tilt the steamer over to starboard is represented by a line drawn towards the bow, and a couple tending to tilt the steamer to port by a line drawn towards the stern. Hence, if the steamer heels over to starboard, her bow, in consequence of gyrostatic action, precesses to starboard, but the starboard wheel, becoming somewhat more deeply immersed, uses more power and exerts a turning influence to port. Thus the steersman has less difficulty in keeping the vessel on a straight course.

But if the vessel be turned by the rudder, say to port, the vessel will by gyrostatic action be slightly heeled over to starboard, and the starboard wheel, being more deeply immersed, will assist the turning action of the rudder.

Though the gyrostatic action of the wheels is not very great, calculation shows that it is enough to produce an appreciable variation in the immersion of the wheels.

The gyrostatic action of the flywheel in a motor-car is of some practical interest. The flywheel is placed with its plane athwart the car—that is, with the axis, so to speak, fore and aft. It rotates in the clockwise direction as viewed by an observer behind the car. The effect of turning a corner to the left gives a gyrostatic couple, throwing the weight of the car more on the back wheels; turning to the right throws the weight more on the front wheels. The forces applied by the ground to the front wheels are diminished in the former case and increased in the latter. There is danger, therefore, of the steering power of the car being interfered with, if the corner is taken at too great a speed.

As a final example, we take an aëroplane. Here the rotor of the engine and the propeller together form a compound gyrostat of considerable power. As the bearings are fore and aft, the action is similar to that of the flywheel of the motor-car. Turning horizontally in one direction gives rise to a gyrostatic couple tending to make the aëroplane dive, turning the opposite way sets up a couple which makes the aëroplane rear up in front. If the aëroplane is kept horizontal such couples have to be balanced by stresses in the framework. These considerations show that sudden turning of aëroplanes should, if possible, be avoided. Manœuvres calling for such turning are accompanied by very considerable danger. No doubt aviators are aware of the existence of gyrostatic action, but there is considerable haziness in people's minds as to its direction in the various possible cases. The peculiar properties of rotating bodies need not, of course, be understood theoretically by aviators, though it is well to know something about them. But the aviator, like a person walking or swimming, must know instinctively what to do in an emergency, and what motions must be avoided. The gyrostatic action he has to contend with lies hid, as it were, until he tries some new and violent manœuvre; and then it brings him to grief.

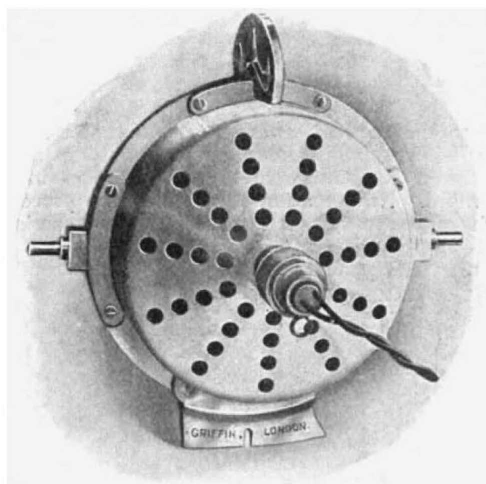

FIG. 4.—Motor-gyrostat balancing on a skate.

I now pass on to some special experiments which can be carried out with these motor-gyrostats. First take one or two old experiments (see Thomson and Tait's "Natural Philosophy," § 345^{x} *et seq.*), which are more effectively performed with these fast-running instruments. Here is a skate attachment (Fig. 4) on which I place the gyrostat after its speed has been adjusted to the moderate value of about 6000 revolutions per minute. The plane of the flywheel is inclined to the vertical, and you see that the top does not fall down, but precesses round on the table. I increase the inclination and the precession becomes more rapid. Now I attempt to hurry the precession, and the gyrostat stands up erect; I try to resist the precession and the gyrostat falls over.

FIG. 5.—Motor-gyrostat on gimbals.

I mount the gyrostat with its wheel horizontal over a flexible support, in the present case a universal joint (Fig. 5). Without rotation the instrument would fall over at once, but you see that it stands stably erect when the flywheel is spinning, and has a precessional motion when disturbed from the upright position.

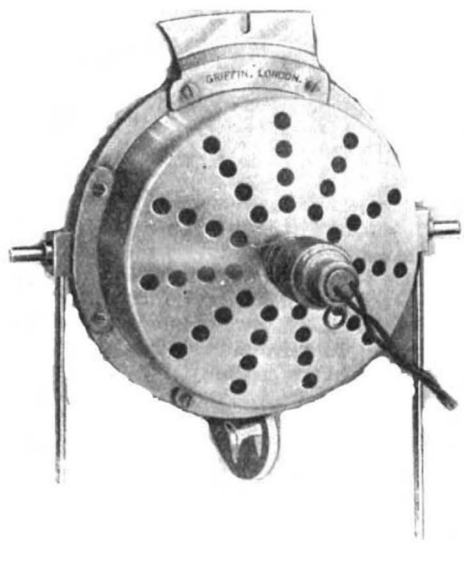

FIG. 6.—Motor-gyrostat balancing on stilts.

Again, here is a two-stilt support (Fig. 6). One of the stilts is held by a long socket, at one side of the case, and may be regarded as rigidly attached. The other stilt is simply a bit of wire pointed at both ends; one end rests on the table, the other, the upper end, rests loosely in a hollow in the under-side of this projecting piece attached to the case. The gyrostat is thus supported between two stilts, one fixed the other quite loose, and its axis is at right angles to the plane of these when the arrangement stands upright. It would be hard to devise a more unstable support. You see that there is no possibility of making the arrangement stand up without spin. But you see, on the other hand, that there is a fair amount of stability with the flywheel spinning if the arrangement is allowed to oscillate, or, as one might say, wriggle, backwards and forwards, horizontally.

In the next experiment (due originally, I have been told, to the late Prof. Blackburn) the gyrostat is rigidly clamped to this metal bar, which, as you see, is hung by two chains attached to its ends. The chains have been crossed by passing one through a large ring in the middle of the other. I turn the gyrostat so that the chains and the rim of the case are in the vertical plane. You observe that the arrangement is one of instability. The gyrostat has perfect freedom to fall over towards you, or towards me. Further, in consequence of the crossing of the chains the gyrostat is unstable as regards motion about a vertical axis. The arrangement is thus doubly unstable without rotation.

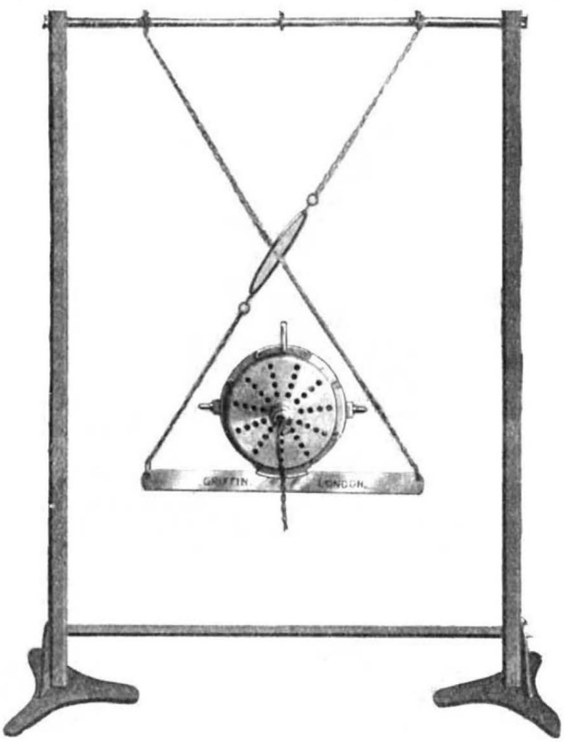

FIG. 7.—Motor-gyrostat on crossed bifilar support.

I now set the flywheel into rapid rotation, arrange the instrument as before, and leave it to itself, when, as you observe, it balances with great ease.

I now repeat the experiment with the chains uncrossed. Here there is only one instability without rotation, and you observe that the gyrostat falls over. An important point to be observed here is that the rotation will completely stabilise two non-rotational instabilities but not one. In point of fact, a system possessing non-rotational freedoms, all of which are unstable, can be completely stabilised if the number of freedoms is even, but not if the number is odd.

A general explanation of the experiment just performed may be given, as follows. Starting with the bar, gyrostat rim, and chains (crossed) in one vertical plane, we may suppose the gyrostat to fall over slightly. In consequence of the tilting couple introduced the gyrostat precesses so that its axis turns in a plane which is nearly horizontal. The chains now get slightly out of the vertical, and at once a couple hurrying the precessional motion is brought to bear on the gyrostat, which, in consequence, erects itself into the vertical position. The couple does not retard but hurries the precession because the chains are crossed. This holds for both directions in which it is possible for the gyrostat to fall over. Again, suppose, starting with the rim, bar, and chain in the same vertical plane, the chains get out of the vertical. There is now a couple brought to bear on the gyrostat tending to turn its axis in a horizontal plane. In consequence the gyrostat tilts over on the bar—in other words, it has a precessional motion about a horizontal axis in the plane of the flywheel. This brings into action a couple due to gravity, which is such as to hurry the last-mentioned precessional motion; the horizontal motion is opposed and reversed, and with the reversal the gyrostat regains the upright position. This holds for both directions in which the bar tends to turn in consequence of the crossed chains. The result is complete stability.

Similar explanations are applicable to the other cases of motion you have seen.

(*To be continued.*)

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

THE foundation-stone of the new building of the agricultural department at Armstrong College, Newcastle-upon-Tyne, was laid on April 5, by Dr. C. Stephenson, of Newcastle, whose gift of 5000*l.* enabled the college council to cooperate with the Board of Agriculture in a scheme proposed by the Development Commissioners. The new block of buildings has three floors, and includes administrative offices, class-rooms, laboratories for botany and zoology, a museum, research laboratories, &c.

IT is proposed to hold a short spring holiday course in science at the University of Leeds on Thursday, Friday, and Saturday, April 24, 25, and 26. The course is designed primarily for teachers who wish to keep in touch with modern scientific work, but it will also afford an opportunity for all who are interested to meet and discuss among themselves, and with members of the University staff, the problems which arise in their teaching and research. In the department of physics Prof. Bragg will give three lectures on radioactivity and its lessons, Dr. N. R. Campbell two lectures on the electron theory, Mr. A. O. Allen one lecture on modern technical optics, and Mr. S. A. Shorter one lecture on capillarity. In the department of chemistry Dr. H. M. Dawson will give three lectures on recent work in physical chemistry. The fee for the course is 10*s.*, but graduates of the University of Leeds will be admitted free.

A DEPUTATION urging the views expressed at the recent Eugenic Education Conference was received by Mr. Trevelyan, Parliamentary Secretary of the Board of Education, on April 2. Among the speakers were Major L. Darwin, president of the Eugenics Education Society, and the Headmaster of Eton. The deputation presented the following resolution, which was passed at the conference:—"That the Minister of Education be asked to receive a deputation requesting an inquiry as to the advisability of encouraging the presentation of the idea of racial responsibility to students in training, and children at school." It was indicated that there is no idea of advocating the addition of "eugenics" as an extra subject in the curriculum, or of requiring it to be taught by unwilling teachers. It was urged that if the idea of individual racial responsibility were inculcated by means of presenting the eugenic ideal, and the subject approached from the evolutionary point of view, it would both assist the teachers and tend to strengthen the moral tone of the country; and also that the training-college curriculum should be adapted to include the necessary biological and physiological knowledge on which the eugenic ideal can be based. Mr. Trevelyan expressed his sympathy with the general objects which the deputation put before him. He said the Board of Education has no wish to discourage any experiments in teaching on these lines, and recognises the importance of the matter, and will consider carefully the representations made by the deputation.

AT a meeting of the Society of Engineers (Incorporated), held on Monday, April 7, Mr. W. Ransom read a paper on how to improve the status of engineers and engineering, with special reference to consulting engineers. He pointed out that the civilisation of to-day has become possible only because of the efforts of the engineer, but that the public does not sufficiently appreciate the advantages it has gained or the men whose work has secured these advantages. Engineers have many lessons to learn from the legal and medical professions, both of which exclude unqualified men and exercise a benevolent professional control over their members; and the State should recognise the engineering profession by giving it an official standing equal to that of other professions. Admission to the profession requires to be carefully guarded, and the number of pupils allowed to an engineer should be regulated by the extent of his practice, while the climax of the period of pupilage should be a State examination. Much more may be done to make examinations of practical value to those who prepare for them, but no other form of test is possible. When State recognition is obtained for engineers, the members of the profession will constitute one great society, amalgamating the existing societies into one body, which should have the control of professional matters and be the mouthpiece of the profession. Such a society would necessarily have subsections dealing with special branches of the profession. While the growth of specialisation must be recognised, it is essential for those who are training for the profession to acquire a sound general scientific knowledge before beginning to specialise.

THE following are among the courses of advanced lectures upon scientific subjects announced in the *London University Gazette of April* 2:—Six lectures on the activities of plants in relation to light, at Bedford College, by Harold W. T. Wager, F.R.S., on April 28, May 5, 19, 26, June 2 and 9; three lectures on geological problems of the desert, at University College, by Dr. J. Walther, professor of geology in the University of Halle, on April 23, 24, and 25; eight lectures on surface tension and physiological processes, by Prof. A. B. Macallum, F.R.S., at the