

in the subdivision of the Centrechinoidea (*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  $\text{CH}_2\text{OH}$  is replaced by  $\text{CH}_3$ . 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  $\beta$ -methyl glucoside, from which it is derived, it is hydrolysed by emulsin, though somewhat more slowly. Apparently the substitution of  $\text{CH}_3$  for  $\text{CH}_2\text{OH}$  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- $\beta$ -methyl glucoside is likewise hydrolysed by emulsin. It is therefore all the more remarkable that  $\beta$ -methyl xyloside, which differs only in that the  $\text{CH}_3$  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.<sup>1</sup>

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-

<sup>1</sup> 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.