

which, at the request of the Society of Apothecaries, the Commissioners had drawn up for the future government of the Chelsea Physic Garden, in the ownership of which the Royal Society had by the deed of grant of Sir Hans Sloane, a reversionary interest. The Council appointed a Committee to consider the Charity Commissioners' scheme, and this Committee having reported to the Council in favour of the scheme, with certain amendments which the Charity Commissioners expressed their willingness to adopt, the Council have concurred in the scheme, which provides for the maintenance of the Garden, under the Charitable Trusts Acts, for the purposes of botanical study, and gives to the Royal Society, among other Institutions, a representation upon the Committee of Management.

"PRIVILEGED" CANDIDATES FOR FELLOWSHIP.

The attention of the Council having been drawn to the regulations governing the election of Fellows under privileged conditions, a Committee was appointed early in the year to consider whether any alteration in them would be desirable. The Committee have duly reported, and, in accordance with their report, the Council have under consideration a modification of the Statutes, enabling the Council to recommend to the Society for election persons who either are Members of Her Majesty's Privy Council, or have rendered signal service to the cause of science, provided that not more than three such persons shall be elected in any one year, the persons so recommended to be selected by the Council by ballot in accordance with a procedure to be established by Standing Orders of Council. The Standing Orders which the Council propose to make correspond in the main with the procedure for the adjudication of the medals, but are still more stringent in character.

In the evening the Fellows and their friends dined together at the Whitehall Rooms.

STEREOCHEMISTRY AND PHYSIOLOGY.

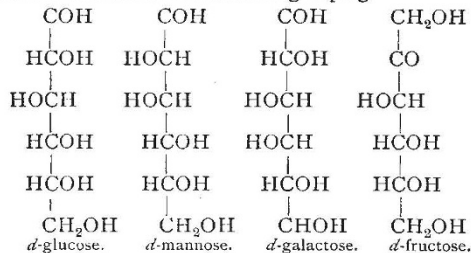
IN a recent number of the *Zeitschrift für physiologische Chemie*, Prof. Emil Fischer has reviewed the facts by which, in conjunction with Thierfelder, he has sought to explain the selective action exhibited by the enzymes either in effecting fermentation or in producing hydrolysis.

Pasteur was the first to show that a solution of racemic acid becomes *lavo-rotatory* in presence of *penicillium*, owing to the destruction of the *dextro-tartaric acid* by the fungus—an observation which has been frequently utilised in the attempt to isolate one of the optically active constituents of a racemic compound.

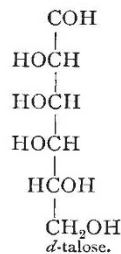
Configuration and Alcoholic Fermentation.—This selective action is exhibited in a very marked degree by the beer yeasts in producing fermentation of the carbohydrates. Of the eleven known aldohexoses (glucose type) only the three natural products are fermentable, viz. *dextro-glucose*, *dextro-mannose* and *dextro-galactose*, and of the ketohexoses only *dextro-fructose* is decomposed.

All the yeasts susceptible of inducing fermentation transform *dextro-glucose*, *mannose* and *fructose* with about equal velocity; but the action of yeast on *dextro-galactose* is slower, and certain species—*Saccharomyces apiculatus* and *productivus*—are totally without action upon it.

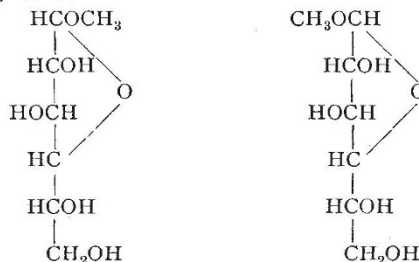
A comparison of the configuration of these four sugars will exhibit the differences in molecular grouping.



In glucose, mannose and fructose the grouping of the H and OH round the three lower asymmetric carbon atoms is the same, but differs from that of galactose, a fact which may account for the slower fermentive action of the latter. The other hexoses are not fermentable. The small difference in configuration which suffices to arrest the action is seen in the case of *d*-talose, which only differs from *d*-galactose by the position of one hydroxyl group.



Configuration and Zymolysis of the Glucosides.—By the combination of glucose with methyl alcohol, to form methyl glucoside, a new asymmetric carbon atom is created, and consequently two stereo-isomeric derivatives are possible. E. Fischer has obtained from *d*-glucose both modifications, which he terms α and β methyl *d*-glucosides, also the corresponding α and β methyl *l*-glucosides and similar products from the other aldoses. Fischer has allotted to the α and β methyl *d*-glucosides the following formulae.



An aqueous solution of the emulsin of bitter almonds hydrolyses the β modification, but has not the least action on the α modification. Exactly the reverse happens with an aqueous extract of dry yeast. In this case the α compound is hydrolysed, whilst the β modification remains unchanged. The ethyl and phenyl glucosides, which are only known in one modification, behave like the α methyl compound, and probably belong to the same category. Neither emulsion nor yeast affect the two methyl *l*-glucosides.

D-galactose forms two methyl derivatives, one of which is attacked by emulsin and the other by the enzyme of yeast, but more slowly than the corresponding glucosides, the difference in rate corresponding with that observed in fermentation. Neither methyl *d*-mannoside nor methyl *l*-mannoside is attacked by emulsin or the enzyme of yeast. The second *d*-mannoside, which would probably be hydrolysed by one or the other ferment, is still unknown. The pentoses and heptoses are non-fermentable, and their methyl glucosides are likewise indifferent to both enzymes.

The following is a list of natural and artificial glucosides. The action of the enzyme is denoted by a + when it produces hydrolysis and by a - when it is without action.

	Artificial glucosides.	Emulsin.	Enzyme of yeast.	
Aldoses.	Hexosides.	α methyl <i>d</i> -glucoside ...	-	+
		β methyl <i>d</i> -glucoside ...	+	-
		α methyl <i>l</i> -glucoside ...	-	-
		β methyl <i>l</i> -glucoside ...	-	-
		α ethyl <i>d</i> -glucoside ...	-	-
		phenyl <i>d</i> -glucoside ...	+	-
		α methyl <i>d</i> -galactoside ...	-	+
		β methyl <i>d</i> -galactoside ...	+	-
		methyl <i>d</i> -mannoside ...	-	-
		methyl <i>l</i> -mannoside ...	-	-
		methyl arabinoside ...	-	-
		α methyl xyloside ...	-	-
		β methyl xyloside ...	-	-
		methyl rhamnoside ...	-	-
methyl gluco-heptoside ...	-	-		
Ketosides.	{	methyl sorboside ...	-	-
		methyl fructoside (not crystallised) ...	-	+

Natural glucosides.				Emulsin.	Enzyme of yeast.
Simple derivatives of glucose	Salicin	...	...	+	-
	Helicin	...	...	+	-
	Æsculin	...	...	+	-
	Arbutin	...	...	+	-
	Coniferin	...	...	+	-
	Phylbyrin	...	...	-	-
	Aprin	...	...	-	-
	Syringin	...	...	+	-
	Saponin	...	...	-	-
	Phloridzin	...	...	-	-
	Glucoside of mandelic nitrile	...	...	+	-
	Amygdalin	...	...	+	-
	Quercitrin	...	...	-	+

It would appear that the natural glucosides, which are for the most part phenol derivatives, probably belong to the group of β -glucosides. The indifference of some of these glucose derivatives to both enzymes is at present unexplained.

Configuration and Zymolysis of the Polysaccharoses.—The recent researches of E. Fischer on the hydrolysis of the polysaccharoses point to the fact that none of these carbohydrates is directly fermentable by the enzyme of yeast, but that without exception they first undergo hydrolysis by a hydrolytic enzyme associated with the ferment. The di-saccharoses—cane sugar, maltose, milk sugar, melibiose, trehalose, &c.—are anhydrides formed by the union of two hexoses. The structural formulæ of maltose and lactose are probably identical, seeing that each splits up on hydrolysis into two molecules of aldohexose, but since maltose yields only glucose, whereas lactose forms an equal number of molecules of glucose and galactose, the two compounds must be regarded as stereoisomeric. They probably correspond, too, with the α -methyl- and β -methyl-dextroglucoside, for emulsin hydrolyses lactose, but not maltose; whereas the enzyme of yeast produces the reverse effect.

Without discussing in detail the ingenious methods by which Prof. Fischer has successfully attacked the problem of the hydrolysis of the polysaccharoses, the following results may be briefly recorded.

The action of invertase, an enzyme which accompanies beer yeast, in hydrolysing cane sugar into glucose and fructose previous to fermentation, was first observed by O'Sullivan, and although Bourquelot and Lintner recorded a similar decomposition in the case of maltose, the experiments were not decisive. Fischer, however, extracted with water from dry yeast an enzyme which, unlike invertase, hydrolyses maltose, and which he has therefore named maltase of yeast. Instead of the aqueous extract, the dry yeast itself may be employed; in which case a little toluene must be added to the maltose solution to arrest the alcoholic fermentation.

The conclusion may be drawn that yeasts incapable of inducing alcoholic fermentation of cane sugar and maltose are destitute of invertase and maltase. This conclusion has been fully corroborated by subsequent experience.

Kephir grains and the yeast which ferments milk sugar do not ferment maltose, and are also without hydrolytic action upon it.

Saccharomyces martianus, which according to Hansen does not ferment maltose, does not hydrolyse it, and is therefore free from maltase. Beyerinck's *Schizosaccharomyces octosporus*, which acts on maltose but is indifferent to cane sugar, contains maltase but no invertase. *Monilia candida* is a particularly interesting case, since it contains neither invertase nor maltase, but nevertheless produces fermentation of both cane sugar and maltose. No aqueous extract which hydrolyses these two sugars could be obtained from it, but if the dried yeast is added to a solution of cane sugar in presence of toluene a vigorous hydrolysis is produced. The hydrolytic enzyme is present, but in this case it is insoluble in water.

Milk sugar, which is not attacked by beer yeast, is fermented by kephir grains and milk sugar yeast, which Beyerinck suspected to contain the hydrolytic enzyme lactase. The existence of this enzyme has been placed beyond question by Fischer, who has prepared the enzyme from kephir grains and milk sugar yeast in the dry state. It is accompanied by invertase, but maltase is entirely absent, and indeed no substance is yet known in which maltase and lactase are associated.

The hydrolysis of trehalose by an enzyme contained in *Aspergillus niger* and in green malt was observed by Bourquelot, and has since been confirmed by Fischer, who found also that a Froberg dry yeast affected a similar but much more feeble decomposition.

Melibiose, which is a disaccharose, is obtained from raffinose. It is fermented by a low fermentation brewer's yeast. Fischer and Lindner have now been able to prove the existence in this yeast of a hydrolytic enzyme which they call melibiase.

In regard to the action of different yeasts on α -methylglucoside and its congeners, Fischer has shown that all yeasts which ferment maltose attack the α -methyl glucoside. The question then arises, has each glucoside or polysaccharose its special enzyme and each fermentable sugar its special ferment or zymase? Fischer considers such a proposition untenable, but inclines to the view that one and the same enzyme of yeast, maltase, attacks α -methyl glucoside as well as melibiose and the complex carbohydrates known as dextrins.

Theoretical considerations.—All these facts indicate that the chemical action of enzymes, in which may be included the zymase of yeast, is of quite a special character and distinct from that of the more simple organic and inorganic compounds. The cause of this selective action probably resides in the asymmetrical structure of the enzyme molecule. Although these substances are not yet known in the pure state, their relation to the proteids is so close and their derivation from the latter so probable, that they may be regarded as optically active molecular aggregates, and consequently asymmetrical. Fischer and Thierfelder have based upon this the hypothesis that between the enzymes and those substances which they attack, there must exist a correspondence in molecular configuration, which they compare to a lock and key. The observations of G. Bertrand on the relation of the polyvalent alcohols to their oxidisability by the sorbose bacteria, shows clearly that stereochemical considerations may be applied to other fermentive processes. Fischer applies the same idea to the chemical changes occurring in the bodies of higher organisms, which lead to the conclusion that in the chemical changes in which the proteid substances take a part as active masses, undoubtedly the case with protoplasm, the configuration of the molecule (*i.e.* space arrangement of the atoms) plays a part fully as important as its structure (*i.e.* plane, or relative arrangement of the atoms). It is easy to conceive on this hypothesis that the three isomeric tartaric acids should be assimilated at an unequal rate in the organism of the dog, and that of two sugars so closely allied as glucose and xylose, it is only the former which is oxidised or converted into glycogen, whereas xylose passes unaltered through the system.

The results of stereochemistry may also throw some light on chemical transformations occurring in the organism. The four sugars, *d*-glucose, *d*-mannose, *d*-fructose and *d*-galactose are not only those that are exclusively attacked by yeast, but those which in the animal system are assimilated as glycogen. The conversion of glucose, mannose and fructose into one another was first achieved by Fischer by a process of alternate reduction and oxidation, since when Lobry de Bruyn and van Ekenstein have arrived at the same result by simply warming with alkalis.

As von Baeyer pointed out twenty-eight years ago, all these phenomena may be explained by the intramolecular migration of an oxygen atom from one carbon atom to the other. The intermediate phases of this process are unknown; but alcoholic fermentation is an example of the facility with which the operation is effected. In regard to the assimilation of carbon dioxide by plants, which gives rise to exclusively active sugars, a similar explanation may be found, seeing that the carbon dioxide in process of assimilation is associated with the optically active chlorophyll bodies.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Mr. F. C. Kempson, of Caius College, has been reappointed a Demonstrator of Anatomy for one year; and Dr. Elliot-Smith, Fellow of St. John's College, a Demonstrator of Anatomy for five years.

The work of Mr. W. Rosenhain, advanced student of St. John's College, which includes the joint Bakerian Lectures, with Prof. Ewing, delivered this year, has been approved for the University certificate of research.

Dr. Hill, Dr. Allbutt, Dr. Sladen, and Prof. Woodhead have