opening. Start the vacuum pump and bear down upon the furnace top for a short time until it takes hold. Allow about fifteen minutes for pumping before turning the current on the crucible. The temperature of the crucible rises very fast following the ammeter quite closely. In fact, for careful melts we have found it desirable for one man to follow the crucible temperature with an optical pyrometer while another reads the milliammeter and adjusts the controls accordingly.

Crucibles so made are inexpensive and need not be used more than once. Such a furnace will not function if there are leaks in the system, as the crucible burns readily under such conditions. Some burning is unavoidable, owing to the release of absorbed air on heating. Due to this burning we have not been able to hold a melt at a high temperature for a prolonged period of time. In the selection of carbons to be used for crucibles, soft carbons are preferable to hard carbons.

A modification of this type of furnace has been used to determine melting points with moderate accuracy. Drill a hole in the side of an arc lamp carbon and place the material to be melted in the hole. Attach the lead wires to the ends of the carbon and support it on something such as transite board. The whole may then be mounted on a microscope stage and the melting observed while another observer reads the temperature with an optical pyrometer. Since this is not done in a vacuum the carbon burns rather rapidly but there is ample time for careful and deliberate measurements.

Others may have used furnaces similar to those described here. This description is offered at the suggestion of a visitor who expressed surprise that the higher temperatures could be reached so easily, and who believed that there were others who would be interested in these methods.

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SPECIAL ARTICLES

THE STRUCTURE OF GLUCOSE

The remarkable difference in stability and properties of the pyranose and furanose ring forms, respectively, of carbohydrates and polysaccharides points to some marked fundamental difference in their structure. This point of view receives added emphasis from the lack of a similar striking difference in properties between the five- and six-membered carbon rings.

The old von Baeyer strained ring hypothesis is no longer acceptable in the light of Ruzicka's synthesis of higher-membered lactone and ketone rings. There now appears to be definite evidence for the belief that while in the case of a pentamethylene strainless ring all the carbon atoms lie in one plane, in the case of hexamethylene, as first pointed out by Sachse and Mohr, a strainless ring is only possible if all the atoms are *not* assumed to lie in one plane; in other words, are united as a "puckered" strainless ring (A) or (A′).

It has been tacitly assumed, without any proof, however, that replacement of a carbon atom by oxygen does not influence the valence direction of the carbon atoms, and that the oxygen functions in this respect similar to carbon, namely, with an assumed normal valence angle of 109° 28′.

While it is true that certain X-ray data point to the tetrahedral character of the oxygen atom, the more recent work of Debye, of Sänger and of Williams serves to show that the valence angle of an oxygen atom attached to two carbon atoms, as in ethyl ether, is 32°, in other words, corresponds to that of the oxygen atom when linked with two atoms of hydrogen.

If now this latter value of 32° be taken as the *normal* carbon-oxygen-carbon valency angle, certain very interesting results follow.

For example, it is found that a ring system consisting of five carbon atoms and one oxygen forms a "puckered," strainless, pyranose ring (B). In this the carbon atoms are joined to one another at a (theoretical) valence angle of 109° 28′ and lie in one plane. The –C–O–C linkages with an oxygen valence angle of 32° subtend an angle of 109° 28′ with the plane of the carbon atoms.

On the assumption that in the furanose form (C) all the atoms lie in one plane, and that the *normal* –C–O–C– valence units form a much smaller oxygen valence angle than the system –C–C–C– (32° as compared with 109° 28′) such a ring must represent a strained system and one which should show a marked tendency to undergo ring scission, and ready conversion, under the influence of mild physical and chemical agents into the "puckered," strainless, pyranose ring type. That this must be the case is evident from the simple calculation, $360° - 3(109° 28') = 31° 36'$, or the approximate angle suggested above for –C–O–C– linkage. It is not necessary to assume that the structure is that of a regular pentagon, inasmuch as the –C–O–C– linkage may represent some value smaller than that assumed in the regular figure.

The theory appears to offer an explanation of many abnormalities occurring between the various isomeric ring structures of carbohydrates and polysaccharides.

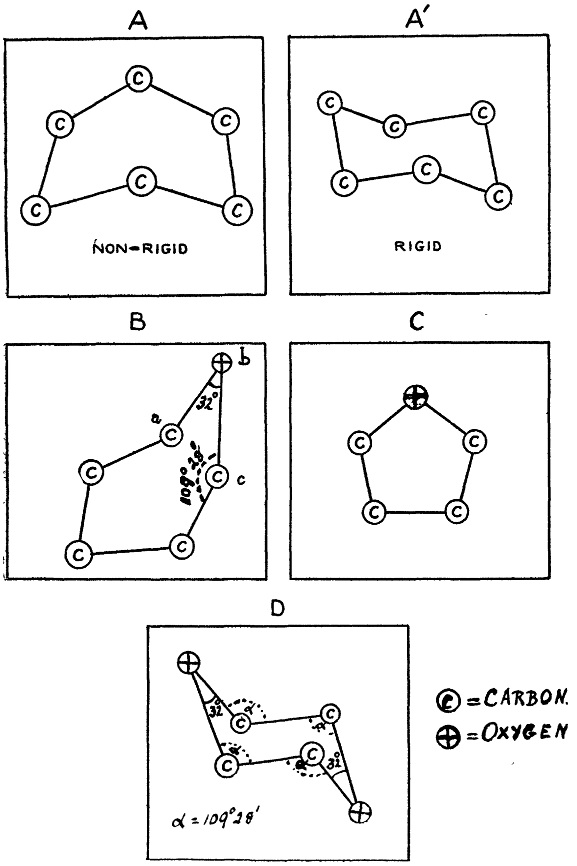

FIG. 1

The above ring forms may be readily demonstrated by use of the Goth carbon models. To represent an oxygen atom, two of the carbon valence bonds are removed from a carbon atom model and the two remaining valence units then bent over so as to subtend an angle of 32°.

It will be seen that in such a model (B) the passage from the "puckered," pyranose ring form into that of the Sachse-Mohr hexamethylene ring type is merely that of a transition of the valence direction of the oxygen atom from 32° to 109° 28′, this being shown on the model in very simple manner by the rotation of the oxygen-valence units *ab* and *bc* into the 109° 28′ position. In the case of the dioxane ring, containing two oxygen atoms, the new theory indicates a strainless ring structure for the compound, as represented by (D). It is seen that a perfectly symmetrical ring is obtained and one therefore having no dipolar moment.

The theory also offers an explanation of the well-known difference in properties found between ethylene oxide derivatives of carbohydrates and polysaccharides, and those of the trimethylene type.

The structures suggested above would seem to apply with equal force to other aldoses, to ketoses, polysaccharides, etc.

It is possible that the remarkable changes occurring in the character of the carbohydrate constituents during plant and animal cell metabolism are to be associated with the marked tendency of the furanose (gamma, active) strained ring type to pass over into the strainless, pyranose, "puckered" ring form as indicated above.

A more complete discussion of the theory is to be given in a forthcoming communication to the *Canadian Journal of Research.*

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NORTH AMERICAN FRESH-WATER SPONGES

IN order that the records of occurrence of fresh-water sponges in North America may be kept as nearly as possible up to date, I wish to make available the following notes upon the materials with which I have recently worked.

Some years ago while on furlough in South Carolina the writer collected several small bits of fresh-water sponges from a floating log in a fish pond near Summerton, South Carolina, and sent these on to the U. S. National Museum. They were, in the course of time, forwarded to Dr. Frank Smith, who identified them as *Trochospongilla horrida.* This find was of peculiar interest, both because it was, so far as I know, the first fresh-water sponge to be found in South Carolina and also because it was the second time this species, which is a comparatively common one in Europe, had been found in the United States. Dr. Smith had reported it from Illinois in 1921.

Dr. C. McLean Fraser, of the University of British Columbia, gave me a small bit of sponge which had been collected in October, 1925, in Beaver Lake, Stanley Park, Vancouver, British Columbia. This specimen is a typical form of *Spongilla lacustris.*

Professor Y. T. Chu, of St. John's University, Shanghai, China, while studying at Cornell University, Ithaca, New York, in 1925, sent me in September and October of that year two small specimens of fresh-water sponges, one taken from the fish hatchery at the university. This proved to be *Carterius tubisperma;* another from Beebe Lake at Ithaca has proved to be *Ephydatia mülleri* with heavy, smooth skeleton spicules. The opinion which places *Ephydatia japonica* as a synonym of *E. mülleri* is now generally, we believe, accepted. This sponge is very variable and *E. japonica* was separated from *E. mülleri* because it had smooth skeleton spicules: we now know that many specimens of this sponge contain