If in equation (4) we insert that value for N which results from a combination of equations (1) and (3), that is

$$(6)\quad N = e^4/(f^2 m_p^2 m^2)$$

we find

$$(7)\quad M = e^3/(f^{3/2} m_p m).$$

By inserting on the right-hand side of (7) the well-known values for the constants, we obtain

$$(8)\quad M = 4 \times 10^{33} \text{ grams}$$

or about twice the mass of the sun. This result is in good agreement with astronomical observations, since the fixed stars were found to have masses varying between about 0.2 and 50 times the mass of the sun, the average mass being a modest multiple of that of the sun.

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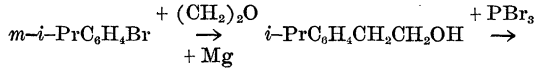
AN APPROACH TO THE SYNTHESIS OF FICHTELITE

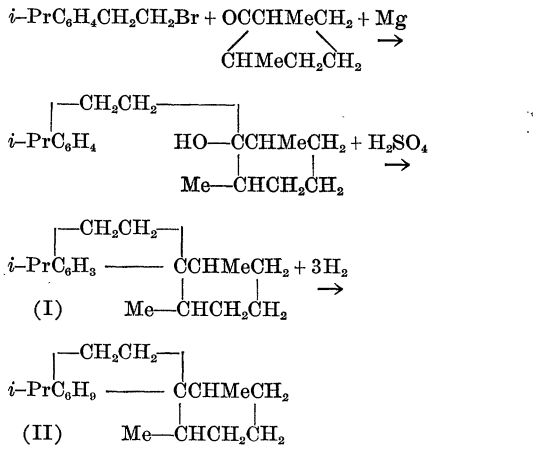
ONE of the most interesting of the retene derivatives is the fichtelite which occurs, usually associated with retene itself, in partially fossilized pine trunks found in various European peat and lignite beds. Its source is evidently the resin acids originally present in the coniferous woods in which it lies buried. It has been known for just about a century. For many years it was believed to be perhydroretene, $C_{18}H_{32}$, until Ipatiew's synthesis of the latter proved that the two were not identical. Based upon some new experimental work, Ruzicka and Waldmann recently[1] proposed for fichtelite the structure of 12-methyl-perhydroretene, or perhydroabietane, $C_{19}H_{34}$ (II).

In the January, 1938, issue of the *Journal* of the American Chemical Society, Fieser and Campbell (p. 167) have described a tetrahydroabietic acid (m.p. 163–164.5°), decarboxylation of which should yield 12-methyl-perhydroretene.

Since in these laboratories we have for some time been attacking, from the synthetic side, this problem of the constitution of fichtelite, it seems to us desirable to report here briefly the progress to date.

Steps followed in this synthesis have been the following, using *m*-bromocumene as the initial material:





The octahydro derivative (I) gave retene when fused with selenium. Catalytically hydrogenated at 225° and 150 atmospheres pressure, for four hours, in the presence of Raney nickel, in methylcyclohexane solution, it absorbed 3 moles of hydrogen per mole of hydrocarbon, with formation of a $C_{19}H_{34}$ hydrocarbon, as an odorless, colorless, transparent, viscous oil, b.p. 179–181° at 12 mm., n_{25}^{D} 1.5025, which congealed to a glassy solid when cooled well below laboratory temperature. With cold alkaline permanganate or with a carbon tetrachloride solution of bromine, it behaved as a saturated compound and also was inert to concentrated sulfuric acid.

As fichtelite is a white crystalline solid, m.p. 46°, our synthetic product obviously is not identical therewith. It may be that the difference between the two is a stereochemical one[2] or that our product requires further purification.

A critical comparison of the synthetic with the natural product has been delayed by the difficulty we have encountered in securing an adequate supply of fichtelite.

The research is being continued, in the endeavor to clear up these points.

To Professor Homer Adkins, of the University of Wisconsin, we are particularly indebted for his assistance in the catalytic hydrogenation of the octahydro derivative (I).

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

A BATH FOR SMOOTH MUSCLE

IT is difficult when recording smooth muscle contractions *in vitro* to change the fluid surrounding the muscle without exposure of the preparation to the atmosphere. This may be accomplished rapidly and easily with the smooth muscle bath shown in the ac-

[1] *Helv. Chim. Acta*, 18: 611, 1935.

[2] *Cf.* Ruzicka, Balaš and Schinz; *Helv. Chim. Acta*, 6: 695, 1923.

companying diagram. The chamber is 3.5 cm in diameter and 14 cm long. The stopcock B is very carefully ground so that it is tight without grease but does not bind. To prevent any possibility of the water in the constant temperature tank contaminating the fluid in the bath the whole stopcock is surrounded by a glass jacket. After warming to the required temperature by passage through a glass coil immersed in the tank, the bath fluid is saturated with O_2–CO_2 mixture. This is done in a 2L Erlenmeyer also immersed in the constant temperature tank and provided with a release valve. The pressure is utilized to force the fluid from the

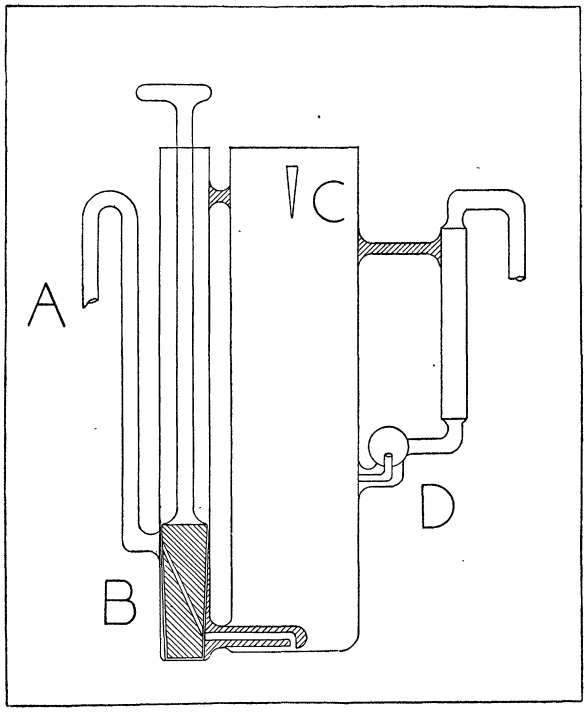

FIG. 1

Erlenmeyer into the bath through the tube A when the stopcock B is open. Fluid is allowed to flow until it reaches the glass level-marker C. When it is required to change the fluid the stopcock B is opened and more fluid allowed to flow until the syphon D operates. It will be seen that the flow through the syphon will cease before the muscle, which is suspended as low as possible in the chamber, is exposed. Because of the arrangement of the tube in the bottom of the chamber through which the fluid enters, complete displacement of the original fluid may be accomplished in two washings. This was ascertained by tests with dyes. The flow of fluid from the tube does not interfere in the least with the normal contractions of the muscle and it is impossible to tell by inspection of the kymographic record when the fluid is changed. Continuous aeration of the bath fluid may be performed, should it be desired, by allowing the level of the fluid in the Erlenmeyer to fall below the delivery tube, when the gas mixture may be passed directly through the tube A and regulated by stopcock B.

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THE MEASUREMENT OF pH IN CIRCULATING BLOOD[1]

CONTINUOUS records of changes in blood acidity were obtained with a MnO_2 electrode by Gesell and Hertzman in 1926.[2] The technique was improved by Voegtlin, De Eds and Kahler,[3] who replaced the MnO_2 electrode with a glass electrode and succeeded in more accurately estimating the pH of circulating blood. They demonstrated convincingly at that time, and again more recently,[4] the suitability of the glass electrode for pH studies in living systems.

The microvoltmeter of Burr, Lane and Nims,[5] with slight modifications, is an ideal instrument for the measurement of glass electrode potentials, not only because of its high sensitivity, but also because of its inherent stability which makes possible continuous recording over long periods of time. This has been demonstrated by Dusser de Barenne, McCulloch and Nims[6] in a study of functional activity and pH of the cerebral cortex.

In the present experiments, the pH of circulating blood was determined by means of a glass electrode, a microvoltmeter, a Leeds and Northrup potentiometer and a General Electric photoelectric recording galvanometer. Skin and other extraneous DC potentials were eliminated by placing a normal saline salt-bridge close to the glass electrode, both electrodes being in contact with the circulating blood.

This technique makes it possible to obtain, with a high degree of accuracy, the differential changes in the pH of the blood, as the conditions of the experiment are varied. Also the time relationships of such changes can be precisely determined, whether they be hours or seconds. Fig. 1 is a record of a single experiment,

[1] From the Laboratories of Physiology and Neuro-Anatomy, Yale University School of Medicine.

[2] R. Gesell and A. B. Hertzman, *Am. Jour. Physiol.*, 78: 206, 1926.

[3] C. Voegtlin, F. De Eds and H. Kahler, U. S. Pub. Health Reports, 45: 2223, 1930.

[4] C. Voegtlin, H. Kahler and R. H. Fitch, *U. S. Nat. Inst. of Health Bulletin*, No. 164; 15, 1935.

[5] H. S. Burr, C. T. Lane and L. F. Nims, *Yale Jour. Biol. and Med.*, 9: 65, 1936.

[6] J. G. Dusser de Barenne, W. S. McCulloch and L. F. Nims, *Jour. Cell. and Comp. Physiol.*, 10: 277, 1937.