

*Citation:*

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In the same way the formula (3) gives

$$\begin{aligned} \mathfrak{E}_1 &= \frac{1}{2} a_0 b_1 + \frac{1}{2} (a_1 b_2 - b_2 a_2 + a_2 b_4 - b_4 a_4 + \dots) \\ \mathfrak{E}_2 &= \frac{1}{2} (a_0 b_2 + a_1 b_1) + \frac{1}{2} (a_1 b_3 - b_1 a_3 + a_2 b_5 - b_3 a_5 + a_4 b_7 - b_5 a_7 + \dots) \\ \mathfrak{E}_3 &= \frac{1}{2} (a_0 b_3 + a_1 b_2) + \frac{1}{2} (a_1 b_4 - b_2 a_4 + a_2 b_6 - b_4 a_6 + a_4 b_8 - b_6 a_8 + \dots) \\ \mathfrak{E}_4 &= \frac{1}{2} (a_0 b_4 + a_1 b_3 + a_2 b_1) + \frac{1}{2} (a_1 b_5 - b_1 a_5 + a_2 b_7 - b_3 a_7 + a_4 b_9 - b_5 a_9 + \dots) \\ \mathfrak{E}_5 &= \frac{1}{2} (a_0 b_5 + a_1 b_4 + a_2 b_2) + \frac{1}{2} (a_1 b_6 - b_2 a_6 + a_2 b_8 - b_4 a_8 + a_4 b_{10} - b_6 a_{10} + \dots) \\ \mathfrak{E}_6 &= \frac{1}{2} (a_0 b_6 + a_1 b_5 + a_2 b_3 + a_3 b_1) + \\ &\quad + \frac{1}{2} (a_1 b_7 - b_1 a_7 + a_2 b_9 - b_3 a_9 + a_4 b_{11} - b_5 a_{11} + \dots) \\ &\dots \dots \dots \end{aligned}$$

from which the following relations may be obtained

$$\begin{aligned} \frac{1}{1^2 \cdot 3^2} + \frac{1}{3^2 \cdot 5^2} + \frac{1}{5^2 \cdot 7^2} + \dots &= \frac{\pi^2}{16} - \frac{1}{2} \\ \frac{1}{4 \cdot 1^2} - \frac{1}{2 \cdot 5^2} + \frac{1}{6 \cdot 3^2} - \frac{1}{4 \cdot 7^2} + \dots &= \frac{\pi^2}{12} - \frac{31}{54} \\ \frac{1}{5 \cdot 1^2} - \frac{1}{1 \cdot 5^2} + \frac{1}{7 \cdot 3^2} - \frac{1}{3 \cdot 7^2} + \dots &= \frac{\pi^2}{16} - \frac{4}{9} \\ \frac{1}{6 \cdot 1^2} - \frac{1}{2 \cdot 7^2} + \frac{1}{8 \cdot 3^2} - \frac{1}{4 \cdot 9^2} + \dots &= \frac{7\pi^2}{60} - \frac{347}{900} \\ \frac{1}{7 \cdot 1^2} - \frac{1}{1 \cdot 7^2} + \frac{1}{9 \cdot 3^2} - \frac{1}{3 \cdot 9^2} + \dots &= \frac{\pi^2}{24} - \frac{187}{675} \\ &\dots \dots \dots \end{aligned}$$

**Chemistry.** — “*On a crystallised d. fructose tetracetate*”, by Dr. D. H. BRAUNS. (Communicated by Prof. A. P. N. FRANCHIMONT).

Very few crystallised derivatives of *d.* fructose have as yet been obtained. A pentacetate was described by ERWIGS and KOENIGS as a gummy substance. A number of researches have shown, however, that the high temperature at which the reactions generally took place causes a conversion or decomposition of the fructose. As no satisfactory results were obtained with acetic anhydride and acetyl chloride acetyl bromide was employed which reacts at a comparatively low temperature. The greatest possible precautions were taken to exclude moisture and to let the reaction take place at a low temperature. The details will be published in full later on.

Refrigerated *d.* fructose in fine powder was mixed with a little more than 5 mols. of acetyl bromide at  $-15^\circ$  and after starting the reaction by touching one spot with a tube having the ordinary

temperature, I waited until most of the hydrogen bromide had been evolved and the reaction was consequently nearly over. The excess of acetyl bromide was then distilled in a high vacuum and the *product*, consisting of a tenaceous, yellow mass, treated with iced water, then dissolved in alcohol and placed in a desiccator containing caustic potash and kept at a low temperature. A crystallised mass was obtained which after being submitted to pressure was recrystallised at a low temperature when beautiful crystals, free from bromine, were deposited.

These crystals are colourless, odourless, taste bitter and melt at  $131^{\circ}$ — $132^{\circ}$ . In a high vacuum they may be sublimed even at  $95^{\circ}$  more rapidly at  $105^{\circ}$ , the sublimate has the same melting point.

The ultimate analyses gave a mean result of C 48.26%, H 5.86%.

The molecular weight determination by the lowering of the freezing point of benzene gave a mean of 355.

The acetyl determination was carried out by saponification with  $n/10$  sodium hydroxide at a low temperature. Blank experiments made under similar conditions showed that fructose is not altered or converted into acids. The saponification was nearly complete after two hours and quite so in 18 hours; after 28 hours no sensible decomposition of the fructose had set in and about the same figures were obtained as those in 18 hours. The average amount of acetic acid found was 69.42%.

It is, therefore, a fructose tetracetate  $C_{14}H_{20}O_{10}$  for which theory requires C. 48.25%, H. 5.86%, molecular weight 348 acetic acid 68.96%.

This compound is but little soluble in water, ether, benzene and ligroin, readily so in alcohol and chloroform.

The chloroform solution was used to determine the rotatory power. It polarises to the left and the specific rotation of d. fructose tetracetate at  $20^{\circ}$  was found  $[\alpha]_D^{20} = -91^{\circ}.38$ .

Dr. F. M. JÄGGER was kind enough to investigate the crystals and reported as follows:

d. Fructose tetracetate (BRAUNS).

$C_{14}H_{20}O_{10}$ ; Melting point  $132^{\circ}$  C.

Sp. Gr. of the crystals at  $15^{\circ} = 1.388$ ; Mol. Vol. = 250.72.

From ethyl alcohol + ether, it is obtained on slow evaporation, in beautiful, colourless, shining little crystals which may be readily measured and which possess a pure geometrical structure.

The compound is *hemimorphous*; its symmetry is that of the *monoclimo-sphenoidic* class. It, therefore, does not possess a single

symmetry-plane or a symmetry centre; but only one single unipolar, twin axis. All the crystals which I investigated represented the same variety of the two possible enantiomorphous forms.

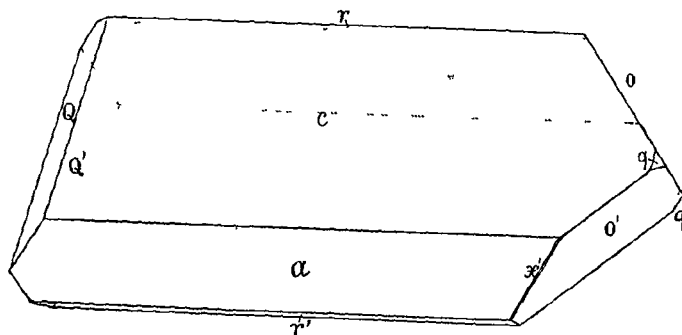


Fig. 1. d. Fructose tetracetate (BRAUNS).

The symmetry assigned here to the crystals is not only proved by their habit, but also proved beyond all doubt by the investigation of the etched figures obtained by means of 95% alcohol; these were very distinct particularly on {100} and {001}.

$$\text{Parameters: } a : b : c = 1, 3463 : 1 : 1, 5733$$

$$\beta = 52^{\circ}.12'$$

*Forms observed:*  $c = \{001\}$ , broad and very shining;  $a = \{100\}$ , somewhat narrower;  $o = \{\bar{1}11\}$ , large and yielding sharp reflexes;  $q = \{011\}$ , small but reflecting well;  $Q = \{0\bar{1}1\}$ , large and shining;  $r = \{\bar{1}02\}$ , very narrow and dull;  $x = \{\bar{9}11\}$  exceedingly narrow and measurable only with difficulty. Once or twice one plane of  $\{\bar{1}\bar{1}1\}$  was observed, rudimentary and striped parallel to the plane  $\{001\}$ .

<i>Angular values:</i>	<i>Measured:</i>	<i>Calculated:</i>
$c : a = (001) : (100) =$	$52^{\circ}.12'$	—
$o : o = (\bar{1}11) : (11\bar{1}) =$	$75.41$	—
$c : o = (001) : (\bar{1}11) =$	$79.37$	—
$a : q = (100) : (011) =$	$67.21\frac{1}{2}'$	$67^{\circ}.24\frac{1}{2}'$
$q : o = (011) : (\bar{1}11) =$	$43.10\frac{1}{2}'$	$43.17\frac{3}{4}'$
$x : o = (91\bar{1}) : (11\bar{1}) =$	$60.44$ (about)	$60.53\frac{1}{2}'$
$x : a = (91\bar{1}) : (100) =$	$8.36$ (about)	$8.27\frac{1}{4}'$
$a : o = (100) : (11\bar{1}) =$	$69.29\frac{1}{2}'$	$69.20\frac{3}{4}'$
$q : q = (011) : (01\bar{1}) =$	$77.39$	$77.37\frac{1}{2}'$
$c : q = (001) : (011) =$	$51.10\frac{1}{2}'$	$51.11\frac{1}{4}'$
$c : r = (001) : (\bar{1}02) =$	$35.44$	$35.43\frac{1}{2}'$
$r : a = (\bar{1}02) : (\bar{1}00) =$	$92.4$	$92.4\frac{1}{2}'$

Readily cleavable parallel to  $a$  and  $c$ .

The optical axial plane is  $\{010\}$ . Very faint, inclined dispersion:  $\rho > \nu$ ; double refraction negative. On  $c$  one optical axis emerges at a small angle with the normal.

Topic axial relation:  $\chi : \psi : \omega = 7.1503 : 5.3109 : 8.3556$ .

**Physics.** — “*New observations concerning asymmetrical triplets*”. By Prof. P. ZEEMAN.

*Asymmetry investigated by means of FABRY and PEROT's method.*

1. In the second part of the paper “Magnetic resolution of spectral lines and magnetic force” I<sup>1)</sup> investigated, by means of a method, which I called that of the non-uniform field, the asymmetry predicted from theory by VOIGT<sup>2)</sup> in the case the original line is resolved into a triplet.

A glance at Plate II of my paper immediately shows that observation seems to confirm strikingly VOIGT's theoretical result that the component of the triplet towards the red is at a somewhat smaller distance from the middle line than the one towards the violet.

In order to exclude however all doubt as to the reality of this experimental result I thought it desirable to continue my work in a direction independent of ROWLAND's method.

I have shown<sup>3)</sup> that the resolution of spectral lines by magnetic forces can be investigated by means of the semi-silvered parallel plates of FABRY and PEROT.

Using the special form of instrument in which the distance of the silvered surfaces is constant, the étalon, we may yet choose between two ways of comparison of the wavelengths of the centre line and of the components, originating by the action of the magnetic field.

Firstly we may measure, the intensity of the field being arbitrarily chosen, the diameters of the interference rings. By combining only measurements of rings originating from the same ring the calculation becomes very simple; for as shown in my last paper even a knowledge of the ordinal number of the rings then is unnecessary.

2. We may use however also the method of coincidences, regulating

<sup>1)</sup> ZEEMAN. These Proceedings 30 November 1907.

<sup>2)</sup> VOIGT. Ann. d. Phys. 1. p. 376. 1900, see also the last paper by VOIGT. Physik. Zeitschrift 9. p. 122. 1908.

<sup>3)</sup> ZEEMAN. These Proceedings 28 December 1907.