

exchange chromatography followed by fractional reprecipitations, we were able to obtain a nearly complete separation of the two components. The less soluble barium salt fraction gave the absorption spectrum of a guanylic acid derivative and a ratio of 1 : 1 : 2 for guanine : difficultly hydrolysable phosphate : acid labile phosphate. Only a trace of the uridylic acid derivative could be detected by paper chromatography before and after hydrolysis. The most soluble barium salt fraction gave the absorption curve of the uridylic acid derivative and a ratio of 1 : 1 : 2 for uracil : difficultly hydrolysable phosphate : acid labile phosphate. Paper chromatography revealed the presence of traces of the guanylic acid derivative. Pentose estimations using the orcinol reagent before and after bromination⁹ for the determination of purine- and pyrimidine-bound pentose, gave confirmatory results. Experiments on the periodate oxidation and copper complex formation of guanosine and uridine triphosphates in comparative tests with ATP, and adenosine 5'- and 3'-phosphates showed that the two new triphosphates behaved as if the phosphate groups were in the 5'-position. Although location of the acid labile phosphate groups in the purine or pyrimidine part of the molecule is not excluded, we consider that their rates of acid hydrolysis as compared with ATP render their formulation as 5'-triphosphates most likely. The structural analogy of ATP coupled with the isolation of uridine 5'-diphosphate derivatives¹⁰, from which uridine triphosphate may be formed^{11,12} supports this view. In spite of many attempts, no carbohydrate other than pentose and no ninhydrin-reacting material has so far been detected in our triphosphate preparations.

An unequivocal proof of the constitution of guanosine triphosphate and uridine triphosphate must await the results of further investigations at present in progress. Fuller details together with a consideration of possible biochemical implications will be given in a separate communication.

This work has been supported by a grant from the Swedish Natural Science Research Council.

1. LePage, G. A. *Biochemical Preparations* 1 (1949) 5.
2. Cohn, W. E., and Carter, C. E. *J. Am. Chem. Soc.* 72 (1950) 4273.

3. Deutsch, A., and Nilsson, R. *Acta Chem. Scand.* 7 (1953) 1288.
4. Markham, R., and Smith, J. D. *Biochem. J. (London)* 49 (1951) 401.
5. Hanes, C. S., and Isherwood, F. A. *Nature* 164 (1949) 1107.
6. Albaum, H. G., and Umbreit, W. W. *J. Biol. Chem.* 167 (1947) 369.
7. Marshak, A., and Vogel, H. J. *J. Biol. Chem.* 189 (1951) 597.
8. Fischer, E. *Ber.* 30 (1897) 2253.
9. Massart, L., and Hoste, J. *Biochim. et Biophys. Acta* 1 (1947) 83.
10. Caputto, R., Leloir, L. F., Cardini, C. E., and Paladini, A. C. *J. Biol. Chem.* 184 (1950) 333.
11. Kornberg, A. *Phosphorus Metabolism* 1 (1951) 392.
12. Kalckar, H. M., and Cutolo, E. *Résumés des communications, II^e Congrès international de biochimie, Paris 1952*, p. 260.

Received September 26, 1953.

Molecular Structure of Perhydroanthracene, M. P. 90° C

S. BOG, O. HASSEL and E. HADLER
VIHOVDE

Universitetets Kjemiske Institutt,
Blindern-Oslo, Norway

If the "cis" connection between the six-membered rings in the perhydroanthracene is of the same kind as that observed for *cis* decalin¹ the "trans-trans", "trans-cis" and "cis-cis" forms of perhydroanthracene would be represented by the forms I, II and III of Fig. 1. Judging from the physical constants of these substances J. W. Cook *et al.*² have suggested that the substance melting at 90° C is the "trans-trans" form (I).

Crystals of this substance are usually twinned, but in two cases we succeeded in growing single crystals suited for X-ray measurements. The crystals are triclinic:
 $a = 5.46$; $b = 5.60$; $c = 10.20$ (Å)
 $\alpha = 93.9^\circ$; $\beta = 94.6^\circ$; $\gamma = 102.0^\circ$

The space group is $P\bar{1}$ and the unit cell contains one molecule which must therefore have a centre of symmetry. Suggesting that the strong 008 reflexion corresponds to the 1.26 Å spacing of the "trans-trans" form and taking into account the pseudo-symmetry respective to the a and b axes it proved possible to find approximate carbon atomic coordinates which explained in a

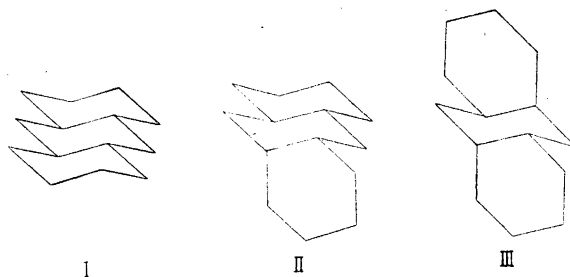


Fig. 1. "trans-trans"-, "trans-cis"-. and "cis cis"-Perhydroanthracene.

qualitativ way the intensities of observed reflexions. On the basis of these coordinates Fourier maps along the b and a axes were worked out (Compare Fig. 2). It follows from these projections that the substance indeed is the "trans-trans" isomeride.

The X-ray analysis was carried out using CuK-radiation only. This in combination with the fact that good single crystals are difficult to obtain, makes the experimental material rather limited and we think therefore that a reinvestigation using X-rays of shorter wavelength will be necessary in order to derive exact values of atomic distances and valency angles.

The analysis of the lower melting isomerides is in progress. Unfortunately these crystals are also triclinic and mostly twinned. In both cases there are two molecules in the unit cell.

We wish to express our gratitude towards professor J. W. Cook for placing the substances mentioned at our disposal.

1. Bastiansen, O., and Hassel, O. *Tidsskr. Kjemi, Bergvesen, Met.* **6** (1946) 70.
2. Cook, J. W., McGinnis, N. A., and Mitchell, S. *J. Chem. Soc.* **1944** 286.

Received October 5, 1953.

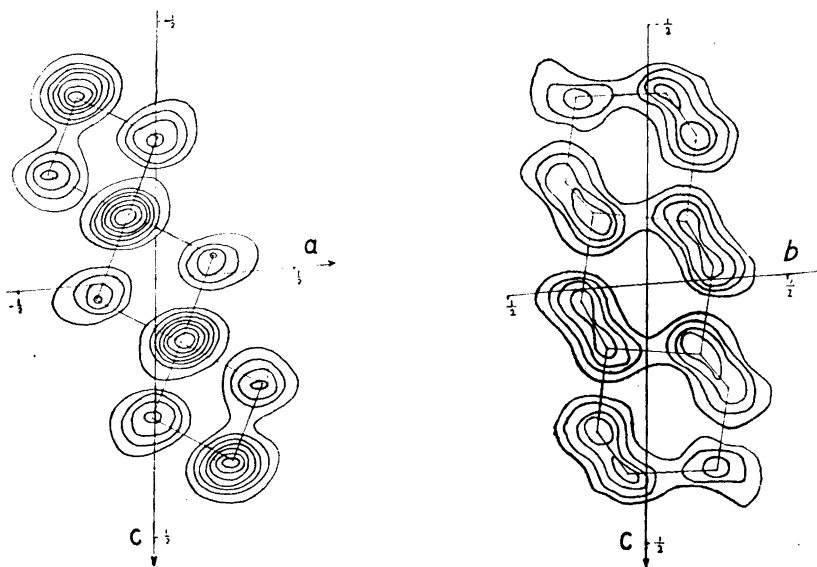


Fig. 2. Electron density maps projected: a) along the b -axis, b) along the a -axis.