wir, dass der Bazzit eine Struktur vom *Berylltypus* aufweist. Die detaillierte Kristallstrukturbestimmung ist im Gange.

Wir danken Herrn Ing. O. HAGER für die Bazzitstufe, Herrn Prof. W. FEITKNECHT für die Überlassung des Spektrographen und den Herren Dr. H. BÜRKI und G. F. BONSMA für die Herstellung der Röntgenaufnahmen.

H. HUTTENLOCHER, TH. HÜGI und W. NOWACKI

Mineralogisch-Petrographisches Institut der Universität Bern, den 6. Juli 1954.

Summary

Bazzite recently found in Val Strem (Aarmassif, Ct. Graubünden, Switzerland) was investigated by means of X-ray (lattice constants, space group) and spectrographic methods (major and minor constituents). It seems to have a structure of the beryl type.

Separation of *Cis*- and *Trans*-Azobenzene by Chromatography on Paper

We have found that *cis*- and *trans*-azobenzene can be separated by chromatography on paper using acetic acid (40%) as eluent. The *cis*-form migrates with the eluent as a yellow spot while *trans*-azobenzene remains stationary. The method was applied also to the separation of the two isomers from a solution of *trans*-azobenzene placed on filter paper and irradiated, while wet, by sun or ultraviolet light. Using a quartz vessel, the separation can also be effected by simultaneous irradiation and chromatography of *trans*-azobenzene, the *cis*-azobenzene appearing here as a yellow band. Separations of other geometrical isomers will be reported shortly.

M. FRANKEL and R. WOLOVSKY

Department of Organic Chemistry, The Hebrew University, Jerusalem, Israel, May 15, 1954.

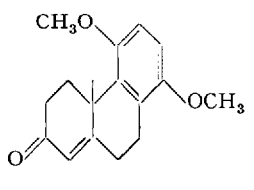
Zusammenfassung

Cis- und *trans*-Azobenzol lassen sich papierchromatographisch durch Elution mit wässriger Essigsäure trennen.

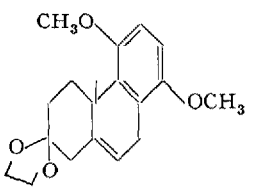
Versuche zur Synthese von Verbindungen der Steroidreihe

4b-Methyl-1,2,3,4,4aα,4b,5,6,7,9,10,10aβ-dodekahydrophenanthren-1,4,7-trion

Vor mehreren Jahren wurde eine Synthese von 7-Keto-1,4-dimethoxy-4b-methyl-4b,5,6,7,9,10-hexahydrophenanthren (I) beschrieben[1], das am bequemsten aus Chloropren und Benzochinon erhältlich ist[2].



I



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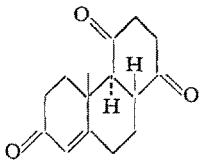
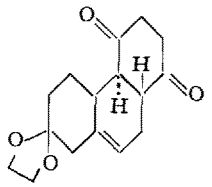


III



IV

Nach einem durch äussere Umstände bedingten Unterbruch haben wir unsere Versuche zur Totalsynthese von Verbindungen der Steroidreihe wieder aufgenommen und in diesem Zusammenhang die Reduktion des Äthylenketals II von I untersucht. II liess sich mit Lithium in flüssigem Ammoniak, das kürzlich von WILDS und NELSON[3] bei schwer reduzierbaren aromatischen Systemen mit Erfolg verwendet worden ist, reduzieren. Saure Hydrolyse des rohen Reduktionsproduktes (Dihydroderivat von II) lieferte ein Triketon vom Smp. 121°, das mit dem anti-trans-4b-Methyl-1,2,3,4,4aα,4b,5,6,7,9,10,10aβ-dodekahydro-phenanthren-1,4,7-trion (III) von POOS *et al.*[4] identisch war. Unsere Synthese liefert demnach die den natürlichen Steroiden entsprechende Verknüpfung der drei Ringe.

Bei der schonenden Hydrolyse des Dihydroderivates von II nach der früher beschriebenen Methode[5] blieb die Ketalgruppe in 3-Stellung intakt. Das so erhaltene Triketon-monoketal IV vom Smp. 124° war mit einer nach POOS *et al.*[4] hergestellten Probe identisch.

Wir danken Herrn Prof. T. REICHSTEIN sowie der Haco-Gesellschaft, AG., Gümligen, für die Förderung dieser Arbeit.

C. A. GROB und O. SCHINDLER

Organisch-chemische Anstalt der Universität Basel, den 18. Juni 1954.

Summary

Reduction of the ketal II of 7-keto-1,4-dimethoxy-4b-methyl-5,6,7,9,10-hexahydrophenanthrene with lithium in liquid ammonia furnishes a corresponding dihydro derivative, from which a tricyclic triketone, m.p. 121°, is obtained upon acid hydrolysis. This triketone is identical with the recently described anti-trans-4b-methyl-1,2,3,4,4aα,4b,5,6,7,9,10,10aβ-dodecahydro-phenanthrene-1,4,7-trione III and thus conforms to the stereochemistry of the natural steroids.

[1] C. A. GROB und W. JUNDT, Helv. chim. Acta *31*, 1691 (1948). – C. A. GROB und H. WICKI, Helv. chim. Acta *31*, 1706 (1948).

[2] C. A. GROB und W. JUNDT, Helv. chim. Acta *35*, 2111 (1952).

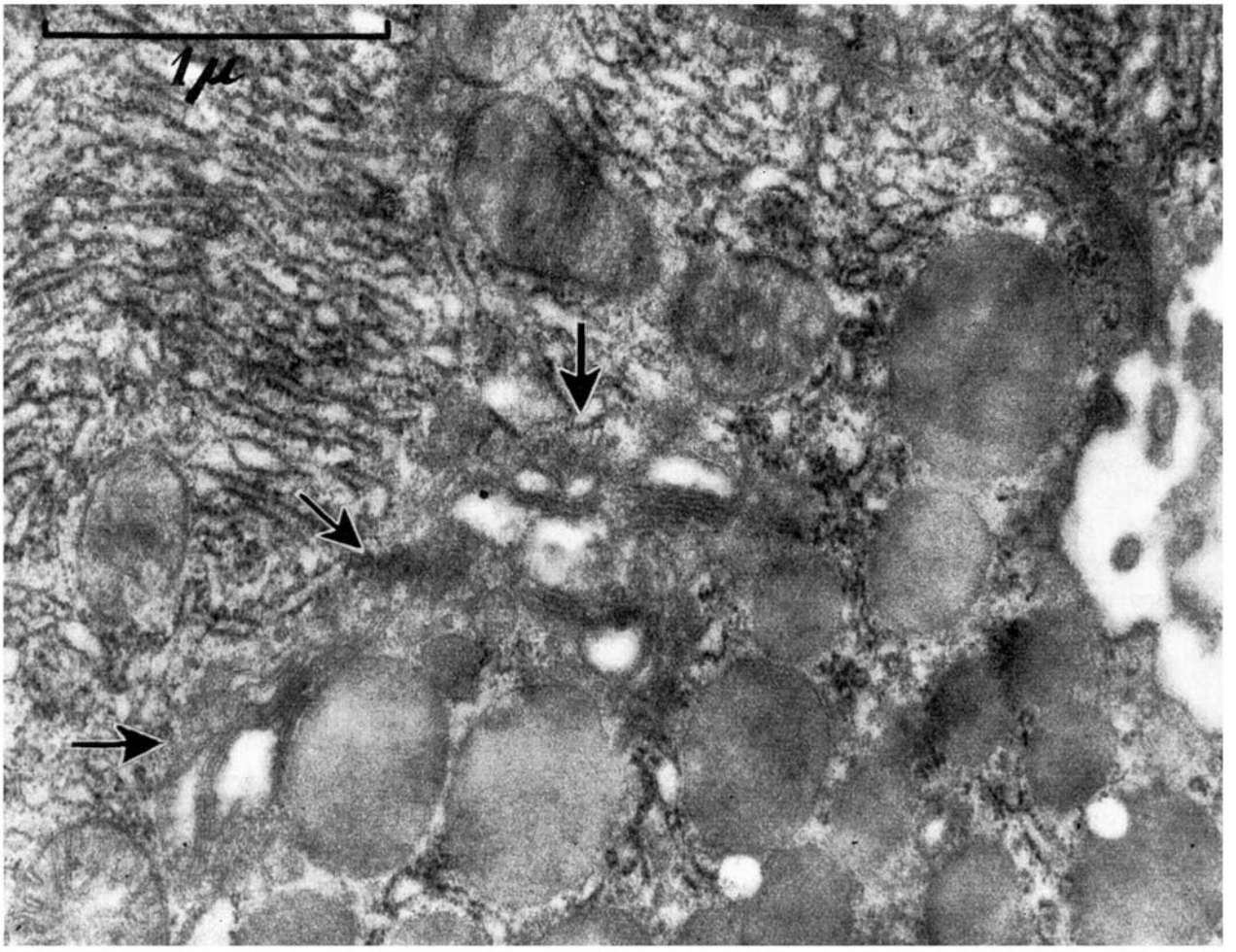
[3] A. L. WILDS und N. A. NELSON, J. Amer. Chem. Soc. *75*, 5360 (1953).

[4] G. I. POOS, G. E. ARTH, R. E. BEYLER und L. H. SARETT, J. Amer. Chem. Soc. *75*, 422 (1953). Wir danken der CIBA-Aktiengesellschaft für die freundliche Überlassung dieses Materials.

[5] C. A. GROB, W. JUNDT und H. WICKI, Helv. chim. Acta *32*, 2427 (1949).

Electron Microscopy of the Golgi Apparatus of the Exocrine Pancreas Cells

The lack of agreement reflected in literature as to the interpretation of the GOLGI apparatus is due to the inadequacy of light microscopical techniques for visua-



GOLGI apparatus (indicated by the arrows) in exocrine cell of mouse pancreas. The arrows point to a region of the GOLGI apparatus containing GOLGI granules. To the right an excretory duct, in the lower part of the picture zymogen granules, above the GOLGI apparatus mitochondria and in the left upper part and between other cell components intracellular cytoplasmic membranes. In the right upper corner, the cell membranes of two adjacent cells. Magnification: 46,000 ×.

lizing this cytoplasmic component. These techniques are not sufficiently specific even to make it certain that different investigators have been studying identical structures under the classification of GOLGI apparatus. The difficulties in observing the GOLGI apparatus in living normal cells has also contributed to doubts as to its reality.

DALTON and FELIX[1] have demonstrated a GOLGI apparatus in epithelial cells supravitally in teased preparation using phase contrast microscopy. In electron micrographs of sections through the same kind of cells they observed "cytoplasmic strands" and vacuoles indicating a region organized differently from the rest of the cytoplasm. DALTON and FELIX[2] later described the GOLGI material as consisting of vacuoles marginated "by lamellae comparable to those of the basophilic substance".

In connection with a study of the ultrastructural organization of the mouse pancreas, a structurally well-defined cytoplasmic region has constantly been observed in the distal part of the cells. As the cytoplasm of these cells is organized in a very characteristic way (SJÖSTRAND[1], SJÖSTRAND and HANZON[2]), these regions appear with great distinctness forming sharply outlined areas of rather irregular form and with a structure contrasting to the rest of the cytoplasm. The localization of these zones corresponds exactly to the site of the GOLGI apparatus as determined by means of light microscopy.

This study was performed on ultra-thin sections prepared with the SJÖSTRAND[3] ultramicrotome. The tissue was fixed in isotonic acetate-veronal buffered osmium tetroxide solution (pH 7·2). Due to the minute thickness of the sections, high resolution pictures could be obtained which made it possible to observe a series of structural components within the GOLGI zone. In a finely granular or homogeneous *ground substance*, a group of three to five tightly packed pairs of membranes or lamellae are embedded. These GOLGI *membranes* are smooth and, in contrast to the cytoplasmic membranes (SJÖSTRAND[1], SJÖSTRAND and HANZON[2]), they are not associated with any opaque particles. They show a

[1] A. J. DALTON and M. D. FELIX, Am. J. Anat. *92*, 277 (1993).
[2] A. J. DALTON and M. D. FELIX, J. Appl. Phys. *24*, 1425 (1953).

[1] F. S. SJÖSTRAND, Nature *171*, 30 (1953).
[2] F. S. SJÖSTRAND and V. HANZON, Exptl. Cell Res. (in press).
[3] F. S. SJÖSTRAND, Exper. *9*, 114 (1953).

fairly irregular course and to a varying extent are split apart by vacuolar spaces of more or less irregular form.

In addition to the GOLGI membranes, *granules* are found in the GOLGI ground substance. These granules show intimate topographic relationship to the GOLGI membranes. Their size, form and opacity varies considerably. The biggest granules are zymogen granules, exhibiting all the characteristic morphological features of such granules. There are found all kinds of transmission stages from small sized granules to these zymogen granules. Topographic relationships produce the impression of a transition of GOLGI membrane material into granules which, when moving away from the membrane zone, are gradually transformed into zymogen granules. Further studies which take the time factor into account seem necessary for a sound interpretation of such relationships.

Our experiments using starving and fed animals, and injections of pilocarpine hydrochloride, in order to vary the functional conditions of the exocrine pancreas cells, have failed to present sufficiently well-defined states of activity for a more critical analysis of the functional significance of the GOLGI apparatus.

One great difficulty in accepting the GOLGI apparatus as a preformed cell component has been the lack of a specific method for demonstration. The high degree of organization observed in EMG's of the GOLGI apparatus, make it now stand out as a morphologically well-defined and characteristic cell component which is easily recognized in the cell. It certainly impresses us as a structure that is preformed in the living cell.

A cell component similar to the one described here as the GOLGI apparatus has been observed in the columnar epithelial cells, in the GOBLET cells of the intestines (SJÖSTRAND and ZETTERQUIST[1]) and in the tubular cells of the mouse kidney (RHODIN[2]).

A more detailed report on this study will be presented in Experimental Cell Research.

This investigation has been supported by grants from the Knut and Alice Wallenberg Foundation, the "Riksföreningen för Kräftsjukdomarnas bekämpande" and the Foundation "Therese och Johan Anderssons Minne".

F. S. SJÖSTRAND and V. HANZON

Department of Anatomy, Karolinska Institutet, Stockholm, March 5, 1954.

Zusammenfassung

In den exokrinen Pankreaszellen der Maus wurde der Golgiapparat im Elektronenmikroskop mit hoher Auflösung auf ultradünnen Schnitten studiert. Der Golgiapparat zeichnet sich durch ein deutlich abgegrenztes, unregelmässiges Zytoplasmagebiet mit eigenartiger Struktur aus, wobei man drei verschiedene Komponenten unterscheiden kann: 1. eine fast homogene Grundsubstanz; 2. Gruppen von 3 bis 5 dicht gepackten Golgimembranpaaren, von unregelmässigen Vakuolbildungen getrennt; 3. Golgigranula von verschiedener Form, Grösse und Dichte. Die grössten sind typische Zymogengranula.

[1] F. S. SJÖSTRAND and H. ZETTERQUIST, in preparation.

[2] J. RHODIN, *Correlation of Ultrastructural Organization and Function in Normal and Experimentally Changed Proximal Convoluted Tubule Cells of the Mouse Kidney* (Stockholm, 1954).

Electron Microscopy of the Intercalated Discs of Cardiac Muscle Tissue

The interpretation from light microscopic observations of the significance of the intercalated discs of heart muscle has been very controversial. A very extensive light microscopic study was presented by AURELL[1] in a monograph in which the literature was carefully reviewed up till 1945. Even earlier electron microscopic studies[2] have failed to give a conclusive answer. The intercalated discs have recently been subject to a histochemical study by BOURNE[3] who found a high enzyme concentration in the discs indicating their interest from a biochemical point of view.

The present study, which will be reported on in more detail elsewhere, has revealed that the intercalated discs of cardiac muscle tissue represent cell boundaries of a special kind. This type of cell boundary is, however, far from unique as far as pure morphology is concerned.

Heart muscle from frog, mouse and guinea pig has been studied after fixation in buffered isotonic osmium tetroxide solution (modified Palade solution[4]) embedded in methacrylate and sectioned with the ultra-microtome designed by SJÖSTRAND[5]. The about 200 Å thick sections have been studied in an RCA EMU 2 c electron microscope without dissolving or subliming the embedding medium.

Figure 1 shows a longitudinal section through a myofibril from guinea pig heart muscle. The myofibril consists of two fibril components similar to those described by HUXLEY[6] (not clearly shown in this picture). At the end of the sarcomere seen in the picture a very opaque zone runs across the whole diameter of the myofibril. In the middle of this dark zone a bright line is observed. At higher magnification, as in Figure 2 (which is from a section in series with that presented in Fig. 1), it is seen that the bright, less opaque line has a sharp boundary against the opaque material; and in very thin sections a well defined thin dark line is observed at this boundary. This thin line is continuous with the sarcolemma facing the interstitial connective tissue spaces.

The elementary fibrils of the myofibrils do not bridge over the gap formed by the less opaque area of the intercalated disc.

The width of this bright zone is 150–200 Å. The adjacent opaque areas show a finely granular appearance. Its boundary towards the sarcomere is somewhat irregularly outlined and not sharply demarcated as it is towards the bright central zone.

The analysis of a great number of EMG's indicate that the cardiac muscle tissue is completely subdivided into units representing cell territories without any anastomoses. This conclusion is further supported by the very careful light microscopic study of AURELL[7] with three dimensional reconstruction of the arrangement of the intercalated discs. The rod-like structure frequently observed at the intercalated discs when studied by means of light microscopy corresponds to a wavy arrangement of the cell boundary at the site of the disc. When the amplitude of these waves is pronounced

[1] G. AURELL, *Die Glanzscheiben des Herzmuskelgewebes und ihre Verbindungen* (Stockholm, 1945).

[2] V. L. VAN BREEMEN, Anat. Rec. *117*, 49 (1953).

[3] G. H. BOURNE, Nature *172*, 588 (1933).

[4] G. PALADE, J. exptl. Med. *95*, 285 (1952).

[5] F. S. SJÖSTRAND, Exper. *9*, 114 (1953).

[6] H. E. HUXLEY, Biochim. biophys. Acta *12*, 387 (1953).

[7] G. AURELL, *Die Glanzscheiben des Herzmuskelgewebes und ihre Verbindungen* (Stockholm, 1945).