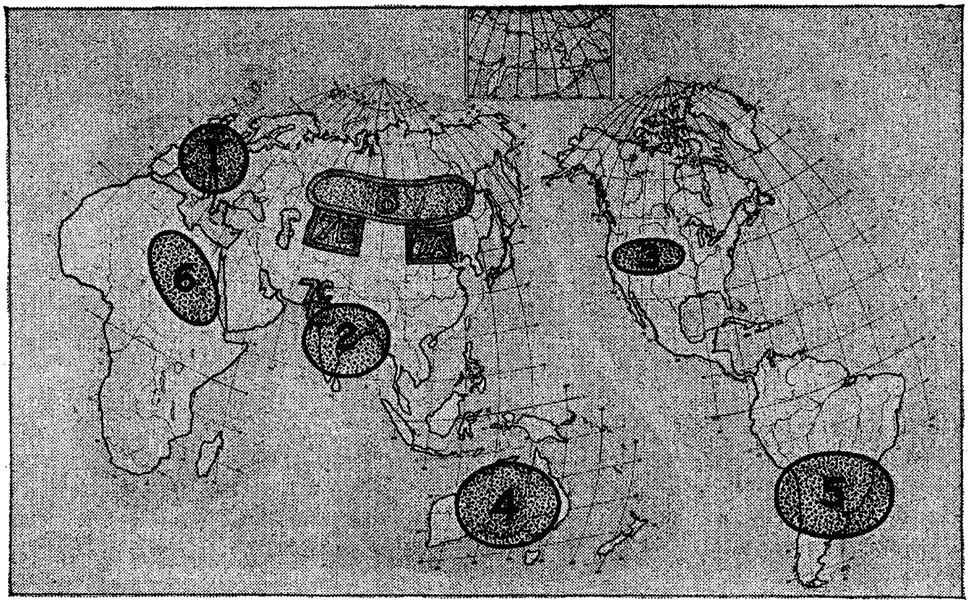


Chart II. World Centers of Mammalian Origin in Order of Discovery

(1) Western Europe—Cuvier. (2) India and Burma—Falconer and Cautley. (3) Western America—Leidy, Marsh, and Cope. (4) Australia—Owen. (5) South America—Ameghino and Scott. (6) North Africa—C. W. Andrews and Osborn.

(7 A) East central Asiatic area—Roy C. Andrews (1922–1929). (7 B) West central Asiatic area—Borissiak. (7 C) Baluchistan area—Forster Cooper. (8) Unexplored north central Asiatic area, in which will probably be found the plains and uplands ancestors of the tapirs, horses, titanotheres, rhinoceroses. The chief adaptive radiation center of the odd-toed ungulates or Perissodactyla.

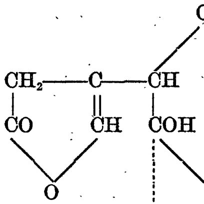
moreover the central Asiatic fauna (7 A, B, C) seems to point to a series of invasions from the north. During the early Tertiary, at least up to the close of Oligocene time, this center (7 A, B, C) was in close connection by migration with the North American center (3), and in Oligocene time it formed a close connection with the west European center (1). Another very striking feature of the central Asiatic center (7 A, B, C) is the absence of any trace of the Proboscidea until Miocene time, a fact which serves to establish north Africa (6) as the probable center of adaptive radiation of the Proboscidea, because all the primitive members both of the mastodontine and elephantine divisions have now been discovered in Africa. Accordingly from central Asia (7 A, B, C) and from north Africa (6) it now appears probable that India (2) was populated chiefly by heat-loving mastodonts and elephants and by offshoots of the great bovines and antelopines of Africa, because the adaptive radiation of these animals now seems to have had its center in the upland plateaus of that continent (6). Returning to the central Asiatic region (7 A, B, C), the mammalian fauna was not only extremely varied in Eocene and Upper Oligocene times but extremely flourishing, all the genera and species being represented by animals of relatively stupendous size. Aside from the absence of the horses and of other ancestral perissodactyls, it is important to note the absence as well of all trace of the Palaeotheres, the discovery of which by Cuvier in (1) aroused such excitement, and also of the ancestors of the great bovine family. This central Asiatic fauna, discovered by Andrews, Granger, Berkey and Borissiak, is accordingly highly characteristic of the Northern Hemisphere—it is the ancient Holarctic or North Hemispheral fauna of the world.

Henry Fairfield Osborn
American Museum of
Natural History

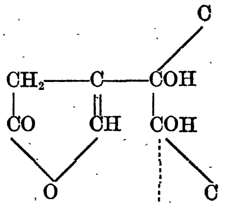
THE STRUCTURAL CORRELATION OF GITOXIGENIN WITH DIGITOXIGENIN

It has been the assumption that digitoxigenin and gitoxigenin, the two aglucones found in the principal cardiac glucosides of the digitalis plant, are structurally very closely related. Recent work from our laboratory as well as from that of Windaus and coworkers has brought partial confirmation of this assumption. However, to what extent the structural analogy between these substances may be developed remained to be determined. The solution of this question, which is of great importance in the problem of the structural chemistry of the digitalis glucosides, has now been practically completed. Our recent investigations, which will be published more fully elsewhere, have conclusively shown that gitoxigenin is hydroxydigitoxigenin. The hydroxyl group which is presumably of tertiary character is situated probably on a carbon atom adjoining the one which bears the other tertiary hydroxyl of digitoxigenin and which is involved in the isomerization to iso compounds.

This relationship is shown in the following partial formulas:



digitoxigenin

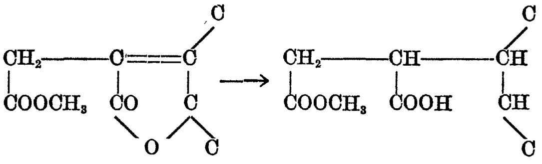


gitoxigenin

In all other respects the two aglucones are structurally identical. These conclusions have been reached from the study of the following series of substances.

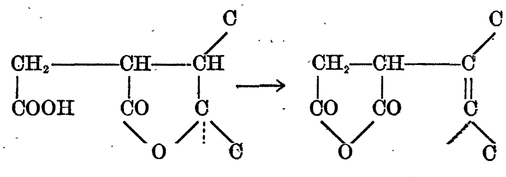
Gitoxigenin on isomerization by alkali is converted into isogitoxigenin.[1] On saponification of the lactone group of the latter substance, the salt of isogitoxigeninic acid results, which can be oxidized by hypobromite to isogitoxigenic acid. When the latter is treated with concentrated hydrochloric acid, the remaining tertiary hydroxyl is replaced by chlorine with the formation of chloroisogitoxigenic acid. Simultaneously stereo-isomerization occurs under the influence of the reagent on some center of asymmetry in the molecule. The chlorine atom in this acid can be removed under certain conditions as hydrochloric acid with the production of anhydro isogitoxigenic acid.

It was hoped that on catalytic hydrogenation this anhydroacid (as the ester) would absorb one mol of hydrogen with the formation of a substance identical, or at least isomeric, with the previously described isodigitoxigenic acid obtained from isodigitoxigenin. The reaction, however, took an abnormal course in that two mols of hydrogen were consumed. Investigation showed that not only was the double bond hydrogenated but the lactone group was cleaved with the formation of a saturated acid in accordance with the following scheme:



On saponification this half ester readily yielded the dibasic acid.

Following a number of unsuccessful attempts the identical dibasic acid was obtained also from digitoxigenin through the following steps. Isodigitoxigenin[2] after saponification was oxidized by hypobromite to isodigitoxigenic acid. On treatment with concentrated hydrochloric acid the latter was isomerized to γ-isodigitoxigenic acid. When treated with acetic anhydride and acetyl chloride a reaction occurred, which involved cleavage of the lactone group and formation of a substituted succinic anhydride while simultaneously the newly uncovered hydroxyl group was removed as water.[3] The secondary hydroxyl group elsewhere in the molecule was also acetylated. When this anhydro anhydride acetate (acetate of anhydro-γ-digitoxenoldiacid)



was treated with methyl alcohol containing one per cent. of hydrochloric acid, the succinic anhydride group was converted into the half ester. Catalytic hydrogenation of the resulting unsaturated half ester gave rise to the saturated substance, the acetate and half ester of γ-digitoxanoldiacid. On saponification γ-digitoxanoldiacid was produced and this substance proved to be identical with the above described dibasic acid obtained from gitoxigenin. This conclusion was substantiated by the comparison of the neutral dimethyl esters prepared from both acids as well as of the stable half esters which resulted on partial saponification of the latter.

WALTER A. JACOBS
EDWIN L. GUSTUS

THE ROCKEFELLER INSTITUTE
FOR MEDICAL RESEARCH

BOOKS RECEIVED

The American Annual of Photography. 1930. Vol. XLIV. Edited by Frank R. Fraprie. Pp. 272. Illustrated. The American Photographic Publishing Company. $1.50.

APPLETON, A. B. *Laboratory Guide to Vertebrate Dissection.* Pp. xix + 152. Cambridge University Press. 6s.

CONKLIN, EDMUND S. *Psychology of Religious Adjustment.* Pp. xiv + 340. Macmillan. $2.00.

DAMPIER-WHETHAM, W. C. D. *A History of Science.* Pp. xxi + 514. Cambridge University Press. 18s.

DANIELS, FARRINGTON, J. HOWARD MATHEWS and JOHN WARREN WILLIAMS. *Experimental Physical Chemistry.* Pp. xvi + 475. 132 figs. McGraw-Hill. $3.50.

DICKSON, LEONARD E. *Introduction to the Theory of Numbers.* Pp. viii + 183. University of Chicago Press. $3.00.

POLLARD, A. F. C. *The Kinematical Design of Couplings in Instrument Mechanisms.* Pp. 64. 25 figs. Adam Hilger, London. 4s. 6d.

POOL, RAYMOND J. *Flowers and Flowering Plants.* Pp. xx + 378. 191 figs. McGraw-Hill. $3.50.

RAMSAY, SIR WILLIAM, and F. G. DONNAN, Editors. *The Effects of Moisture on Chemical and Physical Changes.* Pp. xii + 235. 44 figs. 50 tables. Longmans, Green. $5.00.

---

[1] W. A. Jacobs and E. L. Gustus, *J. Biol. Chem.*, 1928, 79: 553; 1929, 82: 403.

[2] W. A. Jacobs and E. L. Gustus, *J. Biol. Chem.*, 1928, 78: 573.

[3] W. A. Jacobs and E. L. Gustus, *J. Biol. Chem.*, 1929, 84: 183.