as determined by melting and mixed melting points, optical rotation and crystal form with oleanene III, obtained by Winterstein and Stein[2] from oleanolic acid. Inasmuch as the preparation of both hydrocarbons involves a Clemmensen reduction which Winterstein and Stein[2] have shown results in a molecular rearrangement in the case of oleanene III, and both hydrocarbons are decarboxylated derivatives, it is not possible to state that echinocystic acid and oleanolic acid have exactly the same skeletons but the possibility that such is the case is very likely.

Experimental

A solution of 0.132 g. of norechinocystenone in 250 cc. of 95% ethyl alcohol was added to 5 g. of amalgamated zinc. The mixture was boiled under a reflux condenser and a slow stream (2–3 bubbles per second) of dry hydrogen chloride was passed in for thirty-six hours. The solution was poured into an equal volume of water and evaporated to 50 cc. After dilution with water to 100 cc. the mixture was extracted with ether. The ether layer was washed with dilute hydrochloric acid, sodium hydroxide and water and dried over anhydrous sodium sulfate. After removal of the ether the residue was crystallized from methyl alcohol in which it is only slightly soluble, and then from acetone to a constant melting point of 224–225°; $[\alpha]^{25}_{D}$ +31.3 ± 3°; c = 1.408 in toluene, l = 0.5 dm.

Anal. Calcd. for $C_{29}H_{48}$: C, 87.80; H, 12.20. Found: C, 87.79; H, 12.12.

The same product as determined by melting and mixed melting points was obtained on reducing norechinocystendione by the above procedure.

Oleanylene II and oleanene III were prepared from oleanolic acid[3] according to the procedures of Winterstein and Stein.[2] The oleanene III was crystallized twice from glacial acetic acid and then from acetone until its melting point was 216.5–220.5°[4]; $[\alpha]^{25}_{D}$ +30.7 ± 3°; c = 2.082 in toluene, l = 0.5 dm.

A mixture with an equal part of the hydrocarbon obtained from norechinocystenone, m. p. 218–221.5°[4], melted at 216.5–221°. The melting points of the mixture and of the two pure products were taken simultaneously in the same bath. Slow evaporation of solutions of the hydrocarbons from both sources gave well formed hexagonal plates which were indistinguishable under a lens. The properties of oleanene III recorded by Winterstein and Stein[2] are m. p. 225–226°; $[\alpha]^{20}_{D}$ +30.1, c = 1.76 in chloroform.

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(2) Winterstein and Stein, *Ann.*, **502**, 223 (1933).

(3) We are indebted to Dr. C. N. Anderson of Lever Brothers Company, Cambridge, Mass., for a supply of crude barium oleanolate derived from clove oil residues.

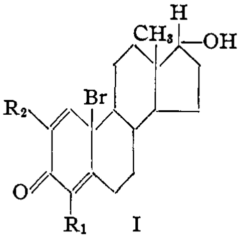
(4) The maximum melting point of 224–225° is obtained only with difficulty and large losses, so that the lower melting product was used for comparison purposes.

2,4-Dibromo-α-oestradiol

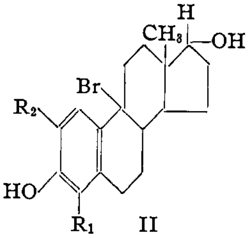
BY ROBERT BURNS WOODWARD

As evidenced by the investigations of Doisy,[1] Butenandt,[2] and Marrian,[3] the phenolic sex hormones are extensively halogenated under the conditions obtaining in the determination of the iodine number with the Rosenmund–Kuhnmann reagent. The number of halogen atoms consumed by one mole of the hormone varied widely with the conditions. Although both Butenandt and Doisy isolated halogen-containing products, these were insufficiently characterized and until further investigation must be regarded as of equivocal nature. Only in the case of equilenin has a definitely pure halogen-substituted hormone been prepared, *viz.*, monobromoequilenin, prepared by Girard, *et al.*,[4] likewise by the action of the Rosenmund–Kuhnmann reagent. On the other hand, Marrian and Haslewood[3] found that the methyl ethers of the hormones consumed approximately one mole of halogen quite smoothly in the iodine number determinations, and this result was confirmed by the isolation of monobromoestrone methyl ether and monobromoestriol methyl ether.

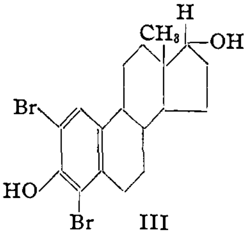
In the course of a related investigation, we have found that α-oestradiol is converted smoothly and almost quantitatively into a dibromoestradiol on standing overnight in alcohol solution with the theoretical quantity of N-bromoacetamide. Since no halogen was removed on treatment with alcoholic silver nitrate or potassium hydroxide, the product was not 2-(*or* 4)-10-dibromo-$\Delta^{1,4}$-oestra-



I



II



III

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(1) Thayer, Levin and Doisy, *J. Biol. Chem.*, **91**, 791 (1931).

(2) Butenandt, Störmer and Westphal, *Z. physiol. Chem.*, **208**, 149 (1932).

(3) Marrian and Haslewood, *J. Soc. Chem. Ind.*, **51**, 277T (1932).

(4) Girard, Sandulesco, Fridenson and Rutgers, *Compt. rend.*, **195**, 981 (1932).

dienon-3-ol-17 (I, R_1 *or* R_2 = H *or* Br), nor the corresponding pseudo-bromide, 2-(*or* 4)-9-dibromo-α-oestradiol (II, R_1 *or* R_2 = H *or* Br). Consequently our product has the only alternative structure, 2,4-dibromo-α-oestradiol (III).

It is highly probable that the introduction of bromine by bromoacetamide will be of service in the case of other phenolic compounds which defy clean-cut halogenation by the more usual methods.

Experimental

One-half gram of α-oestradiol and 0.54 g. of recrystallized N-bromoacetamide were dissolved in 40 cc. absolute alcohol and the reaction mixture was allowed to stand at room temperature for about eighteen hours. By this time the originally faintly yellow solution had become almost colorless. The alcohol solution was evaporated on the hot plate to about one-third of its volume and allowed to cool, when the brominated product was precipitated by the addition of water. On crystallization from alcohol–water, 0.54 g. of 2,4-dibromo-α-oestradiol was obtained as beautiful colorless rosets of needles, melting at 215.5–216.5° (cor.) to an emerald-green liquid, with gas evolution. From the filtrate another 0.2 g. of the product was obtained by dilution with water and recrystallization.

Anal.[5] Calcd. for $C_{18}H_{22}O_2Br_2$: C, 50.20; H, 5.14. Found: C, 50.10; H, 5.13.

No turbidity developed when an alcoholic silver nitrate solution of the substance was allowed to stand for twenty hours, and the material was recovered unchanged after solution for an hour in alcoholic potassium hydroxide.

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(5) Analysis by D. M. Bowen.

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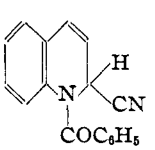
The Formation of Reissert's Compounds in Non-aqueous Media

BY ROBERT BURNS WOODWARD

By shaking quinoline with benzoyl chloride and an aqueous solution of potassium cyanide, Reissert[1] prepared 1-benzoyl-1,2-dihydroquinaldonitrile (I).



I

This compound was remarkable in that it split on hydrolysis into benzaldehyde and quinaldinic acid. The availability of a considerable number of substances differing from Reissert's original compound only in the nature of the acyl group would afford the possibility of a new general method for the reduction of carboxylic acids to aldehydes. However, the ready hydrolysis of many aliphatic acid chlorides vitiates Reissert's original method.

In an attempt to surmount this difficulty, we have investigated the formation of Reissert's compound in non-aqueous media. Dieckmann and Kämmerer[2] observed the formation of the substance in unstated amount while investigating the action of quinoline and other tertiary bases in accelerating the formation of benzoyl cyanide from benzoyl chloride and hydrogen cyanide in ether solution. We found that the formation of acyl cyanide was largely preponderant when benzoyl chloride was used and exclusive in the case of acetyl chloride, either on conducting the reaction in ether or other inert solvents, or on using quinoline as its own solvent. No reaction was observed when acetonitrile, benzonitrile, ether, dioxane, acetone or chloroform was substituted for water in the original procedure of Reissert.

On the other hand, quinoline and potassium cyanide reacted smoothly with either benzoyl or cinnamoyl chloride[3] in liquid sulfur dioxide to give the corresponding aroyl dihydroquinaldonitrile in excellent yield. The use of acetyl chloride, however, led to the formation of intractable dark mixtures from which no pure product could be isolated.

The striking difference in this case between liquid sulfur dioxide and the organic solvents is in consonance with the probable ionic character of the reaction.

Experimental

1-Benzoyl-1,2-dihydroquinaldonitrile.—Ten grams of benzoyl chloride, 10 g. of quinoline (freshly distilled *in vacuo*) and 7 g. of potassium cyanide were placed in a pressure bottle. After approximately 35 cc. of liquid sulfur dioxide had been added, the bottle was sealed and allowed to stand with occasional shaking for twenty-four hours. The sulfur dioxide was then allowed to evaporate, and the residue washed successively with water, dilute hydrochloric acid and ether. On crystallization from alcohol of the white powder so obtained, 16 g. of 1-benzoyl-1,2-dihydroquinaldonitrile separated as glistening needles, m. p. 154–155°, of a very faint greenish tinge which was lost on two further crystallizations.

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[1] Reissert, *Ber.*, **38**, 1610 (1905).

(2) Dieckmann and Kämmerer, *ibid.*, **40**, 3737, Note 2 (1907).

(3) *Cf.* Sugasawa and Tsuda, *J. Pharm. Soc. Japan*, **56**, 557 (1936); *C. A.*, **32**, 5836 (1938). The original is here incorrectly reported as appearing on p. 103.