COMMUNICATIONS TO THE EDITOR

DIMENSIONS OF SOAP MOLECULES AS SUPPOSEDLY DEDUCED FROM SURFACE TENSION MEASUREMENTS

Sir:

The surface tension measurements of Du Noüy [*Phil. Mag.*, [6] **48,** 664 (1924)] as carried out with the ring method were recently reproduced by Washburn and Berry [This Journal, **57,** 975 (1935)] using the capillary rise method for sodium palmitate solutions. The equilibrium surface tension–concentration curve shows three minima and the same number of maxima.

According to the Gibbs theorem for these concentrations no adsorption at all takes place. Instead, the interpretation of Du Noüy as now repeated by Washburn and Berry introduces the hypothesis that the minima are due to condensed films on the water surface, but differing in orientation corresponding to the three dimensions of the adsorbed molecule. No other confirmation for the validity of this view has been available.

However, the assumptions on which the theory of Du Noüy is based—besides contradicting the thermodynamics of Gibbs—are also objectionable. First, the acceptance of the supposition that the adsorbed quantities are proportional to the concentrations is quite untenable. Second, in calculating the surface tensions the possible influence of the angle of contact was completely disregarded, because it was tacitly taken for granted that perfect wetting always occurred.

This point, alone, seems to lead to a very plausible explanation of the experiments, if they are compared with the wonderful results of Miss Blodgett [This Journal, **57,** 1007 (1935)], who proved the existence of polymolecular soap films of alternating orientation as adsorbed on glass and other solids, when in contact with the solutions. The same phenomenon, unfortunately, is to be expected at the platinum ring of Du Noüy as well as at the walls of the glass tubes.

As Miss Blodgett showed, the first layer of molecules is always fixed with the active groups toward the adsorbent, whereas the paraffin groups are directed toward the solution. Therefore, with increasing concentration the glass or platinum is covered at first with a film of paraffin character which, as is well known, repels water. But the second layer may be orientated in the opposite direction, causing a decrease of the angle of contact. Consequently the apparent surface tension rises, unless a new paraffin surface is deposited.

The author in collaboration with E. J. Better applied the bubble pressure method, as being independent of the angle of contact, for the measurement of oleate solutions. Only one minimum was found, and that at a higher concentration than any of the minima of Du Noüy.

Stanford University, Calif. Hans M. Cassel

Received August 21, 1935

THE RELATIONSHIP OF ERGOTOCIN TO ERGOMETRINE

Sir:

Dudley and Moir [*Brit. Med. J.*, i, 520 (1935)] recently described the isolation from ergot of an alkaloid, chemically and pharmacologically different from any of the then known alkaloids of ergot, which they named ergometrine.

Although there were strong grounds for believing that ergotocin [Kharasch and Legault, This Journal, **57,** 956 (1935)] was identical with ergometrine, Kharasch and Legault have not adopted this view, but have suggested that the two substances may be different [*e. g.*, *Lancet*, i, 1243 (1935)]. They have now published a formula, $C_{21}H_{27}O_3N_3$, for ergotocin [This Journal, **57,** 1140 (1935)], while analyses of ergometrine and its salts now very accessible [Dudley, *Pharm. J.*, iv, **80,** 709 (1935)] indicate the formula $C_{19}H_{23}O_2N_3$, which is still being critically examined. [Further work on this substance since this "Communication" was dispatched (July 11, 1935) affords convincing evidence that this formula is correct.]

Ergometrine: *Anal.* Calcd. for $C_{19}H_{23}O_2N_3$: C, 70.15; H, 7.08; N, 12.92. Found: C, 70.0; H, 6.96; N, 12.91.

Ergometrine Hydrobromide. *Anal.* Calcd. for $C_{19}H_{23}O_2N_3\cdot HBr$: C, 56.15; H, 5.91; N, 10.35; Br, 19.71. Found: C, 56.24; H, 6.19; N, 10.71; Br, 19.76.

Ergometrine Hydrochloride. *Anal.* Calcd. for $C_{19}H_{23}O_2N_3\cdot HCl$: C, 63.08; H, 6.64; N, 11.62; Cl, 9.82. Found: C, 63.1; H, 6.81; N, 11.29; Cl, 9.54.

Ergometrine Oxalate: *Anal.* Calcd. for $C_{19}H_{23}O_2N_3\cdot$

$H_2C_2O_4$: C, 60.73; H, 6.02; N, 10.12. Found: C, 60.58; H, 5.98; N, 10.18.

Taken by themselves these formulas would seem to support Kharasch and Legault's contention, but all other available evidence points to the identity of the substances. It is therefore probable that the apparent difference in elementary composition is not real, and that further analyses of ergotocin and its salts may yet lead to the establishment of its complete identity with ergometrine.

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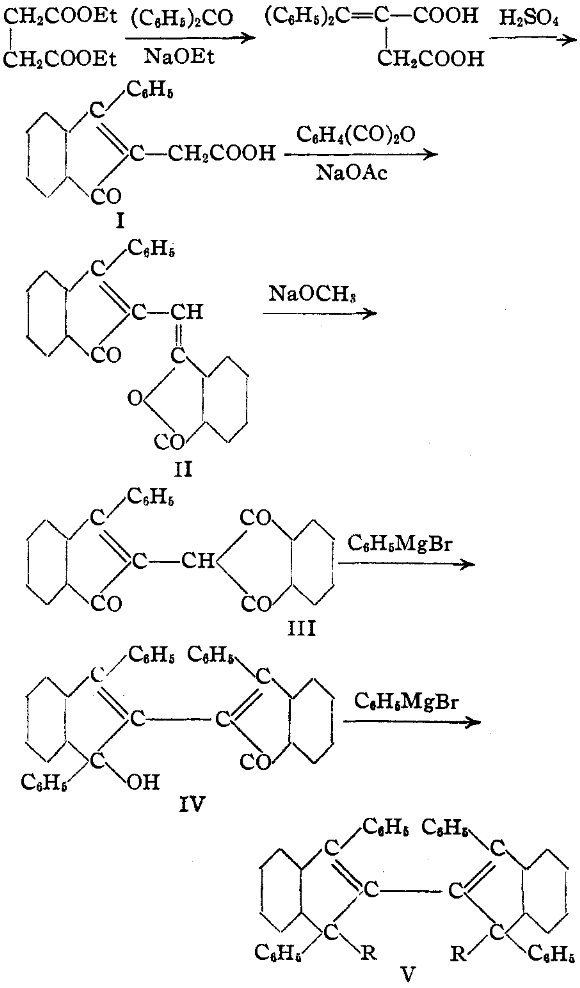
RECEIVED JULY 22, 1935

THE SYNTHESIS OF BIS-2,2'-(1,3-DIPHENYLINDENOL-3)

Sir:

In connection with attempts to synthesize rubrene we have prepared bis-2,2'-(1,3-diphenylindenol-3) by the following series of reactions



I

II

III

IV

V

TABLE I

PROPERTIES OF COMPOUNDS INVOLVED

Compound	M. p., °C.	Formula	Analyses, % Calcd. C	H	Found C	H
I	166–167	$C_{17}H_{12}O_3$	[a]			
II	173.5–174	$C_{24}H_{14}O_3$	82.2	4.0	81.9	4.3
III	190.5–191.5	$C_{24}H_{14}O_3$	82.2	4.0	82.0	3.9
IV	244–245	$C_{36}H_{24}O_2$	88.5	4.9	88.0	4.8
V, R = OH	292	$C_{42}H_{30}O_2$	89.0	5.3	89.0	5.5
V, R = Cl	237–242	$C_{42}H_{28}Cl_2$	83.6	4.6	83.6	4.6

[a] Stobbe and Vieweg, *Ber.*, **35**, 1728 (1902).

The product is identical with the one obtained by a different method by Eck and Marvel [THIS JOURNAL **57**, 1898 (1935)].

TABLE II

PROPERTIES OF BIS-2,2'-(1,3-DIPHENYLINDENE) DERIVATIVES

Compound	Source	M. p., °C.[c]	Mixed m. p., °C.[d]
V, R = OH	[a]	293	
			291
	[b]	292	
V, R = Cl	[a]	240–245	
			237–242
	[b]	237–242	

[a] Eck and Marvel. [b] Koelsch and Richter. [c] Melting involves decomposition, and the temperature at which it occurs depends to some extent on the stage of subdivision of the compound and on the rate of heating. [d] We are indebted to Professor Marvel for the melting points reported here.

Like these authors we have found the derived dichloride to be unreactive toward metals (zinc or mercury). The dichloride, however, appears to give an alkali derivative with 40% sodium amalgam and we hope to make use of this reaction in converting it into the di-radical.

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C. F. KOELSCH
H. J. RICHTER

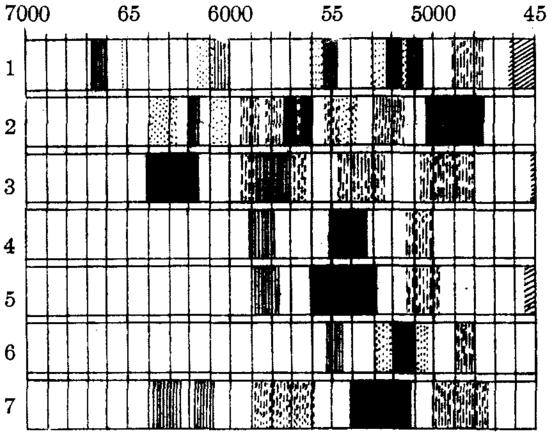
RECEIVED SEPTEMBER 18, 1935

FORMATION OF PORPHYRINS FROM PYRROLE AND ALDEHYDES

Sir:

Porphyrin formation was observed under the following conditions: pyrrole, C. P., was dissolved in a solution of gaseous acetaldehyde (I) or formaldehyde (II) in methanol (saturated in the cold), and the reaction mixture was either (a) kept at room temperature for several weeks, or (b) heated under reflux for fifteen to twenty-five hours, or (c) heated in a sealed tube to 85–90° for ten to twenty hours in a water-bath.

The reaction mixture was then subjected to vacuum distillation to remove the methanol and the aldehyde; the oily residue was taken up in warm pyridine, transferred into ether and the ether solution was fractionated with hydrochloric acid. The results are indicated in a somewhat abbreviated form in the chart of the absorption spectra.



Absorption spectra.

(1) Porphyrin from reaction I (pyrrole + acetaldehyde) in ether. (2) Porphyrin from reaction II (pyrrole + formaldehyde) in ether. (3) Porphyrin from reaction I in 0.05% hydrochloric acid. (4) Porphyrin from reaction II in 3.0% hydrochloric acid. (5) Copper complex salt of porphyrin from reaction I in ether. (6) Copper complex salt of porphyrin from reaction II in ether. (7) 3% hydrochloric acid fraction from the reaction pyrrole + furfuraldehyde in ether.

The main fraction in case I enters 0.5% hydrochloric acid and has a hydrochloric acid number of 0.075. The main fraction in case II enters 3% hydrochloric acid, its hydrochloric acid number is 3.3. The porphyrin from I crystallized in rhomb-shaped crystals, the one from II in platelets. The corresponding copper complex salts and hemins were prepared.

The yield increased upon addition of pyridine to the original solution, or when suitable agents (*e. g.*, $CaCO_3$ + MgO, $PbCrO_4$) were added; the resulting porphyrins were different from the ones mentioned above when the reaction was performed in presence of PbO_2.

Further studies are in progress to secure information on the structure of the porphyrins formed, and to determine the applicability of the reaction to other aldehydes; a comprehensive report of the research will soon be published. From theoretical considerations and in the light of numerous porphyrin syntheses by H. Fischer [*Ann.* since 1926; H. Fischer and H. Orth, "Die Chemie des Pyrrols," Leipzig, 1934 and 1935], the main porphyrin formed from acetaldehyde and pyrrole seems to be $\alpha,\beta,\gamma,\delta$-tetramethylporphin. The reaction between formaldehyde and pyrrole apparently leads to porphin, the as yet hypothetical tetracyclic parent ring system of the porphyrins, and hence, also the fundamental structure in the physiologically important pigments, hemin and chlorophyll.

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PAUL ROTHEMUND

RECEIVED AUGUST 23, 1935

CONTRIBUTION TO THE KNOWLEDGE OF THE TESTICULAR HORMONE

Sir:

The communication of E. S. Wallis and E. Fernholz [THIS JOURNAL, **57**, 1511 (1935), received July 15] occasions the present note. In an article accepted on June 1 and published in the number of *Helv. Chim. Acta* [**18**, 986 (1935)] which appeared on July 1, we described the preparation of androstene-3,17-dione (I) and suggested the probability that the testicular hormone (not then isolated) is identical either with this diketone or with androstene-3-one-17-ol (II).

At our request, Dr. E. Tschopp in Basel began the investigation of this hypothesis by submitting (I) to the usual tests on capons and castrated rats. The details of his study, which were communicated to the League of Nations committee in London (July 15–17), will be published elsewhere; they are summarized in the table.

Substance investigated	Capon unit	Seminal vesicle wt. in mg. after 20 days[a] 50 γ daily	100 γ daily	200 γ daily
(I) Androstene-3,17-dione	100 γ	25	51	285
(III) Androstane-3,17-dione	100 γ	16	27	51
(IV) Androstane-3,17-diol	15 γ	14	25	40
(V) Androsterone	60 γ	11	14	17

[a] The control animals had a seminal vesicle weight of about 6 mg.

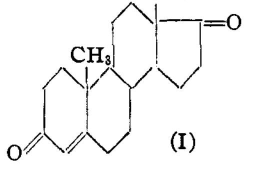
Compared in terms of capon units, (I) is five times as effective on seminal vesicle growth as (V), on the basis of the 50 γ daily dose; on the basis of the 200 γ daily dose, however, (I) is 25 times as effective as (V). The corresponding activity ratios for (IV) and (I) are 1:12 and 1:50, respectively.

This constituted the first description of the physiological activity of a substance of known constitution which exhibits the relationship between rat-tests and capon-test potency characteristic of testicular extracts. The natural expectation that this observation would prove significant in the elucidation of the constitution of the testicular hormone was fulfilled with surprising promptitude.

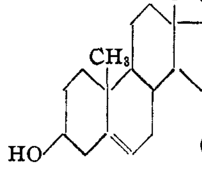
Laqueur, *et al.* [*Z. physiol. Chem.*, **233,** 281 (1935), appearing on June 7] described the isolation of a testicular hormone of unknown constitution (m. p. 154°), with a capon activity of about 10 γ, which was called testosterone (VI). Although (VI) showed the characteristic difference in capon-test and rat-test effectiveness, the published figures do not permit a rigorous comparison with (I).

At London, Laqueur expressed the opinion, based on chemical evidence, that (VI) is an isoandrosterone. The physiological activity of (I) suggested further investigation of (VI) and we have recently learned by private communication from Prof. Laqueur that (VI) yields (I) upon oxidation. Therefore it appears highly probable that formula (II) is that of testosterone (VI).

In pursuance of the program outlined in our paper (*loc. cit.*) we reduced androstene-3-ol-17-one (VII) with sodium and alcohol to androstene-3,17-diol (VIII), m. p. 175–178° corr. Utilizing the greater reactivity of the 3-substituent we partially oxidized the dibromide of (VIII) to produce (II) upon subsequent debromination. We also partially saponified the diacetate of (VIII) to produce the 17-monoacetate, which, upon oxidation of its dibromide and debromination, should yield the acetate of (II).



(I)



(VIII)

Further details will be published elsewhere, and we hope that the previous announcement of our research program (*loc. cit.*), together with the work initiated before the isolation of testosterone, may serve as a reservation of this project.

Footnote (*Sept. 7*).—At the time this note was written the author was unaware that testosterone (androstene-3-one-17-ol) had already been synthesized in his laboratory in Zürich by his assistants. The substance was made by partially saponifying the unsaturated diol diacetate and oxidation of the monoacetate dibromide.

GEORGE HERBERT JONES LABORATORY L. RUZICKA
UNIVERSITY OF CHICAGO
CHICAGO, ILLINOIS

RECEIVED AUGUST 20, 1935

EXPERIMENTS ON THE CONSTITUTION AND PREPARATION OF THE TESTICULAR HORMONE

Sir:

In the preceding Communication of L. Ruzicka it is evident from the dates given that the publication of his experiments on the preparation of androstendione-3,17 antedates the publication of our experiments on the preparation of this same compound. However, we would like to state that the particular issue of the *Helv. Chim. Acta* to which reference is made was not received in our library until August 8, three days after the publication of our experiments, and that a sample of dehydroandrosterone prepared by our method (received by THIS JOURNAL, June 4) was sent to Professor Butenandt on May 20. We were unaware, therefore, of Professor Ruzicka's experiments, and our suggestion as to the constitution of the testicular hormone and our experiments on its preparation were made independently. At the time of the appearance of his article in the *Helv. Chim. Acta* we were engaged in the preparation of 17-hydroxy-androsten-one-3, and we had succeeded in preparing androstendiol (m. p. 175°), and its diacetate (m. p. 159°) by the reduction of our synthetically prepared dehydroandrosterone when the above Communication reached us. In view of Professor Ruzicka's Communication, and of his request that this project be reserved we are discontinuing our work in this particular direction.

FRICK CHEMICAL LABORATORY EVERETT S. WALLIS
PRINCETON UNIVERSITY E. FERNHOLZ
PRINCETON, N. J.

RECEIVED SEPTEMBER 23, 1935

THE PREPARATION OF β-CHLOROVINYLARSINE SULFIDE

Sir:

β-Chlorovinylarsine sulfide was first described by Lewis and Stiegler [THIS JOURNAL, **47,** 2546 (1925)] as a clear, amber-colored plastic mass insoluble in the usual solvents other than carbon disulfide and possessing an extraordinarily irritating and noxious odor.

We have succeeded in obtaining this substance, β-chlorovinylarsine sulfide, in a crystalline condition by the following procedure. Hydrogen sulfide was conducted for two hours through a solution of 45 g. of β-chlorovinyldichloroarsine (b. p. 78° at 12 mm.) in 50 cc. of alcohol. The solution became noticeably warmer and a yellow viscous oil gradually separated out. After two hours separation ceased and this was taken as the end of the reaction. The resulting product was an amber-yellow viscous oil which adhered to the walls of the flask. The alcoholic solution was poured off, the oil washed repeatedly with alcohol and then dissolved with warming in carbon disulfide. After cooling and distilling off part of the solvent, the substance separated in crystalline form. In order to obtain a more complete separation an equal volume of benzene may be added to the solution; yield 20 g. or 51% of the theoretical. After recrystallization from benzene and drying in a vacuum desiccator, the melting point was 114°.

Anal. Calcd. for C_2H_2ClSAs: As, 44.49; Cl, 21.05; S, 19.03. Found: As, 44.55; Cl, 21.06; S, 19.27.

β-Chlorovinylarsine sulfide crystallizes in cubes, possesses a pale yellow color and a weak, not unpleasant, odor; is easily soluble in carbon disulfide, less so in benzene and ether and insoluble in water. Under the influence of sunlight the substance acquires an orange color.

Moscow, U. S. S. R. S. L. Warschawski

Received July 17, 1935

THE ISOLATION OF CROTYL AND METHYLVINYLCARBINYL BROMIDES

Sir:

The composition of bromide mixtures arising from the action of hydrogen bromide and phosphorus tribromide on crotyl alcohol or methylvinylcarbinol has been the subject of much discussion. Some claim that pure products [Charon, *Ann. chim. phys.*, [7] **17,** 216 (1899); Prévost, *Ann. chim.*, **10,** 113 (1928); Claisen and Tietze, *Ber.*, **59B,** 2344 (1926); Juvala, *Ber.*, **63B,** 1989 (1930)] are obtained from alcohols of this type while others report the formation of mixtures of bromides but have not separated them [Baudrenghien, *Bull soc. chim. Belg.*, **31,** 160 (1922); Meisenheimer and Link, *Ann.*, **479,** 211 (1930); Young and Prater, This Journal, **54,** 404 (1932); Gredy and Piaux, *Bull. soc. chim.*, [5] **1,** 1481 (1934)]. The bromides obtained in this Laboratory have always been mixtures. We have recently separated these mixtures into the primary (crotyl bromide) and secondary (methylvinylcarbinyl bromide) isomers by fractional distillation at 0°. The properties are $n^{23}\mathrm{D}$ 1.4805 and 1.4612; d^{25}_4 1.3335 and 1.2998; b. p. 49° and 31.0° at 93 mm., >107° and 86.5° at 760 mm., and +2.0° at 5 mm. and −2.0° at 14 mm. for the primary and secondary isomers, respectively. Mixtures of these bromides may be analyzed from density or refractive index measurements since these properties are linear functions of the composition.

Both of the pure bromides rearranged to an equilibrium mixture of 14% secondary and 86% primary in a few days at room temperature, in less than one hour at 75° and in less than five minutes at 100°. If a mixture of the bromides is subjected to slow distillation at atmospheric pressure through a 100-cm. packed column, almost pure secondary bromide is obtained as a distillate. Equilibrium is so rapidly established in the boiler that the secondary bromide is replaced as fast as it is removed from the top of the column.

It is now evident that the bromides reported by Juvala, Baudrenghien and Gredy and Piaux having $n^{23}\mathrm{D}$ 1.4750 to 1.4759 contained from 24–29% of secondary bromide. Their compositions were dependent on the method of distillation and had nothing to do with the method of preparation. The bromides used by Gredy and Piaux must have gone to equilibrium after the refractive index was taken and before the Raman spectra were measured, since their analysis of 90% primary and 10% secondary is qualitatively in agreement with the equilibrium composition and not with the composition calculated from the refractive index.

In the light of these developments, crotyl alcohol and methylvinylcarbinol are being converted into bromide mixtures by various reagents under conditions designed to avoid rearrangement of the product. The composition of these mixtures will be reported in the near future.

Department of Chemistry William G. Young
University of California at Los Angeles
Los Angeles, California Saul Winstein

Received August 12, 1935