Pyrogallol, dissolved in pure water, was also found to be oxidized but only after addition of a little palladium.[4]

In the second series, ascorbic acid (Vitamin C) instead of hydrogen was used as a reductant. It was added to the reaction vessel containing the dye through a stopcock funnel in amount just sufficient to reduce the dye. When thereafter nitric oxide was bubbled through the system, no oxidation of the leuco-dye took place, but on the addition of a few drops of colloidal palladium, oxidation occurred. With tetramethyl- or tetraethyl-*p*-phenylenediamine no previous reduction is necessary. These were dissolved in acetate buffer and de-aerated with nitrogen. They are oxidized by NO, but only in the presence of palladium.

A further series of experiments, using the same apparatus, was made with inorganic salts. Nitric oxide passed into an aqueous solution of ferrous sulfate, pyrophosphate and tartrate gave deeply colored solutions of the nitroso complexes. When, however, the nitric oxide was removed by passing purified nitrogen through the solution,[5] it could be shown that no oxidation had taken place either in the presence or absence of palladium. From the literature it is known that chromous and stannous salts in aqueous solution are oxidized by nitric oxide without a catalyst, ammonia and hydroxylamine being formed. We found, in addition, that when nitric oxide was passed through solutions of cuproammino or chloro complexes prepared in the reaction vessel from the corresponding cupric complex and metallic copper, slow oxidation took place either to the complex cupric salt or to the complex nitroso cupric salt.

CONTRIBUTION FROM THE
LABORATORIES OF THE
ROCKEFELLER INSTITUTE
FOR MEDICAL RESEARCH
NEW YORK CITY
RECEIVED APRIL 30, 1935

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[4] According to Oppenheimer [*Ber.*, **36**, 1744 (1903)], pyrogallol is oxidized without catalyst in alkaline solution, nitrous oxide being formed.

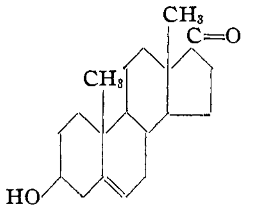
[5] *Cf.* Manchot, *Ber.*, **47**, 1601, 1614 (1914).

COMMUNICATIONS TO THE EDITOR

THE CONSTITUTION OF DEHYDRO-ANDROSTERONE AND ITS PREPARATION FROM CHOLESTEROL

Sir:

In the course of certain experiments on male urine, there has been isolated besides androsterone, $C_{19}H_{30}O_2$, an unsaturated hydroxy ketone of the formula $C_{19}H_{28}O_2$, which has been called dehydro-androsterone [Butenandt and Dannenbaum, *Z. physiol. Chem.*, **229**, 192 (1934)]. In most of these experiments this hydroxy ketone has not been isolated as such, but rather has been obtained in the form of its chloride derivative. Butenandt has transformed this hydroxy ketone into androsterone, and therefore the constitutional formula, I, has been assigned. The position of the double bond and the arrangement of the hydroxyl group in this formula are still uncertain. The name assigned to this unsaturated hydroxy ketone suggests that the hydroxyl group has the same stereochemical arrangement as in androsterone. This seems doubtful to us for the following reasons. Butenandt has shown that on hydrogenation the unsaturated chloro ketone yields a saturated chloro ketone, $C_{19}H_{30}OCl$, which is different from the one which has been prepared by Ruzicka [Ruzicka, Goldberg and Brüngger, *Helv. Chim. Acta*, **17**, 1393 (1934)] by oxidation of β-cholestyl chloride. This suggests that the chlorine atom in the unsaturated chloro ketone isolated from urine does not have the same stereochemical arrangement as the chlorine atom in Ruzicka's chloro ketone but rather it indicates that it



I

possesses the same arrangement as the chlorine atom in cholesteryl chloride. Since it is known that cholesteryl chloride on treatment with sodium acetate in acetic acid yields cholesterol it is to be considered probable that the unsaturated chloro ketone behaves in the same manner and produces an hydroxy ketone, the hydroxyl group of which has the same arrangement as in cholesterol.

In order, therefore, to determine the arrangement of the hydroxyl group in dehydro-androsterone as well as the position of the double bond, we decided to attempt to prepare this ketone from cholesterol by oxidation. It has been found by experiments carried out in this Laboratory that dehydro-androsterone can be prepared from cholesterol by oxidation provided that both the hydroxyl group and the double bond in cholesterol are protected against oxidation. This is accomplished by an oxidation of cholesteryl acetate dibromide with chromic acid. The hydroxy ketone was isolated first in the form of the semicarbazone of its acetate (m. p. 270° with decomposition). Hydrolysis gave a product which melted at 148°, the same melting point which has been reported by Butenandt for dehydro-androsterone. A benzoate was prepared which melted at 250°. This is also characteristic of the benzoate of dehydro-androsterone.

From these results it is to be concluded that dehydro-androsterone isolated from male urine is in reality the epimeric form, that is, the stereochemical arrangement of the hydroxyl group is the same as in cholesterol. As yet, however, we have not been able to compare our substance with the natural product. When this has been done a more detailed report of our experiments will be published in THIS JOURNAL.

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

RECEIVED JUNE 4, 1935

METHYLCHOLANTHRENE

Sir:

The recent communication by Fieser and Newman [THIS JOURNAL, **57,** 961 (1935)] contains the statement, "in a four-step process the German investigators (*i. e.*, Wieland and Dane) converted desoxycholic acid into the actively carcinogenic methylcholanthrene with an over-all yield of approximately 4.3%." This materially underestimates our own share in the investigations on methylcholanthrene, possibly because our publication [*J. Chem. Soc.*, 428 (1934)] was too concisely expressed, and hence conveyed a wrong impression. The actual sequence of events was as follows.

(a) Immediately after the new sterol-bile acid formulation was proposed by Rosenheim and King, attention was directed by Kennaway and Cook [*Chemistry and Industry,* **51,** 521 (1932)] to the possibility of cyclizing the side chain of these natural products to give a structure closely related to that of the known carcinogenic hydrocarbons.

(b) At a discussion meeting of the Royal Society held on June 15, 1933, one of us (J. W. C.) stated that the dehydrogenation of Wieland's dehydronorcholene to a benzanthracene hydrocarbon was under investigation, and the structural formula of the anticipated product, methylcholanthrene, was reproduced in the report of this meeting [*Proc. Roy. Soc.* (London), **B113,** 277 (1933)]. This was the first mention to be made of this carcinogenic hydrocarbon.

(c) In a paper submitted for publication on July 7, 1933, Wieland and Dane [*Z. physiol. Chem.*, **219,** 240 (1933)] reported the dehydrogenation of dehydronorcholene to methylcholanthrene, but adduced no evidence of its structure. As soon as this paper came to our knowledge we published a preliminary account of our own investigations [*Chemistry and Industry,* **52,** 758 (1933)]; we had already succeeded in degrading methylcholanthrene to 5,6-dimethyl-1,2-benzanthraquinone, but had not then identified this quinone.

(d) Our synthesis of the same 5,6-dimethyl-1,2-benzanthraquinone was described in our more complete publication (*loc. cit.*), together with the preliminary tests for carcinogenic activity carried out on methylcholanthrene by Professor E. L. Kennaway. We had obtained a 30% yield of methylcholanthrene by the dehydrogenation of dehydronorcholene, although Wieland and Dane claimed only a 10% yield. This latter figure is presumably the basis of the over-all yield quoted by Fieser and Newman.

While we welcome the interest of our transatlantic colleagues in the line of cancer research which we have thus initiated, we should state that this line of work is being extended here. We have already completed the synthesis of the parent hydrocarbon, cholanthrene, by three different methods.

THE CANCER HOSPITAL (FREE)
LONDON, ENGLAND
J. W. COOK
G. A. D. HASLEWOOD

RECEIVED JUNE 11, 1935

METHYLCHOLANTHRENE

Sir:

In reply to the communication of J. W. Cook and G. A. D. Haslewood under the above title, I should like to disclaim any intention on the part of Newman and myself of underestimating the work of the English investigators on methylcholanthrene. Our note [THIS JOURNAL, **57,** 961 (1935)] was the third of a series of papers on the subject, and in the first paper [Fieser and Seligman, *ibid.*, **57,** 228 (1935)] reference was made to Cook and Haslewood's proof of the structure of methylcholanthrene and to their demonstration, with Kennaway, of its carcinogenic activity. Further reference to the history of the problem seemed beyond the scope of our brief note.

It is quite true that our statement regarding the yield was misleading, and I should like to present an explanation which was omitted before merely in the interest of brevity. Our purpose in estimating the approximate yield of methylcholanthrene from desoxycholic acid by the method first described by Wieland and Dane was to show that the new preparation from cholic acid (which is considerably shorter and more economical) yields about the same amount of material. In the absence of any statements in the literature regarding the yields of recrystallized acids in the first two steps, we used the best results of experiments of our own, namely, 60% for the oxidation and 80% for the reduction. For the cyclization, we took Cook and Haslewood's figure of 30% as being more accurate than the yield (39%) reported by Wieland and Schlichting [*Z. physiol. Chem.*, **150,** 267 (1925)] for a small-scale experiment. For the final step we used the yield of 30% obtained by Cook and Haslewood. I believed that our estimate of 4.3% was a fair one, and the fact that the matter of yields has not been emphasized by the other investigators may excuse us for having considered the details of the calculation sufficiently unimportant to be covered by the word "approximately."

I appreciate the courtesy of Cook and Haslewood in welcoming our participation in the work of developing the important field opened up by the fundamental discoveries of these investigators and their associates at the Cancer Hospital, and I am glad to acknowledge our indebtedness to the English group in providing the inspiration for our efforts to contribute to the cancer problem.

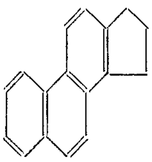
CONVERSE MEMORIAL LABORATORY
HARVARD UNIVERSITY
CAMBRIDGE, MASS.
LOUIS F. FIESER

RECEIVED JUNE 18, 1935

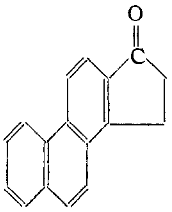
THE SYNTHESIS OF 1,2-CYCLOPENTENOPHENANTHRENE AND RELATED COMPOUNDS

Sir:

β-(2-Phenanthryl)-propionic acid (m. p. 177–177.5°) was obtained through the malonic ester reaction from 2-phenanthrylmethyl bromide; cyclization of the acid chloride by stannic chloride gave 1′-keto-1,2-cyclopentenophenanthrene (m. p. 183–184°); by Clemmensen reduction the ketone was converted to 1,2-cyclopentenophenanthrene (I), which was identical with the product prepared by Cook's method [*J. Chem. Soc.*, 1098 (1933)]. β-(3-Phenanthryl)-propionic acid (m. p. 156–157°) was prepared in a similar manner; the product of cyclization (m. p. 140–140.5°) is probably 1′-keto-2,3-cyclopentenophenanthrene, although the 3,4-structure is not excluded.



(I)

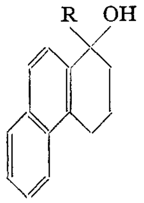


(II)

Of considerable interest as a basic structure of a number of important natural products as the sex hormones is the ketone, 3′-keto-1,2-cyclopentenophenanthrene (II). In order to obtain this ketone we have synthesized β-(1-phenanthryl)-propionic acid through the following series of reactions: phenanthrene ⟶ 1-benzoylphenanthrene ⟶ 1-phenanthraldehyde ⟶ 1-phenanthrylcarbinol ⟶ 1-phenanthrylmethyl bromide ⟶ β-(1-phenanthryl)-propionic acid. The preparation of 1-benzoylphenanthrene has already been described [Bachmann, THIS JOURNAL, **57,** 555 (1935)]. The oxime (m. p. 186°) of this ketone was found to undergo a Beckmann rearrangement to 1-phenanthroic acid anilide (m. p. 245°); from 70 g. of 1-benzoylphenanthrene we obtained

67 g. of the anilide. Reaction of the acid anilide with phosphorus pentachloride followed by reduction of the product by stannous chloride and hydrogen chloride in absolute ether yielded the new phenanthrene aldehyde 1-phenanthraldehyde (m. p. 110–111°; yield, 65%). These reactions now make it possible to prepare many 1-substituted phenanthrene derivatives hitherto difficult to obtain, and we are engaged in the preparation of such compounds. Reduction of the aldehyde to the carbinol (m. p. 165°), followed by a malonic ester condensation with the carbinol bromide (m. p. 97°) gave β-(1-phenanthryl)-propionic acid (m. p. 189–189.5°); experiments on the cyclization of this acid are not yet complete.

The excellent researches of Cook and co-workers [Cook, Dodds, Hewett and Lawson, *Proc. Roy. Soc.* (London), **114**, 278 (1934)] have shown that oestrogenic property is possessed by a variety of polycyclic compounds; and we are having the keto-cyclopentenophenanthrenes and derivatives tested for this property. We have also prepared three 1-hydroxy-1-alkyl-1,2,3,4-tetrahydrophenanthrenes (III) in crystalline state in which the alkyl group R is methyl (m. p. 86–86.5°), ethyl (m. p. 57–57.5°) and *n*-propyl (m. p. 86–87°); these compounds likewise are being tested for oestrogenic activity.



(III)

The physiological tests are being made by Dr. James Bradbury at the University of Michigan Hospital. The details of the experiments will be published later.

CHEMISTRY LABORATORY
UNIVERSITY OF MICHIGAN
ANN ARBOR, MICHIGAN
W. E. BACHMANN

RECEIVED JUNE 13, 1935

THE PREPARATION OF MONOCHLOROACETOCATECHOL

Sir:

In the synthesis of adrenaline according to the method of Stolz [*Ber.*, **37**, 4149 (1904)] the preparation of monochloroacetocatechol is necessary. Chloroacetic acid, catechol and phosphorus oxychloride are mixed together and refluxed on the steam-bath. At the end of an hour the material in the flask is recrystallized from hot water. Using this method as it stands, repeated preparation shows large amounts of tars which obliterate much of the yield. Oxidation of the catechol must also be repressed for greater yields. To carry out this purpose the following method was used.

Fifty grams each of monochloroacetic acid, catechol, and *freshly distilled* phosphorus oxychloride were mixed together in a one-liter short-necked flask fitted with reflux condenser and a tube through which sulfur dioxide was passed. A tube was attached to the end of the reflux condenser to lead away hydrogen chloride gas evolved in the reaction, and the sulfur dioxide. After the flask was filled with the sulfur dioxide from a tank, heating was started, a steady stream of gas always flowing. At the end of an hour heating was stopped, the purple crystals of crude chloroacetocatechol crystallized from hot water, decolorized with acid, Norite and sodium sulfite, and again crystallized. The light violet tinged crystals were washed with absolute alcohol, and finally ether. The yield was 53.6 g., m. p. 173°. Without these modifications, namely, the sulfur dioxide atmosphere and freshly distilled phosphorus oxychloride, the yield was 8.3 g.

COLUMBIA UNIVERSITY
NEW YORK CITY
HENRY D. HOBERMAN

RECEIVED JUNE 15, 1935

THE RAMAN SPECTRUM OF RUBBER

Sir:

It has been previously reported that the Raman effect is exhibited by rubber as a continuous scattering together with the presence of broad bands [Franklin and Laird, *Phys. Rev.*, **36**, 147 (1930); Busse, *J. Phys. Chem.*, **36**, 2862 (1932)]. Busse attributed this result to the viscosity of the solutions or to the possibility that the rubber groups respond to a wide range of frequencies. However, viscous solutions of polysterol in carbon tetrachloride give a line spectrum [Signer and Weiler, *Helv. Chim. Acta*, **15**, 649 (1932)]. As to the second explanation, this does not seem to be the nature of the Raman effect [Bär, *Helv. Phys. Acta*, **4**, 369 (1931); Bär, *Z. Physik*, **79**, 455 (1932)]. The Raman effect has been investigated extensively for terpenes other than rubber.

The bands and continuous background for rubber appear to be due to fluorescence of impurities, oxidation products, or the rubber hydrocarbon. The acetone extract of rubber is fluorescent as observed in ultraviolet light. The intensity of the bands and background for rubber decreases as the rubber is purified. However, acetone extraction and two diffusions with ethyl ether did not remove the fluorescence entirely, as could be seen by examination between complementary light filters. Some of the background is undoubtedly unmodified radiation, that is, Tyndall scattering by the colloidal structure and by motes. This can be reduced by a monochromatic light filter.

In contrast to the previous results, a line spectrum has now been observed for rubber. Gels made with diffusion rubber [Memmler, "Science of Rubber," Am. Ed., Reinhold Publishing Corp., New York, 1934, p. 174)] give Raman lines of sufficient intensity to be seen against the background. A mixture of 43% carbon bisulfide and 57% carbon tetrachloride is suitable as a solvent since this mixture has about the same refractive index as rubber and has a simple Raman spectrum. Carbon tetrachloride has been used alone with petroleum ether diffusion rubber. Concentrations of rubber used were from 10 to 40% by volume. The preparations were clear, colorless gels, free from any gross optical imperfections. They were protected from ultraviolet light by being completely surrounded by a filter solution. They did not show any perceptible darkening due to the exposures. The Raman lines were excited by the 4358 Å. mercury line.

The three most intense Raman frequencies for rubber are 1672, 1460 and 1382 cm.$^{-1}$. Isoprene has frequencies of 1640, 1426 and 1388 cm.$^{-1}$ [Dadieu and Kohlrausch, *J. Opt. Soc. Am.*, **21**, 286 (1931); Bourguel and Piaux, *Bull. soc. chim.*, **51**, 1041 (1932)]. Thus the 1640 frequency for isoprene, ascribed to the double bond, is smaller than the corresponding frequency in rubber. However, trimethylethylene has three frequencies which agree closely with these most intense lines for rubber. Thus the Raman spectrum data appear to confirm the generally accepted views regarding the chain structure of rubber although a cyclic structure is not definitely excluded, since cyclic terpenes have a spectrum of this nature.

The group of lines at 2900 cm.$^{-1}$, characteristic of the aliphatic C–H linkage, can be observed readily for rubber. Measurements of the fainter lines for rubber will be possible with further reduction in the background intensity.

RESEARCH LABORATORIES
GOODYEAR TIRE & RUBBER CO.
AKRON, OHIO
S. D. GEHMAN

RECEIVED JUNE 17, 1935

HINOKININ AS THE ENANTIOMORPH OF CUBEBINOLIDE

Sir:

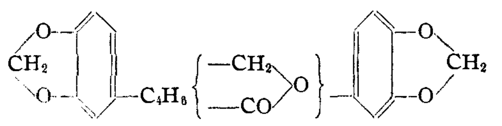
Erdtman [*Ann.*, **516**, 162 (1935)] has recently shown that eudesmin and the dimethyl ether of pinoresinol are enantiomorphs. From hinoki wood (*Chamecyparis obtusa*, Sieb. et Zucc.) Yoshiki and Ishiguro [*J. Pharm. Soc. Japan*, **53**, 73 (1933)] have isolated a crystalline compound, hinokinin, $C_{20}H_{18}O_6$, while Mameli [*Gazz. chim. ital.*, [ii] **42**, 551 (1912); [ii] **51**, 353 (1921)] has obtained a lactone, cubebinolide, $C_{20}H_{18}O_6$, from the oxidation of cubebin, $C_{20}H_{20}O_6$. That these substances are also enantiomorphs is apparent from the following comparison.

	Hinokinin	Cubebinolide
Molecular formula	$C_{20}H_{18}O_6$	$C_{20}H_{18}O_6$
M. p., °C.	64–65	63–64
Rotation	$[\alpha]^{32}_D$ −32.39° (2% alcohol)	$[\alpha]_D$ +33.69° (chloroform)
Dinitro derivative	M. p., °C. 183–184	183–184
	$[\alpha]^{22}_D$ −90.51° (acetone)	.....
Dibromo derivative	M. p., °C. 137–138	137
	$[\alpha]^{22}_D$ −26.94° (chloroform)	.....
Sodium salt of free acid	M. p., °C. 200–205	205–207
	$[\alpha]^{15}_D$ −7.61°	.....
Chloro methyl ester	M. p., °C. 92–93	95
	$[\alpha]^{15}_D$ (−?) 14.64° (chloroform)	$[\alpha]_D$ +13.89°

Both substances also yield piperonylic acid on oxidation. Based on the reactions of cubebinolide and the parent substance cubebin, Mameli has put forward the partial formula for cubebinolide (I). A substance of molecular formula $C_{20}H_{18}O_6$ containing two monosubstituted catechol methylene ether nuclei and a lactone group can only be tricyclic (including the lactone ring), so that the residue C_4H_6 must be saturated and acyclic.

On phytochemical grounds it is thus possible that cubebinolide has one of the alternative formulas (II) or (III). A substance of formula (II) should give the stable piperonoylformic acid as well as piperonylic acid on oxidation but the former acid has not yet been detected in the oxidation products. For this reason the author prefers formula (III).

From the chemical reactions of matairesinol from the wood of *Podocarpus spicatus* [Easterfield and Bee, *J. Chem. Soc.*, **97**, 1028 (1910)], the constitution (IV) has been proposed for this resinol independently by Haworth (private communication) and the author [Briggs, Peak and Wooloxall, *Proc. Roy. Soc. N. S. Wales*, (in press)].



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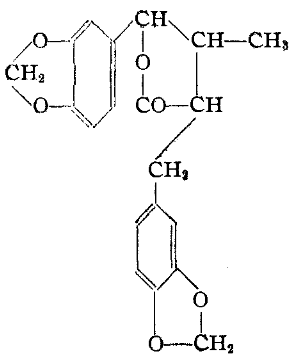

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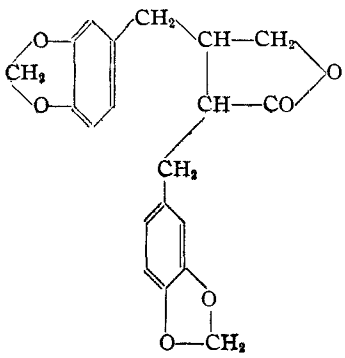

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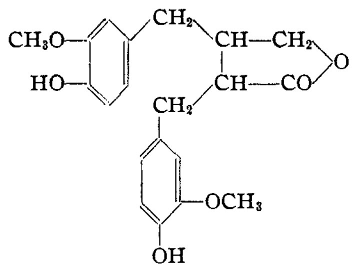
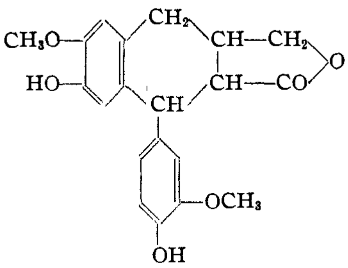


IV



V

Thus the structure suggested for cubebinolide (III) is very similar both to matairesinol and sulfite liquor lactone (tsugaresinol) (V) [Erdtman, *Ann.*, **513**, 229 (1934); Kawamura, *Bull. Imp. Forestry Expt. Sta. Tokyo*, No. 31, 73 (1932); Emde and Schartner, *Helv. Chim. Acta*, **18**, 344 (1935)].

The transformation of matairesinol into a substance of structure (III) is being attempted to prove this assumption.

DEPARTMENT OF CHEMISTRY
AUCKLAND UNIVERSITY COLLEGE
AUCKLAND, NEW ZEALAND
L. H. BRIGGS

RECEIVED JUNE 19, 1935

THE SOLUTION OF TITANIC HYDROXIDE IN HYDROGEN PEROXIDE

Sir:

Several months ago, in the course of some attempts to crystallize a titanium per-salt, we observed an interesting phenomenon, to which there is apparently no reference in the literature. We found that freshly precipitated and well-washed titanic hydroxide dissolves in dilute hydrogen peroxide to give a clear yellow solution. Thus, 50 cc. of a suspension containing 0.0035 mole of $Ti(OH)_4$, treated with 0.4 cc. of 30% H_2O_2 (0.0035 mole), became clear after one hour at room temperature, or after a few minutes when warmed. Larger amounts of hydrogen peroxide hasten solution; much smaller amounts of hydrogen peroxide give solutions with pronounced opalescence.

The solution has colloidal properties. Diffusion through a collodion bag takes place to only a very slight extent. Nearly complete precipitation occurs on addition of small amounts of electrolytes, but high concentrations of hydrogen peroxide render the precipitation less complete. The precipitates in these cases are yellow and contain hydrogen peroxide.

Gels can be prepared by boiling down the solutions and then cooling. Some were obtained which could be remelted by warming. Some were also obtained which had the property, known for other gels, of temporarily liquefying on vigorous shaking.

The most nearly similar phenomenon of which we are aware is the solution of freshly precipitated and washed manganese dioxide in concentrated hydrogen peroxide (see *C. A.*, **5**, 2470 (1911)).

The solution not only is of some scientific interest, but also may find considerable application in the arts.

DEPARTMENT OF CHEMISTRY
JOHNS HOPKINS UNIVERSITY
BALTIMORE, MARYLAND
S. KATZOFF
R. ROSEMAN

RECEIVED JUNE 21, 1935

THE POLYMERIZATION OF ETHYLENE INDUCED BY METHYL RADICALS

Sir:

In continuing our work on chain reactions induced by azomethane, we have found that ethylene is rapidly polymerized at temperatures near 300° by small quantities of azomethane. Over a ninety-fold range of azomethane pressure and a ten-fold range of ethylene pressure, and total pressures all below 60 mm., the initial rate depends on the square root of the azomethane pressure and the three-halves power of the ethylene pressure. The time-pressure curves behave in the ordinary way, and do not exhibit the increasing rate with time found in the thermal polymerization [Storch, THIS JOURNAL, **56**, 374 (1934)]. The rate constant is 6.5×10^{-6} at 310° and 3.0×10^{-6} mm.$^{-1}$ sec.$^{-1}$ at 290°. No special precautions to remove oxygen from the ethylene were taken.

A chain decomposition is also set up in propionaldehyde and isobutane by azomethane. Although 1% of azomethane completely decomposes acetaldehyde [Allen and Sickman, *ibid.*, **56**, 2031 (1934)], 6.5% azomethane in propionaldehyde leads to only 60–70% decomposition. The suggestion of Semenoff [Semenoff, *Z. physik. Chem.*, **28B**, 62 (1935)], that reactions of this type are "degenerate explosions" and that traces of azomethane should lead to complete decomposition cannot apply to propionaldehyde.

MALLINCKRODT LABORATORY
HARVARD UNIVERSITY
CAMBRIDGE, MASS.
O. K. RICE
DARRELL V. SICKMAN

RECEIVED JUNE 21, 1935

NEW BOOKS

An Introduction to Inorganic Chemistry for B.Sc. Students of the Indian Universities. By SATYA PRAKASH, D.Sc., Lecturer in Chemistry, University of Allahabad. Kala Press, Allahabad, India, 1934. iv + 478 pp. 16.5 × 24.5 cm. Price, six rupees; or ten shillings.

This is a textbook designed primarily for the advanced student of science in Indian universities. It assumes some knowledge of the principles of elementary chemistry. The treatment is essentially descriptive and any discussion of physical chemistry, except for a brief chapter on colloid chemistry, is purposely omitted.

The book is chiefly of interest to an American because the subject is dealt with so far as possible from the Indian point of view, the occurrence of various substances in India being treated at length and Indian practice in the various branches of chemical manufacture being set forth in considerable detail. This information, according to the author's preface, is not available elsewhere.

The presentation is clear and judging by the few sections examined, particularly the one on heavy water, is up-to-date.

ARTHUR B. LAMB

Annual Survey of American Chemistry. Volume IX, 1934. Edited by CLARENCE J. WEST, Director, Research Information Service, National Research Council. Published for the National Research Council by Reinhold Publishing Corporation, 330 West 42d Street, New York City, 1935. 396 pp. 14 × 22 cm. Price, $4.50.

The high quality of the earlier volumes of the Survey has been maintained. The general topics selected for consideration have been reviewed by men whose knowledge, contributions to the literature of chemistry, and judgment make them particularly well fitted for the important work. A chapter on biochemistry has not been included, because this field is now covered by another publication. Since the subjects treated vary from year to year, those in the present volume are listed. It is of interest to note that about one-half of the topics are in the field of applied chemistry. The subjects are as follows: Theories of Solution, The Kinetics of Homogeneous Gas Reactions, Subatomics, Thermodynamics and Thermochemistry, Colloids, Contact Catalysis, American Photochemistry During 1933 and 1934, Radioactivity—Natural and Artificial, X-Ray Examination of Materials, Aliphatic Compounds, Carbocyclic Compounds, Heterocyclic Compounds, Non-Ferrous Metals, Advances in Electrochemical Practice, Food Chemistry 1933 and 1934, Fermentation, Alcoholic Fermentation and Beverages, Trade Waste Treatment, Fertilizers, Coal and Coal By-Products, Petroleum Chemistry and Technology, Textile Chemistry, Dyeing and Finishing, Rubber, Solvents, Chemical Engineering.

The book contains an author index, subject index, and references to all the papers mentioned. The Annual Survey has become a necessity to those who wish to know something of the current contributions of Americans to Chemistry.

JAMES F. NORRIS

Dizionario di Chimica Generale e Industriale. (Dictionary of General and Industrial Chemistry.) By Prof. MICHELE GIUA and Dr. CLARA GIUA-LOLLINI. Unione Tipografico-Editrice Torinese, Corso Raffaello 28, Torino 116, Italy, 1933–1934. 20.5 × 29.5 cm. Vol. I, A–E. iii + 1083 pp. 565 figs. Vol. II, F–Z. iii + 1211 pp. 521 figs. Price, lira 165 and 175.

The authors state in the preface that a modern Dictionary of Chemistry, of limited size, but at the same time dealing with diverse branches of Theoretical and Applied Chemistry, is lacking in Chemical Literature. While the older encyclopedias, such as those of Fehling, Muspratt Würtz, Guareschi, have mainly a theoretical and descriptive character, the more recent ones, *e. g.*, those of Thorpe, and of Ullmann, give greater emphasis to Industrial Chemistry.

The aim of this encyclopedia is to provide the elements for the study of chemistry both in its theory and in its