Sabatier with an honorarium and the expenses necessary for a visit to America in 1926 to receive the Honorary Membership of the American Chemical Society and the Doctor of Science (*honoris causa*) of the University of Pennsylvania at the September meeting of the Society in Philadelphia.

Reserve and detachment were characteristic of Sabatier. There is as a consequence little to record of his private life. From his marriage to Mlle. Herail there were four daughters, one of whom became the wife of the Italian chemist, Emilio Pomilio. This daughter and son-in-law accompanied Sabatier on his American visit.

The highest distinctions came to Sabatier as the result of his discoveries. In 1912 he shared the Nobel Prize for Chemistry with his countryman, Grignard. He received the Davy Medal of the Royal Society in 1915. As early as 1897 the Academy of Sciences in Paris awarded him the Lacaze prize and in 1905 the Jecker prize. He became Correspondent Member of the French Academy of Sciences in 1901 and first non-resident member in 1913. Chevalier of the Légion d'Honneur in 1907 he was named Commander in 1922. Foreign academies elected him to membership: to Madrid, 1913; to the Royal Society in 1918; to the Amsterdam Academy in 1919; to the Academia dei Lincei of Italy in 1923; to the Royal Society of Bohemia and the Academy of Roumania. Numerous societies elected him to honorary membership and decorations came to him from many foreign lands, Italy, Portugal, Serbia, Tunis among others. The Franklin Institute bestowed its highest honor, the Franklin Medal, on him in 1933. Of the many distinguished foreign scientists who visited America on the occasion of the Philadelphia Sesquicentennial an observer recorded that Sabatier was "easily the most popular of the foreign guests—although the only one not speaking English." He carried back with him to his beloved Toulouse the memory of a warm and kindly reception from American chemists and a sense of wonder and awe at the development, attained even then, of the industries which were applying his discoveries. Like Faraday before him, Sabatier chose science, rather than the wealth, and cares, of applied science. As Tyndall wrote of Faraday in England, so we may write of Sabatier "for more than forty years his was the glory of holding aloft among the nations" the scientific name of France.

HUGH S. TAYLOR

[COMMUNICATION NO. 976 FROM THE KODAK RESEARCH LABORATORIES]

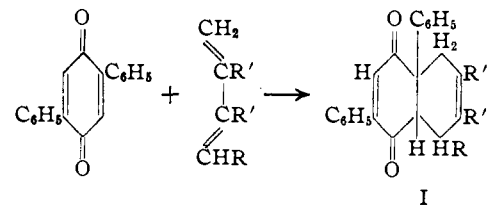
Some Reduced Naphthoquinones Containing an Angular Phenyl Group

BY C. F. H. ALLEN, A. BELL, J. H. CLARK AND J. E. JONES

In connection with our work on the 1,3-rearrangement of a phenyl group,[1,2,3] it seemed desirable to attempt the synthesis of a bicyclic system in which the shift of a phenyl group would not be anticipated. A reaction that would be expected to give a substance having such a structure is a diene synthesis, using 2,5-diphenylquinone and butadiene. In such an addition product, the phenyl group is attached to one of the carbon atoms which is common to both rings and which is not a part of an allylic system, so that a 1,3-rearrangement would not be expected. However, a migration was encountered during the subsequent bromination, the phenyl appearing in the 2-position on the quinone ring.

It has been found that butadiene, 1-phenylbutadiene, and 2,3-dimethylbutadiene all add to 2,5-diphenylquinone.

(1) Allen and Spanagel, THIS JOURNAL, **55**, 3773 (1933).
(2) Allen and Gates, *ibid.*, **64**, 2123 (1942).
(3) Allen and VanAllan, *ibid.*, **64**, 1260 (1942).



I

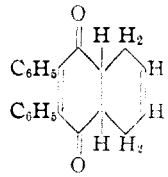
The proof of structure of these addition products I is difficult. In chemical reactions, the products resemble those that result from the interaction of quinones and Grignard reagents. In most instances, there are formed large amounts of intractable oils, the components of which resist separation and identification.

The addition products are yellow, like unsaturated 1,4-diketones. They decolorize permanganate instantly, but react slowly with bromine. In the Grignard machine, the diene adducts consume one mole of methylmagnesium halide by addition, and undergo a slow enolization which is

established by the evolution of one equivalent of methane; thus there is no preformed hydroxyl group. They react with hydroxylamine, but in only one instance could an analytically pure monoxime be isolated. All these properties are consistent with the unsaturated 1,4-diketone structure I.

The addition products are rapidly destroyed by alkaline reagents, including pyridine, and somewhat more slowly by mineral acids. They dissolve in alcoholic alkaline solutions with a deep red color. In boiling ether, they do not react with sodium amide; in xylene, ammonia is evolved, but only a highly colored tar can be isolated.

The addition product is recovered practically unchanged after a short treatment with hydrobromic acid in warm acetic acid, but refluxing gave a dark-colored intractable oil. Sulfuric acid in acetic anhydride also gave an oily product. If the addition product had the structure II



II

in which the phenyl group had already migrated, acidic reagents would be expected to give the hydroquinone almost immediately; consequently, it appears that the angular phenyl is still present in the addition product.

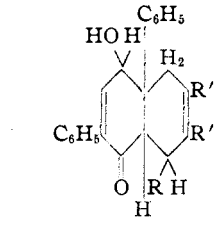
Reduction Products.—Reductive acetylation of the addition products gave mixtures of colorless crystalline substances, very difficult to separate.

(a) Reduction by means of zinc and acetic acid gave only colorless dihydro derivatives with the exception of the dimethyl addition product, which gave a mixture. In the Grignard machine, they show two active hydrogens, one of which appears to be enolic. Upon acetylation, *di*acetates resulted in every instance; in addition to the usual analyses, these substances add four equivalents of methylmagnesium iodide, as would be expected of a diester. The dihydrodimethyl derivative appears to react with two molecules of hydroxylamine, indicating the presence of an α,β-unsaturated ketonic system.

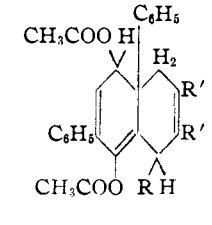
(b) With hydrogen in the presence of a Raney nickel catalyst, the addition product from dimethylbutadiene gave the same dihydro derivative as was obtained by the use of zinc and acetic acid, but the others took up four atoms of hydrogen. This suggests that the two additional hydrogen atoms have added to the isolated double bond in the non-ketonic ring, an assumption which is borne out by the formation of the tetrahydro derivative by a similar catalytic reduction of the dihydro compounds. Such a conclusion is confirmed by the loss of two hydrogens on treatment with bromine, and the formation of new halogen-free yellow diketones. Upon reduction, the latter take up two hydrogens and regenerate the starting material.

The tetrahydro derivatives also show two active hydrogens, one of which appears to be enolic, but no additions in the Grignard machine. They give *mono*acetates under the same acetylating conditions, and are recovered unchanged after treatment with diazomethane. These reactions indicate the presence of an alcoholic group and an enolizable hydrogen. The one from butadiene reacted with two molecules of hydroxylamine, indicating the substance is still an α,β-unsaturated ketone.

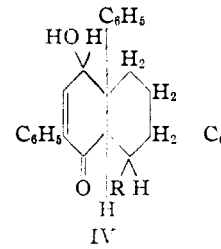
(c) In light of the evidence just given, it is possible to write structures for the reduction products and their derivatives. The dihydro compounds are best represented as unsaturated hydroxyketones III; the tetrahydro compounds have a similar structure IV without the isolated double bond. The dehydrogenation with bromine then gives the unsaturated diketone V. The monoacetates of IV are represented by VI; the diacetates VII are most probably formed through the enolic modification of III.



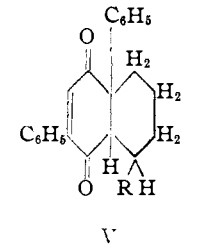
III



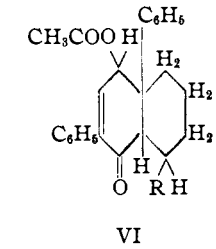
VII



IV



V



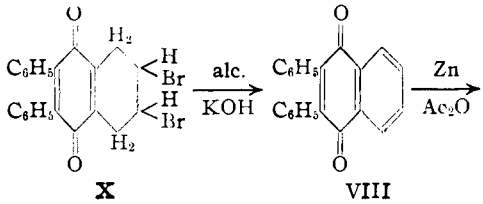
VI

Bromination.—If solutions of the addition products in carbon tetrachloride are first saturated with hydrogen bromide, they rapidly decolorize bromine—otherwise the reaction is slow—but in both instances they evolve hydrogen bromide. Crystalline dibromides were isolated from the addition products of butadiene and dimethylbutadiene, the yields being better in the absence of added hydrogen bromide. Upon treatment with alcoholic potash, hydrogen bromide was eliminated and 2,3-diphenylnaphthoquinones VIII were extracted from the *alkaline* solution. The identity of 2,3-diphenylnaphthoquinone was established by comparison with a specimen kindly supplied by Dr. Kvalnes.[4] As a further proof,

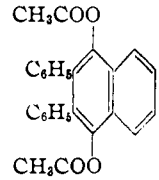
(4) Kvalnes, THIS JOURNAL, **56**, 2478 (1934).

both specimens, when reductively acetylated, gave identical diacetates IX.

In the case of the addition product from phenylbutadiene, it was not possible to obtain a halogen-free material from the oily bromination mixture, from which it may be concluded that it is possible that the bromine may be, in part, attached to an ethylenic carbon atom. The structure X is assigned to the two crystalline dibromides that give quinones, since there is no reason to suspect a rearrangement of a phenyl group in an alkaline medium.



X VIII

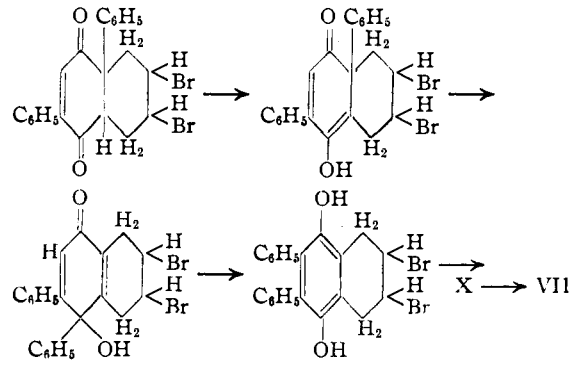


IX

It is clear that there has been a migration of a phenyl group at some stage between the starting material, 2,5-diphenylquinone, and the 2,3-diphenylnaphthoquinone. Since the formation of the addition products takes place at 100° or below, it seems unlikely that the isomerization occurred during the diene synthesis forming I. From a study of the various isomers of I, it was concluded that none was in as good agreement with all the experimental data. It seems most likely that the phenyl group migrated during the bromination, in view of the fact that such shifts have been shown to occur at elevated temperatures or under the influence of mineral acid.[1-3,5]

The mechanism of this rearrangement and the sequence of steps is highly speculative, but it seems plausible that one of the first is an enolization, which sets up an unsaturated system favorable for a phenyl shift. The migration of the phenyl group results in the formation of a semiquinone which can most readily stabilize itself by another rearrangement, the phenyl group going to the 2-position, with concomitant enolization of the hydrogen atom originally attached at this point. The two phenyl groups will now be in adjacent positions, as they are found in 2,3-diphenylquinone; the hydroquinone is then dehydrogenated, probably by the excess bromine. It appears that bromination occurs first, and influences the course of these reactions, inasmuch as such a shift does not appear to take place during the dehydrogenation of the tetrahydro compounds by bromine.

(5) Allen and VanAllan, THIS JOURNAL, 66, 7 (1944).



Experimental

A. 2,5-Diphenylquinone and Related Substances.—The 2,5-diphenylquinone,[6] m. p. 210°, contained a small amount of a high-melting impurity, which persisted even with the addition products, so that they could not readily be obtained in an analytically pure condition. The pure 2,5-diphenylquinone used in this work was obtained by several recrystallizations from benzene; it melted at 217–218°. This impurity, tetraphenylquinone, was the previously unidentified yellow high-melting substance isolated during preliminary attempts to bring about the addition reaction.[7]

The tetraphenylquinone (3–5 g.) was isolated by a careful fractional crystallization of the solid residue from the above reaction; it was contaminated with diphenylquinone and melted at 290–295° with sintering. To get the pure compound, orange needles, m. p. 305–307°, uncor., it is necessary to treat the crude quinone with a diene in alcoholic solution.

Anal. Calcd. for $C_{30}H_{20}O_2$: C, 87.4; H, 4.9. Found: C, 87.7; H, 4.9.

2,5-Diphenylquinone added two equivalents of hydrogen bromide, in acetic acid, to form 3,6-dibromo-2,5-diphenylhydroquinone, which crystallized from ligroin in colorless needles, m. p. 233–235°.

Anal. Calcd. for $C_{18}H_{12}O_2Br_2$: C, 51.5; H, 2.9; Br, 38.1. Found: C, 51.3; H, 2.6; Br, 37.6.

B. The Addition Products.—3,9-Diphenyl-5,8,9,10-tetrahydro-1,4-naphthoquinone XI (I; R, R′ = H) was prepared by heating a mixture of 10 g. of diphenylquinone, 5 g. of butadiene, and 60 cc. of absolute alcohol in a pressure bottle at 80–90° for four days. The solid was redissolved in hot alcohol, treated with Darco, and concentrated; the cooled solution deposited 9.3 g. (77%) of bright yellow prisms; an additional, less pure 1.5 g. was obtained from the filtrate. The physical properties and analyses are given in Table I. It was not reduced by sodium hydrosulfite and did not give a derivative with the Allen and Gates reagent.[8] The monoxime XII was prepared in the usual manner.

6,7-Dimethyl-3,9-diphenyl-5,8,9,10-tetrahydro-1,4-naphthoquinone XIII (I; R = H, R′ = CH_3) was secured in a yield of 79% by six days of refluxing of a mixture of 40 g. of 2,3-dimethylbutadiene-1,3,[9] 52 g. of diphenylquinone, and 600 cc. of alcohol. It formed yellow cubes. This substance was not isolated in the previous work.[7]

3,5,9-Triphenyl-5,8,9,10-tetrahydro-1,4-naphthoquinone XIV (I; R = C_6H_5; R′ = H) was obtained by refluxing a suspension of 50 g. of 2,5-diphenylquinone, 25 g. of freshly distilled phenylbutadiene,[10] and 450 cc. of absolute alcohol for twenty-four hours, and working up as just described. The yield was 66.8 g. (89%); it formed yellow needles.

The monoxime, XV, separated from alcohol as a yellow-brown powder.

(6) Shildneck and Adams, THIS JOURNAL, 53, 2375 (1931).
(7) Allen and Halley, *Can. J. Res.*, 16, 330 (1937).
(8) Allen and Gates, *J. Org. Chem.*, 6, 596 (1941).
(9) "Organic Syntheses," 22, 39 (1942).
(10) Klages, *Ber.*, 37, 2309 (1904).

TABLE I

PROPERTIES AND ANALYSES OF NEW SUBSTANCES

No. of substance	Emp. formula	M. p., °C.	Calcd. % C	Calcd. % H	Calcd. % N	Found % C	Found % H	Found % N	Act. H	Addn.
XI	$C_{22}H_{18}O_2$	112–113[a]	84.1	5.8		83.8	5.6		1	1
XII	$C_{22}H_{19}O_2N$	169–171[b]	80.6	5.8	4.3	80.6	5.8	4.4		
XIII	$C_{24}H_{22}O_2$	99–100[a]	84.2	6.5		84.0	6.2		1	1
XIV	$C_{28}H_{22}O_2$[f]	140–141[c]	86.1	5.7		86.0	5.7		1	1
XV	$C_{26}H_{23}O_2N$	90–93 d.[b]	82.9	5.7	3.4	82.5	5.4	3.0		
XVI	$C_{22}H_{20}O_2$	123–125[b]	83.5	6.4		83.4	6.1		2	0
XVII	$C_{26}H_{24}O_2$	215–216[b]	85.7	6.2		85.5	6.0		2	0
XVIII	$C_{24}H_{24}O_2$	170–171[b]	83.7	7.0		83.5	6.9		1	1
XIX	$C_{26}H_{24}O_4$	144–145[b]	78.0	6.0		77.7	5.9		0	4
XX	$C_{28}H_{28}O_4$	135–136[d]	78.5	6.6		78.6	6.6		0	4
XXI	$C_{32}H_{28}O_4$	230–232 d.[b]	80.6	5.9		80.1	5.8		0	4
XXII	$C_{24}H_{26}O_2N_2$	275 d.[e]	77.0	7.0	7.5	76.0	6.1	7.2		
XXIII	$C_{22}H_{22}O_2$	106–107[b]	83.0	7.0		82.8	6.7		2	0
XXIV	$C_{28}H_{26}O_2$	200–201[b]	85.3	6.7		85.1	6.8		2	0
XXV	$C_{30}H_{28}O_3$	170–171[b]	82.5	6.5		82.4	6.3		1	2
XXVI	$C_{24}H_{24}O_3$	Oil	80.0	6.7		79.1	6.8			
XXVII	$C_{22}H_{24}O_2N_2$	278–280 d.[e]	75.9	6.9	8.0	75.8	6.8	7.3		
XXVIII	$C_{22}H_{20}O_2$	130–131[b]	83.5	6.4		83.5	6.3		1	1
XXIX	$C_{28}H_{24}O_2$	191–192[b]	85.7	6.2		85.6	6.2		1	1
XXX	$C_{29}H_{24}O_2$	160–190[a]	86.1	6.0		86.3	6.0			
X	$C_{22}H_{16}O_2Br_2$	137–138[a]	56.0	3.4	Br, 33.9	56.0	3.8	Br, 33.8	1	2
XXXI	$C_{24}H_{20}O_2Br_2$	178–179 d.[a]	57.6	4.0	Br, 31.9	57.9	4.2	Br, 31.5	1.5	1.6
VIII	$C_{22}H_{14}O_2$	138–140[d]	85.1	4.6		85.1	4.7		0	2
XXXII	$C_{24}H_{18}O_2$	193–194[b]	85.2	5.4		85.4	5.5		0	2
IX	$C_{26}H_{20}O_4$	196–197[b]	78.8	5.1		79.1	4.8			
XXXIII	$C_{28}H_{24}O_4$	246–248[b]	79.2	5.7		79.2	5.7			

[a] From methanol. [b] From ethanol. [c] From ligroin. [d] From hexane. [e] From dioxane–ethanol. [f] Mol. wt., calcd. 390. Found: 395 (benzene), 377 (carbon tetrachloride).

The phenyl derivative XIV was usually used in exploratory reactions, since the products tended to crystallize more readily.

1-Phenylpentadiene-1,3 gave an addition product, XXX, which was presumably a mixture of isomers (needles and plates), since it melted over a considerable range after removal of the unreacted components and several recrystallizations.

C. Reduction. 1. By Zinc and Acetic Acid.—A typical example was as follows: zinc dust in small proportions was added to a solution of 0.3 g. of the addition product in 30 cc. of boiling acetic acid, until the initial yellow color disappeared. The oily mush that separated after filtering, diluting and cooling, was removed and recrystallized, using Darco. The reduction products XVI (III; R, R′ = H) from XI, and XVIII (III; R = H, R′ = CH_3) from XIII separated as colorless plates, while XIV gave XVII (III; R = C_6H_5, R′ = H), which formed needles. The substance XVIII is identical with the one of m. p. 169–170°, previously described.[7]

Diacetates were prepared in the usual way: XVI gave XIX (VII; R, R′ = H) needles; XVIII gave XX (VII; R = H; R′ = CH_3) prisms that were very difficult to purify from the accompanying tarry material; XVII gave XXI (VII; R = C_6H_5, R′ = H) blades.

The dimethyl reduction product XVIII reacted with two equivalents of hydroxylamine; the results of the carbon and hydrogen analyses of the product XXII were 1% low.

2. Catalytic Reductions, Using Raney Nickel.—These were carried out in alcohol or dioxane, at an initial pressure of 45–48 lb. at room temperature; the reduction appeared to be complete after about three hours. The catalyst was filtered, decolorizing carbon used as needed (dioxane, if used was replaced by alcohol), and the oils were left to crystallize. The tetrahydro derivatives XXIII (IV; R = H) and XXIV (IV; R = C_6H_5) do not react with diazomethane. Catalytic reduction of the dihydro derivatives XVI and XVII gave XXIII and XXIV.

The monoacetates were prepared in an acetic anhydride–sodium acetate mixture; only the phenylated one XXV (VI; R = C_6H_5) crystallized. The liquid ester XXVI (XV, R = H) was made from an analytically pure reduction product.

The butadiene derivative XXIII reacted with two molecules of hydroxylamine; on analysis, the product XXVII gave a slightly low nitrogen content.

Attempts to make derivatives such as the *p*-nitrobenzoates or phenylurethans were unsuccessful, and the tetrahydro compounds were recovered unchanged. Hydrogen bromide in acetic acid gave intractable oils.

Dehydrogenation of the tetrahydro derivatives was accomplished, in warm chloroform solution; bromine was decolorized rapidly and hydrogen bromide was evolved. The diketones formed yellow plates, XXVIII (V; R = H) or needles, XXIX (V; R = C_6H_5). They do not decolorize bromine. Reduction by zinc and acetic acid regenerated the starting materials.

D. Bromination.—To a solution of 6 g. of the addition product XI in 160 cc. of dry chloroform was added 6 g. of bromine in 10 cc. of the same solvent and the mixture left in the dark for three hours; hydrogen bromide was slowly evolved. A yield of 5.4 g. (60%) was obtained after appropriate manipulation. 2,3-Diphenyl-6,7-dibromo-5,6,-7,8-tetrahydronaphthoquinone-1,4 (X) formed lemon-yellow needles. Only viscous oils were found in the residues. The yield could not be increased by changes in relative amounts of reagent, time, or temperature; for no apparent reason, neither the yield nor the quality was consistent.

The 2,3-diphenyl-6,7-dimethyl-6,7-dibromo-5,6,7,8-tetrahydronaphthoquinone-1,4 XXXI was prepared in a similar manner, but the oily residual material, after removal of the solvent, was boiled for a few minutes with methanol before it became crystalline. The yield was 80%.

E. The Naphthoquinones.—To a boiling solution of 1.3 g. of the dibromide X in 30 cc. of absolute methanol was

added a boiling solution of 8 g. of potassium hydroxide in an equal volume of the same solvent. The yellow color at once changed to a deep red and potassium bromide separated. After boiling a minute and three-quarters the mixture was poured into 250 cc. of cold water. The yellow suspension was extracted with ether, and the ether solution washed with dilute hydrochloric acid to remove the red color. After evaporation, the residue was crystallized from 15 cc. of ethanol, giving 0.3 g. (33%) of long, slender, deep yellow needles of 2,3-diphenylnaphthoquinone with a m. p. 132–136°. A single recrystallization from hexane gave a product with a m. p. 138–140°; a mixed melting point with an authentic specimen[4] was the same. The residue was an intractable oil, the amount of which was increased by prolonged contact with the alkaline solution.

The conditions given seem to be the most favorable for a maximum yield of quinone. The latter was not affected by alcoholic alkali, indicating that the oils were produced by side reactions.

In a similar manner, 2,3-diphenyl-6,7-dimethylnaphthoquinone XXXII was formed from 3 g. of the dibromide XXXI in 25 cc. of dioxane, 12 g. of potassium hydroxide in 25 cc. of absolute ethanol, and boiling the resultant purple mixture for one and a half minutes. The yield was 0.6 g. (28%); it formed yellow needles.

Reductive acetylation gave the corresponding hydroquinone diacetates, IX (needles) and XXXIII (plates).

Summary

A number of tetrahydronaphthoquinones containing an angular phenyl group have been prepared.

These quinones have been reduced by various methods to dihydro and tetrahydro derivatives.

Dibromo derivatives are obtainable by the use of bromine. Upon treatment of these with alcoholic potash, hydrogen bromide is eliminated and 2,3-diphenylnaphthoquinones are obtained.

The angular phenyl group is rearranged, probably during the bromination reaction.

The evidence for the various structures and proposed mechanism of reactions are discussed.

ROCHESTER, NEW YORK RECEIVED JUNE 8, 1944

[CONTRIBUTION FROM THE DEPARTMENT OF PATHOLOGY OF THE UNIVERSITY OF CHICAGO]

The Unsaponifiable Residue of Human Liver. I. Preparation and Primary Chromatographic Fractionation[1]

BY D. WARREN STANGER, PAUL E. STEINER AND MIRIAM N. BOLYARD

The unsaponifiable residue of some human liver was shown by Steiner[2] and others to be cancerogenic when injected subcutaneously in mice. This residue was shown to be cancerogenic when prepared from some livers of persons who died of non-neoplastic diseases as well as from some livers of persons who died of cancer.[2a] The livers of the first group of persons are referred to as non-cancer livers while those from the second, as cancer livers, although the latter contained no tumor tissue or at most only traces of it. In a study of individual livers 21% of the cancer livers and 20% of the non-cancer livers were found to yield cancerogenic fractions. Even though the cancerogenic material was diluted by pooling each kind of liver it could still be demonstrated as shown by the experiment in which the unsaponifiable residue from 8 pooled cancer livers produced 12 tumors in 37 mice, and from 7 pooled non-cancer livers, 5 tumors in 35 mice.

In order, if possible, to isolate the cancerogen or cancerogens, a chemical study of this material was undertaken. In the present experiments the two kinds of liver, cancer and non-cancer, were studied in parallel to determine whether quantitative and qualitative differences exist which might yield clues as to the nature and importance of the cancerogenic substances.[3]

The unsaponifiable residue was prepared by saponification of the ground liver with alkali, solvent extraction of the non-saponified portion, and resaponification of this concentrate. The percentage of unsaponifiable material found in 248 cancer livers was 0.681 and in 176 non-cancer livers 0.657. This difference is very much smaller than that between 0.75 and 0.56 found by Steiner[4] for a series of 33 cancer and 11 non-cancer livers. In the small series the wide variation among individual livers may explain the difference in the averages.

Cholesterol was removed from the unsaponifiable residue by crystallization from solvents, by chilling, and finally by the use of digitonin. During the course of this work certain fractions of the residues were resaponified. The percentage of unsaponifiable material in the original livers was lowered to 0.533 for cancer and 0.491 for non-cancer. Of these final unsaponifiable residues 49.7% of the cancer and 53.6% of the non-cancer were found to be cholesterol.

The chromatographic fractionation of the cholesterol-free residue was carried out by adsorption of the material from petroleum ether solution on aluminum oxide. Five fractions were

(1) This investigation was aided by a grant from the Commonwealth Fund.

(2) (a) Steiner, *Science*, **92**, 431 (1940); *Cancer Research*, **2**, 425 (1942); **3**, 385 (1943); (b) Kleinenberg, Neufach and Schabad, *Am. J. Cancer*, **39**, 463 (1940); *Cancer Research*, **1**, 853 (1941); (c) Des Ligneris, *Am. J. Cancer*, **39**, 489 (1940); (d) Hieger, *ibid.*, **39**, 496 (1940); (e) Sannié, Truhaut and Guérin, *Bull. assoc. franc. étude cancer*, **29**, 106 (1941).

(3) Preliminary reports of work somewhat similar to this have appeared by Bürger and Plötner, *Deut. z. Verdauungs u. Stoffwechselkrankh.*, **3**, 180 and 183 (1940). Since only the very brief German abstracts are available in this country, no comparison of results is possible.

(4) Steiner, *Am. J. Path.*, **17**, 667 (1941).