


1931

Studies on the structure of the chloraloses

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STUDIES ON THE STRUCTURE OF THE CHLORALLOSES

by

Anne Elizabeth White

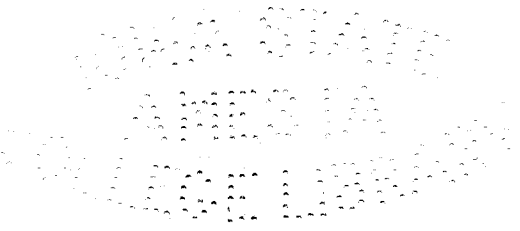
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53-C2

A Thesis submitted to the Graduate Faculty

for the Degree

DOCTOR OF PHILOSOPHY

Major Subject: Plant Chemistry



Approved:

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1931

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ACKNOWLEDGMENT

The author wishes to express sincere appreciation for the advice and encouragement given by Dr. Ralph M. Hixon throughout the progress of this study.

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INTRODUCTION AND HISTORICAL SKETCH

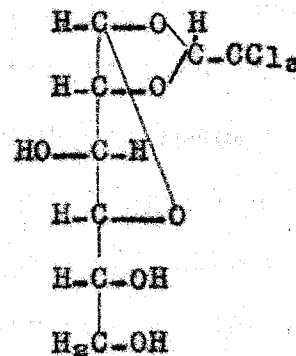
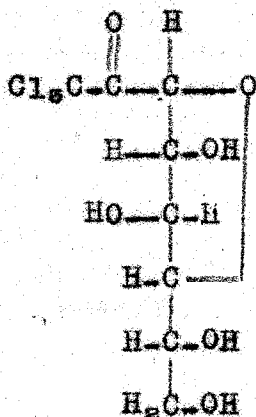
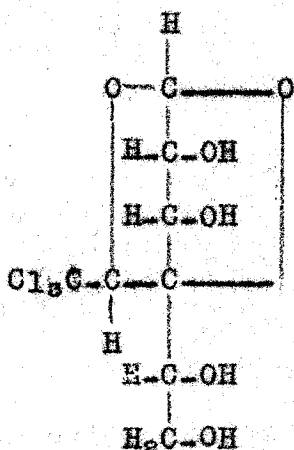
All workers in sugar chemistry have experienced difficulty in controlling degree of reaction because of the uniform labilities of the various hydroxyl groups in a molecule of free sugar. In consequence, partial derivatives are much desired which possess some degree of stability toward various reagents. Acetone sugars have been used to a considerable extent, but their use is limited as they hydrolyze readily in the presence of dilute acids. This thesis is a report of an investigation upon a number of derivatives of the dichlorals, and partial derivatives of glucose, which bear on the structure of the chloraloses and sugars.

The prediction was made in this laboratory that chloral derivatives of the carbohydrates should be of the acetal type rather than the carbon-carbon linkage. The decidedly negative character of the $-CCl_2$ group would increase greatly the stability of the acetal linkage in the chloraloses compared with this linkage in the acetone derivatives. The study of these compounds was undertaken with the expectation that they might serve as intermediates in making partial derivatives of the sugars. So far they have proved quite resistant to hydrolysis, and this may remain a limitation to their usefulness for this purpose. On the other hand they are usually well characterized crystalline compounds with melting points that are definite, and should become useful chloral derivatives of partial derivatives of the sugars.

Monochloraloses from glucose were introduced into the literature by Heffter in 1889 (12) although he proposed no names or structures. Hanriot and Richet (9) did a considerable amount of work on the hypnotic as well as the chemical properties of the monochloralose derivatives of several monosaccharides. α -glucochloralose is known to the physiologists as a desirable hypnotic for experimental work. Reference should be made to the thesis of H. W. Coles (2) for a bibliography on the earlier study of this power. Although Hanriot and Richet found β -glucochloralose (they called it para chloralose) had no hypnotic power, they were able to find more about its chemical properties than about those of α -glucochloralose. Part of the work done by Hanriot on the structure of β -glucochloralose commands consideration today. He oxidized it to a chloralic acid ($C_7H_7O_6Cl_3$ if desiccated), which is identical with the chloralic acid from β -xylochloralose (7). This would indicate that two carbons of the glucochloralose molecule are subject to oxidation without destruction of the molecule. Now, as then, the first four carbons are considered to be in a ring with the glucosidic oxygen, which leaves the other two as an oxidizable side chain.

Concerning the linkage between the chloral group and the glucose molecule there have been confused and conflicting opinions. It was early recognized that each aldehyde group was modified in the condensation, for no reduction is obtained with aldehyde reagents, nor can phenylhydrazine react with it.

All the earlier workers found that the chloral group was attached so firmly that it resisted every attempt at hydrolysis. They considered this to be proof that the chloral group was attached through a carbon to carbon linkage. The formulas proposed by Polonowski (22) and by Pictet and Reichel (23) are given below. They are later modifications of the structure proposed by Hanriot (7) and are found in the reference works. They are, however, subject to the same criticism as is Hanriot's. Formula III shows the acetal type supported by work from this laboratory (6).



I. Polonowski (22) II. Pictet (23) III. Goodhue, White,
and Hixon (6)

All the formulas proposed, previous to the publications of Hixon and co-workers, show a carbon to carbon linkage as well as four hydroxyl groups. The presence of four hydroxyl groups was indicated by the fact that acetyl derivatives consistently gave analytical results indicating tetracetyl derivatives. Only one exception has been detected, and this earlier in-

investigators doubtless overlooked.

The earlier formulas contrast decidedly with the type of linkage found in products of the condensation of polyalcohols with aldehydes or ketones. These products are quite generally considered to be acetal compounds. The theories developed in this laboratory on the electron sharing ability of organic radicals (1, 15) offer theoretical reasons for aligning the chloraloses with the acetal derivatives obtained by condensing glucose with other aldehydes. If the known acetals of glucose are listed in the order of ease of hydrolysis (5) they give a series through which one may notice an increase in the negative character of the group attached to glucose. The $-\text{CHCl}_2$ group, being a very negative group, can readily be assigned a position at the end of this series. It would also be placed there on the experimental basis of its resistance to hydrolysis. Derick (4) found such a relation among the groups in the organic aldehydes that can form stable combinations with a molecule of water. Hibbert (14) found the same sort of series in a study of hemi-acetal formation. The fact that removal of one chlorine from the glucochloralose makes possible the hydrolysis of the compound (8) and recovery of the component parts, i.e., glucose and dichloroacetaldehyde, suggests a linkage which is not inherently resistant to hydrolysis; but whose behavior is modified by the chlorines of the chloral group. Similarly, if two chlorines are removed from such a compound, the resulting bidechloroglucochloralose is more easily hydrolyzed by

acids. No one has succeeded in isolating a compound, analogous to the glucochloralose, from which all three chlorines have been removed. Doubtless such a compound is unstable under the conditions of dechlorination.

Meunier (19) was the first person to report preparation of a dichloral. Recently Ross and Payne (24) studied the dichloral derivatives of glucose more thoroughly than any early workers. In their opinion only acetal linkages could explain the known facts about the dichlorals.

Work in this laboratory was begun by Coles (2), who developed a modification of Haworth's method (10) suitable for methylating the chloraloses. This method yielded a trimethyl β -gluochloralose. But no tetramethyl derivative was obtained to correspond to the tetracetyl monochloraloses. A structure was then postulated whose innovations were the acetal linkage of the chloral group, and a keto-enol isomerism between forms which could have tri- and tetra-derivatives, respectively. Goodhue (6) was able to separate the supposed tetracetyl β -gluochloralose of Hanriot into triacetyl β -gluochloralose and pentacetyl β -gluochloralose. This simplified and strengthened the case for the acetal structure and eliminated the need for keto-enol forms. The pentacetyl derivative can be explained only by opening the oxygen ring of triacetyl β -gluochloralose.

The purpose of the present study was to obtain further

information concerning the stability of the oxygen ring in other chloraloses and to determine, where possible, the positions of free hydroxyls. It was not feasible to employ conventional methods such as have been used in the study of acetone sugars. This paper, therefore, is necessarily of a preliminary nature, presenting methods of approach to the problems; an exhaustive study of the chloraloses is a possibility for the future. Certain new facts, acquired in the study, are also presented.

CHLORALOSE DERIVATIVES AND STRUCTURE

The Stability of the Oxide Ring in the Monochloraloses.

Condensation of the glucose molecule with chloral certainly modifies the firmness of linkage in the oxide ring of the glucose. Oxidations, far more drastic than are necessary for oxidizing glucose to an open chain acid, can only oxidize the monochloraloses to acids of seven carbons, one less than the glucochloralose. One of these, the derivative of β -glucochloralose, can form an anhydride; the chloralic acid from α -glucochloralose cannot. During the experimental work in this laboratory no agent, other than acetyl chloride in the presence of fused $ZnCl_2$, has been found capable of rupturing this ring. Goodhue isolated triacetyl β -glucochloralose which showed no free hydroxyl groups; after treatment of β -glucochloralose with acetyl chloride and $ZnCl_2$, he obtained a compound which contained five acetyl groups. Rupture of the oxygen ring is the only possible means of accounting for two additional acetyl groups in the molecule. Goodhue prepared, not only diacetyl but also tetracetyl β -xylochloralose (unpublished data).

α -glucochloralose, the less well known isomer, has been converted into a pentacetyl derivative by the same treatment. This indicates that α -glucochloralose is also an acetal derivative of glucose, and further, that the oxygen bridge is ruptured by the same degree of treatment. Less drastic acetylation failed to produce the pentacetyl α -glucochloralose. The major

product of such acetylation is a compound melting at 151.5°C. It forms irregular, four-sided, flat crystals, some as large as half an inch at the longer edge. It must be carefully separated from another pentacetyl α -glucochloralose by fractional crystallization. This compound occurs in needlelike crystal with melting point 174°. It is slightly more soluble in ether.

Hanriot reports (7) saponification data for an acetylmannochloralose which are in much closer agreement with the calculated value for a pentacetyl compound, than with the value calculated for the tetracetyl derivative according to his formula. Benzoylation, in the hands of the earlier experimenters, yielded tribenzoyl monochloraloses, excepting the case of α -glucochloralose. Hanriot reports a tetrabenzoyl derivative which may be a mixture of tribenzoyl and pentabenzoyl compounds. No really persistent efforts have been made to prepare the trisubstituted derivatives of the dichlorals. Ordinary methods of acetylation yield monoacetyl dichlorals.

The preparation of the pentacetyl derivatives of α -glucochloralose makes possible certain comparisons. The opening of the oxygen ring did not destroy all differences between α -glucochloralose and β -glucochloralose. The pentacetates differ in appearance, melting point, rotation, and solubility. From the fact that the two chloraloses are oxidized to chloralic acids of the same size, rings of equal size would be anticipated. There remain the matter of position of the acetal linkage, and a possible dextro-leave variation in the spatial

arrangement of the attached $-\text{CHCl}_2$ group, for the basis of this isomerism. From an examination of the arrangement of hydroxyls about the first three carbon atoms in alpha and beta glucose, it is clear that derivatives from these two forms would vary not only in that type of configuration, but also in the positions at which the acetal linkage could occur.

Saponification of these pentacetates was also studied. The question arose whether the open chain compounds would yield on saponification their original chloraloses. Mild saponification was tried and under these conditions pentaacetyl β -glucochloralose was changed to β -glucochloralose. However, under the same conditions, and even milder treatment, the pentaacetyl α -glucochloraloses yielded no trace of either glucochloralose. No nonvolatile compound was recovered, nor was there a satisfactory test for chloride ion in the inorganic residues. This is in harmony with the instability of α -glucochloralose which is usually encountered when alkalies are used.

The Possible Positions of the Various Groups

Another method of approach to the problem of structure is to determine the positions of the characteristic groups. A compound was therefore prepared in which the position of the methoxy group was known. This was condensed into two methyl dichlorals and compared with derivatives made by direct methylation of known dichlorals.

The 3-methylglucose was prepared from diacetone glucose. This is considered by Haworth (11) and by Levene (18) to be a 3-methyl compound. Condensation of this methylglucose with chloral hydrate gave two compounds in each of which, it can be assumed, the position of the methyl group has not been changed from the third carbon. The yield, measured after crystalline products were separated, was from 16 to 20%.

The first product from the condensation, with m.p. of 194°, can be designated as compound IV and the other, which melts at 111°, as compound V. Compound IV agrees in properties with the methyl derivative of the high melting dichloral-268°, of which Ross and Payne (24) reported an incomplete study; their data agreeing well for an approximately purified compound such as they handled. This methyl derivative of the dichloral-268° was also prepared by Coles' method for methylation, and was found to be more difficult to purify than the same compound derived from 3-methylglucose. This sample melts at 191°, and in the same Thiele tube a mixed melting point of samples prepared by two different methods in this laboratory,

melted at 192°. The crystalline appearance of the two samples as well as their behavior in different solvents indicates identity. The possibility that the two chloral groups are attached at the same points left free by the two acetone groups should not be ignored. Certainly the preparation of this methyl dichloral, by direct methylation of the known dichloral, as well as from 3-methylglucose by condensation, shows the position of the free hydroxyl in that dichloral to be at the third carbon atom.

The position of the hydroxyl in this dichloral is of further interest because β -glucochloralose yields both this dichloral and the next high melting one (225°) when it is condensed with a second molecule of chloral. Under conditions of further condensation the first chloral group is not in the least hydrolyzed. It follows that information about the position of the first chloral group of this dichloral can be considered to apply also to the corresponding group in the monochloralose. The 1,2-chloral, 3-hydroxy configuration of the dichloral-268° would strengthen the postulated 1,2 position for the chloral group of the related monochloralose.

The other compound (V) obtained from 3-methylglucose melts at 111°, has a specific rotation of -10.8°, and crystallizes from 76% alcohol. Chlorine analysis checks the theoretical value for a monomethyl dichloral. Its description tallied rather closely with the Hess and Payne report of a monomethyl derivative of the dichloral-225°. Methyl derivatives of both

this 225°-dichloral and the next known dichloral, m.p. 135°, were prepared, but compound V is not identical with either. Its properties fall between those of the two known methyl dichlorals with which it was compared.

Further condensation of α -glucochloralose with chloral.

Since β -glucochloralose was known to condense with chloral (3) to give the two highest melting of four known dichlorals, it was natural to try the condensation of α -glucochloralose as soon as enough compound was available. Obviously the other two known dichlorals would be anticipated from this condensation, but contrary to expectation, neither could be discovered. A compound isolated from the crude product behaved much as a dichloral; it was purified by crystallization from CCl_4 and from 57% alcohol. Its melting point was 199°, and its analysis checked the theoretical value for a dichloral. A quantity sufficient for the preparation of derivatives has not been obtained. However, the m.p. of this dichloral has the same relation to the melting points of the other dichlorals, as the m.p. of compound V has to the melting points of the known methyl dichlorals.

The condensation of this monochloralose to a dichloral is cumulative evidence that the structure of the monochloraloses is intimately related to the dichlorals, which are unquestionably acetal derivatives of the sugars. It is interesting that no dichloral as yet has been found which is derived from both

α -gluchloralose and β -glucechloralose. The existence of such a fifth dichloral would preclude attempts to use any uncomplicated factor to explain the isomeric dichlorals. No single scheme can account for more than four possible isomers.

It is also interesting to note that this new dichloral resembles in appearance a compound isolated in very small quantities after treating the dichloral-135° with metallic sodium in ether solution. Samples of the two and of a mixture melted within half a degree at 199°. Because of the minute amounts of the compound obtained from the sodium treatment of the older dichloral, no further evidence of identity has been obtained. It is realized that there is considerable force in a suggestion that this small amount was existent in the sample and that the treatment with sodium favored the separation. This single fact invites further study as it is very easy to imagine epimerization of the $-\text{CHCl}_2$ groups and corresponding interconversions of the dichlorals.

Significance of the rotation values of the chloraloses.

The available data on the rotations of the chloraloses were examined for any regularities. The aldehyde carbon of the chloral group undoubtedly becomes asymmetric when it is attached to two carbons of the glucose chain. Examples of such isomerism are found in the benzylidenemethylglucosides studied by Ohle (21) and by Freudenberg. Monochloraloses, or dichlorals, and their derivatives which differ only in the spatial configuration of the chloral as attached to the hexose molecule, should be discovered by a constant difference in molecular rotations. Only two monochloraloses are known. Examination of the following table of molecular rotations shows no regular sum or difference.

	(α)D	Mol. Rot.	Sum	Difference
α -glucochloralose	-15.95°	-5,844	7,877	+19,565
β -glucochloralose	+44.55°	13,721		
Pentacetyl α -glucochloralose (needles)	-11.46°	-6,175	22,415	+34,765
Pentacetyl β -glucochloralose	+53.24°	28,590		
Pentacetyl α -glucochloralose (plates)	+66.21°	35,544		

Evidently these isomers do not vary in any simple manner to which Hudson's rule could apply (17). Neither has any constancy appeared in the figures on the rotations of the dichlorals.

It should perhaps be noted that work on the rotatory power of these compounds is attended with certain difficulties. As shown in the experimental data, the solutions observed were

quite dilute. In the extreme case of β -glucochloralose, the highest concentration obtainable gave an observed reading just a few times the possible error in reading the polarimeter.

There exists also the possibility that some solutions measured were equilibrium mixtures of optical isomers. Several preparations have been found to be without optical activity. Only in the case of pentacetyl α -glucochloralose, m.p. 151.5°, was there positive evidence that the compound used could not be resolved.

In this case the crystals obtained were so large, perfect, and well characterized that it could consist of one optical form alone.

EXPERIMENTAL DETAILS

ACETYLATION OF α -GLUCOCHLORALOSE: After refluxing 5 gms. of α -glucochloralose with 35 cc. of acetylchloride and a small amount of freshly fused $ZnCl_2$ for half an hour, the excess acetylchloride was distilled off. The residue was poured into water and washed until free from acid. The insoluble portion was filtered off and recrystallized from alcohol. A mixture resulted which was separated as follows: the solid was dissolved in slightly more than the least amount of boiling alcohol and cooled without disturbing the container. Long needles crystallized out; the liquid was carefully poured off and irregular foursided platelets appeared as from a supersaturated solution. A certain degree of separation was achieved by washing the mixture with ether at room temperature but this was not as sharp as the separation from the alcohol solution noted above. The needles recrystallized well from alcohol. They were more soluble in ether than the platelets; they were also soluble in petroleum ether; m.p. 174° . Specific rotation in $CHCl_3$ (1.4 gms. per 100 cc.) $\frac{[\alpha]_D^{30}}{D} = 11.5^\circ$.

Calculated value for chlorine in $C_{18}H_{22}O_{12}Cl_2$19.80%.

Chlorine found, by Carius.....19.83%; 19.37%^{*}

The figure starred was the result of Cl determination on the mixture before separation.

The platelets crystallized from alcohol and came out most readily when the solution was seeded. Large crystals were obtained by adjusting the concentration for slow crystallization. They melted at 151.5° . Soluble in $CHCl_3$, slightly

soluble in ether, and in petroleum ether, insoluble in water.
Specific rotation in CHCl₃ (1.6 gms. per 100 cc.) $[\alpha]_D^{30} + 66.2^\circ$.

Calculated value for chlorine in C₁₈H₃₂O₁₂Cl₆.....19.80%.
Chlorine found, by Carius.....19.91%; 19.94%.

SAPONIFICATION OF THE PENTACETYL DERIVATIVES: Pentacetyl

β -glucochloralose was saponified with KOH (about 15%) in methyl alcohol at room temperature for twenty minutes. The mixture was poured into water acidulated with enough H₂SO₄ to neutralize the KOH. β -glucochloralose separated out at once; it was recrystallized once and checked by melting point. Pentacetyl α -glucochloralose was saponified under the same conditions but no glucochloralose appeared when the alkali was neutralized. The neutral aqueous solution was evaporated under a vacuum, but only Na₂SO₄ crystallized out. The residue was extracted with alcohol but no material was obtained by extraction. Another sample was mixed with 5 cc. of water and 5 cc. of a solution of KOH in methyl alcohol. Solution was complete after five minutes at room temperature. The solution was at once diluted, neutralized, and allowed to evaporate at room temperature. Only Na₂SO₄ was recovered. The products of this reaction were evidently volatile compounds.

SEPARATION AND PURIFICATION OF α -GLUCOCHLORALOSE. During the routine preparations of β -glucochloralose it seemed possible that a reasonable amount of α -glucochloralose could be ob-

tained as a by-product and studied. Previously the aqueous acid solutions remaining after the separation of β -glucochloralose had been evaporated and ether extracted in order to obtain the alpha isomer. Since heating with acid was known to decompose this compound (7) neutralization of the acid before concentrating the solution was tried. When alkali was added until the acid was as nearly neutralized as possible, without becoming in the least alkaline, the α -glucochloralose was precipitated in a rather impure condition. An improved procedure for purification is given below. Observation of different condensations makes it seem that a low temperature, particularly during the first few hours, favors the production of α -glucochloralose. A similar instance is noted in the work on glycerol ring derivatives by Hibbert (14) and Nieuwland (20). On the strength of a reported failure (23) to obtain β -glucochloralose from cellulose by the usual condensation method, the condensation of cotton with chloral was tried in the hope of obtaining a greater yield of α -glucochloralose. However, the major derivative from the cotton turned out to be β -glucochloralose, although some α -glucochloralose was obtained. Glucose was recrystallized from pyridine, to get β -glucose, and during the condensation particular attention was paid to the cooling of the mixture. Both monochloraloses were obtained in this case also.

To purify the α -glucochloralose the aqueous solution

containing the impure precipitate was brought to boiling and filtered hot (some β -glucochloralose separated here). The solution was evaporated to one-fourth its volume at slightly over room temperature. The precipitate was mixed with Na_2SO_4 ; it was then taken up in alcohol and filtered from the undissolved salt. The clear alcohol solution was diluted with an equal volume of water, warmed on the hot plate until turbid, and cooled slowly. The precipitate came down in needles and was recrystallized from 38% alcohol. It was sometimes recrystallized from water, but the time required for crystallization was greater. It was finally recrystallized from CHCl_3 with a small amount of alcohol, m.p. 187° . Specific rotation (0.9 gm. per 100 cc.) $[\alpha]_D^{28} = 15.96^\circ$.

CONDENSATION OF α -GLUCOCHLORALOSE WITH CHLORAL. A mixture of 25 gms. of α -glucochloralose with 100 cc. concentrated H_2SO_4 and 50 gms. chloral hydrate was stirred mechanically and kept below 20°C . by an ice bath for the first few hours. It was allowed to warm gradually to the temperature of tap water and during the last few hours it was allowed to come to room temperature (about 25°). The total time was eight hours. The insoluble mass was ground with water and the liquid stirred into four times its volume of water. The next morning the insoluble material was filtered off and washed free from acid. Much manipulation of this crude product was for the purpose of finding certain known dichlorals, but it was without success. Finally the water insoluble material was dissolved in

CCl_4 and crystals obtained from that solution. These were later recrystallized from 57% alcohol. The constant melting point was 199° . The small amount available was analyzed by Carius method for chlorine. Considering the very small samples the results were reasonably accurate.

Sample 1. 0.0372 gms. AgCl - 0.0738 gms. 49.08% Cl .

Sample 2. 0.0458 gms. AgCl - 0.0890 gms. 48.07% Cl .

Calculated value for $\text{C}_{10}\text{H}_{10}\text{O}_6\text{Cl}_2$48.48% Cl .

CONDENSATION OF 3-METHYLGLUCOSE WITH CHLORAL. About 30 gms. of 3-methyldiacetoneglucose, 150 cc. of concentrated H_2SO_4 , and 45 gms. of chloral hydrate, were stirred by motor stirrer for ten hours. During the first two hours ice was used around the beaker to cool the mixture; later the evolution of heat decreased and tap water was sufficient for cooling. At the end of ten hours the mixture was slowly poured into 1.5 liters of cold water while the water was being rapidly stirred. After standing over night the insoluble material was washed free from acid and filtered. It was then dissolved in hot alcohol and allowed to crystallize. All the crystals obtained from cooling the alcohol solution were recrystallized several times from alcohol. They reached a constant melting point of 194° .

Specific rotation in CHCl_3 (1.5 gms. per 100 cc.) $\left[\alpha\right]_D^{30} -19.73^\circ$.

These were identified as crystals of methyl derivative of the dichloral -268° and were labeled Compound IV.

When no further precipitate of these crystals could be

obtained from the alcohol solution, the alcohol was diluted with water and the oily residue was dissolved in CCl_4 . After separation it was recrystallized from 76% alcohol. It formed very small needles which melted at 111° . It was very soluble in alcohol and chloroform, slightly soluble in petroleum ether. Specific rotation in CHCl_3 (1.26 gms. per 100 cc.) $[\alpha]_D^{30}$ -10.8° .

Chlorine found by Carius.....47.29%; 47.07%.

Calculated for $\text{C}_{11}\text{H}_{12}\text{O}_6\text{Cl}_2$ 47.27%.

METHYLATION OF DICHLORAL -225° . The usual method of methylation was used (3). The chloroform was evaporated from the extracted material and the solid digested with several portions of petroleum ether. Long monoclinic crystals formed and were lifted from the solution. Three more recrystallizations gave a constant melting product, m.p. 125° . Specific rotation (3.9 gms. per 100 cc.) in CHCl_3 $[\alpha]_D^{27}$ -26.97° .

Chlorine found by Carius.....47.08%; 47.47%.

Calculated for $\text{C}_{11}\text{H}_{12}\text{O}_6\text{Cl}_2$ 47.27%.

ACETYLATION OF DICHLORAL -135° . A mixture of 15 gms. of the dichloral -135° with 25 cc. pyridine and 40 cc. of acetic anhydride was left for 48 hours on a sand bath (about 70°). The mixture was then poured into water and the insoluble oil washed free of acid. The oil was taken up in alcohol and decolorized with charcoal. Long needles slowly crystallized. It also crystallized from petroleum ether, m.p. 95.5° . Optically in-

active in CHCl_3 .

Chlorine found by Carius.....43.92%; 44.06%.

Calculated for $\text{C}_{12}\text{H}_{18}\text{O}_7\text{Cl}_2$ 44.24%.

SUMMARY

It has been shown that the shown that the oxygen ring in α -glucochloralose and in xylochloralose can be opened, though with difficulty, by the action of acetyl chloride and fused $ZnCl_2$. Saponification in the case of pentacetyl β -glucochloralose was stopped with the removal of these acetyl groups and the β -glucochloralose recovered. It was not possible to stop saponification at a similar stage with the pentacetyl derivatives of α -glucochloralose.

The monomethyl derivative of dichloral -268° was made by a method which located the free hydroxyl in this dichloral. This is probably the position of one hydroxyl in β -glucochloralose. The monomethyl derivative of dichloral -225° was prepared and characterized.

α -glucochloralose was condensed with chloral and a new dichloral isolated in small quantity.

No conclusions could be drawn from a study of the molecular rotations of the chloraloses and their derivatives.

The monoacetyl derivative of dichloral -135° was obtained in a crystalline state and has been described.

The structure of the chloraloses has been discussed in the light of the new compounds prepared.

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