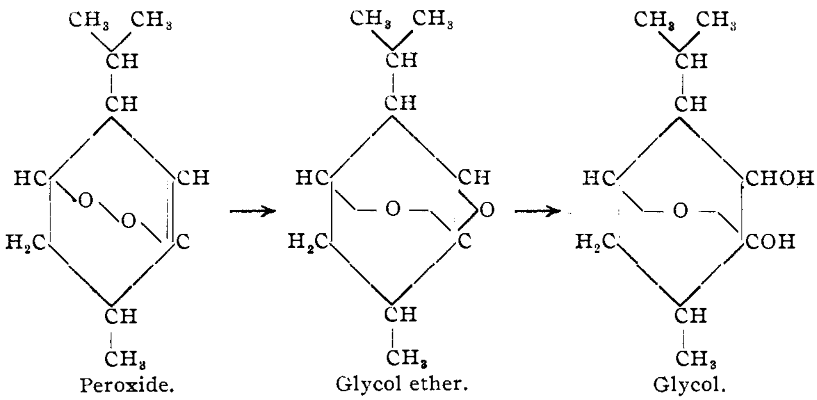
work on acetyl-benzoyl peroxide), as well as the violence of the reaction brought about when treated with ferrous sulfate and other reducing agents, seem to indicate that ascaridole is an organic peroxide.

If so, the following tentative structural formulas, which are intended to show a relationship to hydroxythymoquinone, will indicate the course of the reactions involved.



[Contribution from the Laboratory of Soil Fertility Investigations.]

DIHYDROXYSTEARIC ACID IN GOOD AND POOR SOILS.[1]

By Oswald Schreiner and Elbert C. Lathrop.

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The presence of dihydroxystearic acid in certain infertil soils was reported[2] from this laboratory in 1908 and was followed by a more extensive study of the effects of this substance on plant growth.[3] Since then dihydroxystearic acid has been found so often in the examination of infertil soils brought to the attention of this laboratory as to lead to the conclusion that it is one of the principal factors of infertility in such soils, or at least a contributory factor that is easily determined and thus becomes an indicator of the poor soil conditions which lead to infertility. More accurate knowledge concerning the other organic soil constituents associated with and accumulating under the same conditions as dihydroxystearic acid will doubtless be necessary before this question can be definitly answered, but attention should here be called to the fact that even the knowledge that this one constituent is present leads to a recognition of the fact that poor soil conditions exist and this suggests

[1] Published by permission of the Secretary of Agriculture.

[2] Schreiner and Shorey, This Journal, 30, 1599 (1908); "The Isolation of Harmful Organic Substances from Soils," *Bull.* 53, Bureau of Soils, U. S. Dept. Agr. (1909).

[3] Schreiner and Skinner, *Botan. Gaz.*, 50, 161 (1910); "Some Effects of a Harmful Organic Soil Constituent," *Bull.* 70, Bureau of Soils, U. S. Dept. Agr. (1910).

the practical remedial measures to be employed. The determination of the presence of this compound becomes, therefore, a very valuable and ready means of diagnosing such soil conditions on a limited laboratory sample.

The frequent occurrence of dihydroxystearic acid, together with the fact that it was found in soils unproductive in the field, made it seem highly desirable to test this relationship of soil infertility or low productivity with the presence of this compound more fully and to obtain at the same time an idea of its distribution in the soils of the United States. With this in view, samples were collected in various parts of the United States by field men of the Bureau of Soils. A good sample and a poorer sample of the same soil type were requested. The samples were to be either from the same field, or at least from the same neighborhood and in most cases this request could be complied with although most of the samples thus sent in had no special problem connected therewith. In addition to those collected in this manner, infertil soils with a known record of infertility were examined. These samples of good and poor soils were examined for dihydroxystearic acid by the following method:

Five to ten pounds of soil are extracted for 24 hours with 5–10 liters of 2 per cent. sodium hydroxide solution. The supernatant alkaline extract is siphoned off, made acid with dilute sulfuric acid and filtered. The filtrate is shaken out with ether until nothing more is extracted by ether. The ether extract is allowed to evaporate over a small volume of water and the water solution containing oil and resinous material is boiled vigorously and filtered while hot through a filter wet with hot water. The filtrate containing the dihydroxystearic acid is allowed to cool and is again extracted with ether, evaporated and the water solution boiled and filtered as before. On evaporating the water solution to small volume and allowing it to stand, dihydroxystearic acid will separate out in star-like clusters of white plates or needles which should melt, when pure, at 99°.

A total of 84 soil samples were examined for dihydroxystearic acid; of these 24 were subsoils. Of the total number of samples examined, 27 contained this compound as a constituent part.

The list comprizes a total of 60 surface soils of widely different characteristics, collected in 18 states. They vary from extremely unproductive soils to soils of the highest productivity and represent soils of different origin, different systems of cropping, widely different climatic conditions and of varying texture, from loose sands to plastic clays. Of these soils 33 per cent. showed the presence of dihydroxystearic acid. It was contained in soils under long cultivation, as well as in virgin lands; in soils continually cropped, as well as in soils under permanent sod. This shows that this compound is a common soil constituent and likely to be encountered in soil work anywhere. It was found in soils as widely separated as Massachusetts, Texas and Oregon. This at least indicates that there is some force at work which forms this compound in soils everywhere. Its formation or its accumulation is doubtless due to local soil conditions in any one section, but these local soil conditions are not confined to any region of the United States and probably not to any country or continent.

Incidentally in the present investigation it was hoped that the examination of a considerable number of soils would throw further light upon its origin. For this reason as much information concerning the crop history and native vegetation as could be acquired from the respective owners of the soils examined was obtained, but the information thus gained is so meager and imperfect that we hesitate at this time to draw any definit conclusions. It seems, however, that the dihydroxystearic acid is not connected with any specific crop and what information there is points to its association with soil fungi, as already pointed out.[1] The soil conditions under which it is found are generally poor drainage, poor aeration, too great compactness, deficiency in lime, lack of good oxidation, lack of good nitrification, and, as already mentioned, tendency for fungus development and exceptional poorness of crops. While, therefore, all these factors contribute toward the formation or accumulation of dihydroxystearic acid or exist because of its presence, no single one of these factors can, at the present time, be said wholly to explain its origin.

The surface soils examined may be divided into two classes: (1) Good soils, comprizing those of average or high productivity for the soil types represented; (2) poor soils, comprizing those less productive than Class 1, as well as those of undoubted fertility.

GOOD SOILS.

Containing dihydroxystearic acid:

Dunkirk clay, Monroe Co., N. Y.
Orangeburg fine sandy loam, Marshall Co., Texas

Not containing dihydroxystearic acid:

Amarilla silt loam, Sherman Co., Texas.
Cecil clay, Appling, Ga.
Clarksville gravelly loam, Walker Co., Ga.
Dekalb fine sandy loam, Long Island, Ala.
Dutchess loam, Greenville, N. J.
Hagerstown silt loam, State College, Pa.
Louisa fine sandy loam, Roanoke, Ala.
Madera sand, Fresno, Calif.
Marshall loam, Fargo, N. D.
Norfolk fine sand, Glynn Co., Ga.
Norfolk fine sand, Savannah, Ga.
Norfolk coarse sandy loam, Rockingham, N. C.

[1] *Bull.* **53**, Bureau of Soils, U. S. Dept. Agr. (1909).

Norfolk loam, Mobile Co., Ala.
Norfolk sandy loam, Laurinburg, N. C.
Orangeburg fine sandy loam, Tuscaloosa, Ala.
Orangeburg fine sandy loam, Waynesboro, Miss.
Orangeburg sandy loam, Forrest Co., Miss.
Orono clay, Oldtown, Me.
Peaty soil, Lake Mattamuskeet, N. C.
Cahaba fine sandy loam, Lowndes, Miss.
Sassafras silt loam, Easton, Md.
Stockton, Cal. soil.
Westmoreland silt loam, Clayville, Pa.

Twenty-five of the soils can be classed as good soils, that is, soils of high or average productivity. Of these only two contained dihydroxystearic acid. These were the samples of the Dunkirk clay from New York and the Orangeburg fine sandy loam from Texas. The subsoils of these also contained dihydroxystearic acid. Of the former soil type there was no poorer sample sent in, so no direct comparison of this kind is possible. It is, however, a soil of only fair productivity and the sample may, therefore, not have been so typical of the best fields in this type as should be the case for this classification. It was, however, our judgment, based on the collector's report, that this sample should be classed among the good rather than among the poor soils. With the Texas soil the case is different. Here there is available for comparison a soil sample from an adjoining poorer field of the same type. This poorer field which had not been fertilized and had been so poorly farmed that it was abandoned to native vegetation, contained considerably more than the sample from the better field, which had been well farmed by the growing of truck crops. This is exactly what should be expected in the case of a soil containing this substance when it is improved by manures, fertilizers or thorough cultivation. Ultimately the dihydroxystearic acid should disappear entirely under such conditions.

POOR SOILS.

Containing dihydroxystearic acid:

Baldwin clay, Media Co., Tex.
Boston common soil, 3 samples, Boston, Mass.
Chester silt loam, Philadelphia, Pa.
Clarksville silt loam, Broadhead, Ky.
Clarksville silt loam, Pulaski, Tenn.
Clyde loam, Orleans Co., N. Y.
Durham sandy loam, Clayton, N. C.
Elkton silt loam, Easton, Md.
Frankstown stony loam, Bedford Co., Pa.
Orangeburg fine sandy loam, Marshall, Texas.
Peat, Klamath Marsh, Ore.
Peat, Lanham, Md.
Takoma lawn soil, Takoma Park, Md.
Volusia silt loam, Naples, N. Y.
Woodland soils, 2 samples, Redding, Conn

Not containing dihydroxystearic acid:

Cecil clay, Appling, Ga.
Cecil sandy loam, Charlotte, N. C.
Dekalb fine sandy loam, Long Island, Ala.
Dekalb silt loam, Ravenwood, W. Va.
Louisa fine sandy loam, Roanoke, Ala.
Madera sand, Fresno, Cal.
Muck, Orleans Co., N. Y.
Norfolk coarse sandy loam, Rockingham, N. C.
Norfolk fine sand, Glynn Co., Ga.
Norfolk fine sand, Savannah, Ga.
Norfolk loam, Mobile Co., Ala.
Orangeburg fine sandy loam, Tuscaloosa, Ala.
Orangeburg fine sandy loam, Waynesboro, Miss.
Orangeburg sandy loam, Forest Co., Miss.
Orono clay, Oldtown, Me.
Cahaba fine sandy loam, Lowndes, Miss.
Sandy loam from a pocoson, Trenton, N. C.

The soils which can be classified as poor soils are 35 in number and comprize those less productive than those considered under the designation of good soils as well as some distinctly infertil soils. Of these poor soils, 51 per cent. contained dihydroxystearic acid.

Ten of the soils had distinct problems of infertility. These are the Volusia silt loam from New York, the three soils from Boston Common, the two soils from Redding, Conn., the Elkton silt loam and the Takoma lawn soil from Maryland, the Chester silt loam from Pennsylvania and the Clarksville silt loam from Tennessee. In every one of these samples of distinctly infertil soils dihydroxystearic acid was found in appreciable amounts, except in the surface soil of the Volusia silt loam, but here it was found in the subsoil.

Deducting these 10 very infertil soils, all of which contained dihydroxystearic acid, from the above 35 poor soils, there remain 25 poor soils about which nothing definit is known excepting that they are relatively less productive than other soils in the same regions. Nevertheless 32 per cent. of these soils contained this soil constituent.

The frequent occurrence of dihydroxystearic acid is of special interest and significance because of its known harmful properties to plants. One-third of all the soils examined showed the presence of this compound. It was found in virgin soils as well as in soils under long cultivation; in soils continually cropped as well as in soils under permanent sod; in soils from the Atlantic coast; in soils from the Pacific coast; and in soils from the Gulf states. This compound is, therefore, a common soil constituent and is likely to be encountered in soils anywhere. Its formation or its accumulation is doubtless due to local conditions in any one section, but these local conditions are not confined to any region of the United States and probably not to any country or continent.

Judging from the foregoing relationships established by this investigation it would seem that dihydroxystearic acid is either a direct or indirect factor in the low productivity in soils: direct by virtue of its harmful effects on growing crops, indirect as an indicator of other compounds or conditions which cause soil to become less productive and even infertil. It is not possible to state from the data at hand that dihydroxystearic acid is the only factor which contributes to the infertility or unproductivity in those soils in which it was found, for it must be remembered that this is only one of many compounds, both organic and inorganic, harmful and beneficial, which exist in soils, any and all of which play a part in its relative fertility and infertility. It is certain, however, that the determination of even this one constituent leads to a recognition of the kind of infertility in the soils examined and is, therefore, a readily recognized symptomatic factor of poor soil conditions.

BUREAU OF SOILS. WASHINGTON. D. C.

NOTES.

Detection of Gas in Sealed Tube Reactions.—Occasionally organic compounds in sealed tube reactions undergo partial decomposition with liberation of gas. While it may be of no importance to determin the amount of gas, it is sometimes desirable to know just what has been formed. The usual method of placing the substance in a Carius or Volhard tube, which is then heated, drawn to a capillary tip nd sealed, does not permit the satisfactory examination of gas. As soon as the capillary tip is heated in a flame, inside pressure causes the gas to escape. Even if there is no inside pressure, which rarely occurs when gas is formed, it is not practical to connect the capillary tube with an absorption tube or eudiometer.

The following method has proved satisfactory in such cases: After the substance, with or without a reagent, has been placed in the Carius or Volhard tube, a specially constructed stopcock of the same glass as the tube is sealed to the end. It requires only the slight skill necessary to join two hard glass tubes. The stopcock is open during sealing and a rubber hose, attached to the stopcock and held in the mouth, permits blowing the glass to uniform thickness at the juncture. The seal is then annealed and the stopcock closed. The tube may be heated to any desired temperature, but at temperatures much above 100°, it is a safe precaution, though not absolutely necessary, to wire the stopcock. When the reaction is completed and the tube is cold, connect the latter with the appropriate apparatus and allow the contained gas to escape gradually. To expel more gas, the tube may be heated. When the experiment is finished, the stopcock is removed and used again. Sometimes a tube breaks but not oftener than the ordinary Carius tube. If