the scientific work would not lengthen the voyage more than a week.

The ships sent by the North Sea countries and by Russia, coming through the English channel, could study a section of the Atlantic north of the Plateau of the Azores. The opening of the Panama Canal, which should stand for universal traffic, would likewise form an epoch in the study of the sea, and introduce a future of international cooperation in the scientific activity of nations.

If this opportunity is neglected, it is not likely soon to come again. Experience has taught the difficulties involved in setting in motion an international undertaking of such dimensions; and the opinion is expressed that the time remaining would just about suffice for the diplomatic, scientific and technical preparations.

In preparing the above synopsis the words of the authors are frequently used.

H. C. Jones

SPECIAL ARTICLES

THE POOR NITRIFYING POWER OF SOILS A POSSIBLE CAUSE OF "DIE-BACK" (EXANTHEMA) IN LEMONS

The disease known as "die-back" in citrus trees has, for many years, worried the citrus growers of Florida and California in this country and has thus far baffled the efforts of the agricultural scientist to discover its cause. The writer has recently made some observations and experiments on several citrus soils bearing trees affected with "die-back," which lead him to believe that a poor nitrifying power on the part of the soil, with the ammonifying power remaining normal, may be the cause of the peculiar manifestations which are characteristic of the disease and which, for the purposes of this preliminary report, need not be described. The theory upon which I am working at the present time, looking toward the solution of this problem, is that in the absence of normal nitrification and in the presence of sufficient ammonification, the tree does not obtain a sufficient quantity of nitrate for its development and is sooner or later forced to assimilate ammonia compounds as produced by ammonifying organisms in the soil; or in the presence of a sufficient amount of bases in the soil even the ammonia may be set free, thus causing the plant to starve for want of nitrogen. While it is true that some plants can use ammonia compounds just as well as nitrates as a source of nitrogen and further, that some of them even prefer the ammonia compounds, as Kelley has shown is the case with rice, it is very possible that we have in the citrus tree, a plant which is deleteriously affected by ammonia compounds when it is forced to absorb them. As above explained, however, when a soil's power to fix and hold ammonia is very feeble, owing to the presence of bases in excess, a poor nitrifying power and a strong ammonifying power may mean nitrogen starvation for plants on that soil. The writer has examined and tested the nitrifying power of four citrus soils in various parts of California, on which trees were suffering from "die-back," and has found in every case a very slight nitrifying power or none at all. The tests were made by adding to soils, kept at optimum moisture conditions at a temperature of 26 to 28 degrees C. for approximately a month, both dried blood and sulfate of ammonia, but only slight or no increases of nitrates over the amount in sterile checks or dry soil were obtained. The dried blood was used also in varying quantities from 1 per cent. up to 5 per cent. of the dry weight of the soil, but the same results were obtained in all cases. In some of these soils, particularly, the ammonification of the blood proceeded so rapidly as to give an intense odor of ammonia when the Petri dish cover was raised from the tumbler in which the soil cultures were kept.

This theory of the writer's which inclines to account for the "die-back" by the fact that too much ammonia is assimilated by the tree under compulsion in the absence of nitrates, or, under certain circumstances, because ammonia is set free and therefore there is scarcely any nitrogen for the tree to assimilate, would also seem to be in part confirmed by the observations made by Florida investigators on the disease in question, in which it was noted that in all cases the application of organic manures to citrus groves invariably made conditions worse or increased the amount of "die-back." In accordance with the idea above expressed, and in the absence of nitrification, this would be for the reason that either the added organic matter would be responsible for the formation of so much ammonia, which (through its enforced absorption) would poison the plants or because, under some soil conditions, most of the ammonia would be set free and pass off into the atmosphere in a gaseous form, thus inducing nitrogen hunger.

I feel justified in transmitting this brief preliminary note on the subject in question, before the theory has been fully tested out, by the fact that the disease known as "die-back" has been studied in many different ways without giving encouraging results, and, because, further, this new method of attack related to the chemical and bacteriological conditions of the soil, as affecting plant nutrition and as applied to a problem of this kind, deserves to be called to the attention of other investigators working along this or similar lines. I am vigorously proceeding to test out the theory above given by simultaneous greenhouse and field experiments with citrus trees which are now under way, in which, on the basis of what I have said above, I am not only trying to overcome the disease by variously treating soils in the field, so as to provide a plentiful supply of nitrates and reduce ammonification, but I am also making an effort to produce the disease experimentally in the greenhouse with seedling citrus trees on soils deficient in nitrates by the addition to the latter of various ammonia compounds, and to overcome it by means of adding stimulants for the nitrifying bacteria. The writer feels confident that a definite relationship may be shown between the abnormal soil conditions mentioned and the "die-back" of the lemon and perhaps as well of other citrus trees, when the experiments have progressed far enough. The theory above enunciated is not only in accord with the Florida observations, but also with all other observations with which I have become acquainted in respect to the disease known as "die-back." Moreover, it allows for the production of bad soil conditions which will result in a poor nitrifying power through a large variety of causes. Such are, for example, the poor physical conditions of soils, unfavorable drainage conditions, the presence of a vigorous denitrifying flora of one kind or another, and many other chemical, physical and bacteriological conditions, not to mention conditions respecting the origin of the soil which would seriously affect the nitrifying power thereof.

These lines for the most part were written about a year and a half ago when I first formulated the theory, and may need slight revision and some additions in the light of many new facts with which we are now acquainted, but, in the main, the theory seems to be better supported in fact at the present time than it was two years ago. Moreover, it seems very probable now, from a large series of tests which we have been making, that not only "die-back," the true *exanthema,* is to be accounted for by the theory under discussion, but also that the equally disastrous, and much more widely spread disease known as "mottled leaf" of citrus trees is capable of being explained in a similar way, if I may regard a large series of tests on various soils in this state as a reliable criterion. Quite unlike the "die-back," the "mottled leaf" condition in citrus trees is to be found in all citrus districts of California, and is at the present time regarded as one of the most menacing factors in the production of citrus fruit for profit here.

The "die-back" and "mottled leaf" conditions of some districts in this state are becoming so bad as to make it imperative to solve these questions as quickly as possible from the practical standpoint alone. One orchard on which, in particular, the writer is working, has a very large proportion of its trees badly affected by the first-named disease, and most trees in the orchard show some manifestation of the disease. The trees are about four years old and had for a time grown vigorously, and then suddenly began to give symptoms of one of the worst and most widespread cases of "die-back" of which we have knowledge in the state. It is hoped that our experiments may serve eventually to remedy such conditions.

A description of detailed experiments will soon appear.

CHAS. B. LIPMAN
RESEARCH LABORATORY FOR SOILS,
UNIVERSITY OF CALIFORNIA

THE WATER CONTENT OF THE EMBRYONIC NERVOUS SYSTEM

GROWTH and morphological differentiation go hand in hand in the developing organism, but obviously growth alone can not lead to an increase in the complexity of form without itself being differential. The various tissues and organs of the embryo, however, do grow at different rates, and since, in general, rate and extent of growth are measurable in terms of the rate and extent of water absorption, it follows that differential growth must depend on the ability of the embryonic tissues to absorb and hold, relative to their dry substance, different amounts of water. That this must be true at some period in development follows from the comparative dry substance determinations familiar to every one, but how early in the ontogeny differential absorption occurs has not been known, although its importance as a factor in morphological differentiation has been hinted at often enough.

My investigation of this question was begun on the embryos of *Rana pipiens* in the spring of 1913. The methods employed were tedious but simple. In one series of experiments eggs were allowed to develop normally until a time when the body of the embryo could be cut from the yolk by means of a very thin knife. The division was accomplished easily with a minimal loss of material. Unfortunately the various tissues in the separated portions can not be isolated, but even if this were possible, an unavoidable error due to the presence of considerable quantities of yolk within the cells of the nervous system would remain. However, at the stage of development under consideration, it is safe to assume that the operation results in the separation of two masses, one of which is predominantly yolk, the other, predominantly nervous tissue.

The separated masses were carefully weighed in closed vessels after removal of the superficially adhering water. Following the determination of the fresh weight, the material was reduced to absolute dryness in vacuo over P_2O_5. The results of two series of weighings given in Table I. are:

TABLE I

(*Rana pipiens*)

	Fresh Weight, Gr.	Dry Weight, Gr.	Dry Substance, %	Water, %
24 yolk sacs	.0440	.0204	46.4	53.6
31 yolk sacs	.0585	.0264	45.2	54.8
Average			45.8	54.2
24 nervous systems	.0464	.0098	19.1	80.9
31 nervous systems	.0714	.0149	20.8	79.2
Average			19.9	80.1

Control observations on embryos of *Amblystoma punctatum* were then made, but, owing to technical difficulties, it proved easier to compare the water content of the nervous system with that of the entire embryo rather than with that of the tissues constituting the yolk sac. The results of these preliminary determinations were as follows:

TABLE II

(*Amblystoma* larvæ)

	Fresh Weight, Gr.	Dry Weight, Gr.	Dry Substance, %	Water, %
16 larvæ	.0955	.0399	41.8	58.2
15 larvæ	.0992	.0406	40.9	59.1
Average			41.4	58.6

These figures may serve as a basis for comparison with the water content of the nervous system. As Table III. shows, the values for the latter are identical with those for the frog embryo, and belong to an order of magnitude quite different from the values for the larval body taken as a whole.

Comparing these values with the corresponding ones found for the frog embryos, we may say, within the limits of error, that the larval nervous system of these amphibians is a tissue which contains 80 per cent. of water and 20 per cent. of dry substance.