is interesting to note that the Japanese have, on the other hand, followed the example set by Germany and that their remarkable success in the introduction of western medicine is to be attributed, in no small measure, to the continued influence of the Imperial University Medical Schools on premedical education and especially upon research in the sciences fundamental to medicine.

In concluding this review, attention may be called to a noteworthy feature of the contributions, namely, to the cooperation of foreigners and Chinese. Long may this friendly association continue! In the four volumes under consideration, which represent the initial achievements of the enterprise (so far as they have been published), it is naturally chiefly a matter of the teacher working side by side with his Chinese student, although some of the more mature Chinese have already made important discoveries alone. Let us hope that in the years to come the tendency to work together, once happily initiated, will continue. The reviewer confidently believes that when experienced and fully trained Chinese and foreigners will join hands in united effort, fortified as they are by their peculiar heritages and intellectual endowments, a new force will be brought into medicine, and that mysteries will give way which have long baffled the best minds of England, France and Germany, indeed of all the nations of the west, laboring alone. That this new combination should act in one of the greatest of oriental cities, in an environment rich in intellectual and artistic achievement and altogether different in character from that which has fostered the advancement of science along certain lines in the west, is another factor which may be productive of surprising results. The future is full of promise, and there is a chance that the Peking Union Medical College may contribute, as few other institutions are privileged to do, toward the purpose of the Rockefeller Foundation, namely, "the welfare of mankind throughout the world."

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SPECIAL ARTICLES

EFFECT OF FREEZING AND THAWING ON THE BACTERIOPHAGE[1]

GENERALLY speaking, there are two conceptions as to the nature of the bacteriophage: (1) a living organism and (2) an enzyme. Its transmissibility in series favors the former view, while its "growth" curve and certain of its described physical and chemical properties would appear to class it among the latter.

Temperatures at or slightly below the freezing point are stated to be uninjurious to this lytic substance, but so far as the writer has been able to determine, the effect of repeated freezing-thawing has not been studied.

A bacteriophage active for *Staph. muscae* (Glaser), and another lytic for a human strain of *Bact. coli* were used. Heating at 60° C. for forty-five minutes inactivated the former, whereas the latter was only partially destroyed at this temperature. Using standardized procedures, the lytic titers of the two were very constant.

One cc quantities of the phages were frozen in small, sterile, cotton-plugged tubes on a freezing microtome with CO_2 gas. The cap of the freezing box was first unscrewed and the gas outlet covered with a piece of wire gauze to prevent the small tubes from resting in it. Over the small tubes was inverted a large test-tube, four and one half inches by one and one quarter inches, with a hole in the bottom of sufficient size to permit the escape of gas. CO_2 freely expanding in this chamber quickly lowered the temperature to a point where solid CO_2 was produced, approximately $-78°$ C.

The two phages were frozen and rapidly thawed ten, fifteen and twenty successive times, yet when titrated the titers never varied from those of non-frozen portions run as controls. Even when diluted ten thousand times with bouillon and then subjected to the freezing process for fifteen times no deleterious effect was to be noted on the staphylococcus phage.

By way of contrast, the following figures are given, indicating the numbers of a twenty-four hour old bouillon culture of *Bact. coli* which failed to survive after the first, tenth and fifteenth freezing, respectively: 16 per cent., 86 per cent., 94 per cent.

The results would indicate the bacteriophage to be something other than a viable organism, unless it constitutes an exception to the generally accepted rule that repeated freezing-thawing is injurious to living cells.

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THE RELATION OF MOISTURE CONTENTS OF WOOD TO ITS DECAY

EARLY in 1920, the senior writer began a comprehensive study of the relation of the moisture contents—or air-moisture balance—of wood to its decay and of woody plants to disease. During the past two years, the junior writers have been engaged in working out certain phases of both problems in collaboration with the senior writer.

One article, based on some preliminary experiments, was published,[1] but the publication of subsequent results has been put off from year to year to await more repetitions and more complete results. There are many difficulties in the way of satisfactorily completing such experiments, at least as they have been conducted up to the present. In the first place, the experiments are allowed to run for a year. Therefore, the maintenance of the proper moisture conditions over that period presents somewhat of a problem, not only to prevent drying out of the atmosphere, but to prevent wetting of the test blocks. For example, in the senior writer's absence one summer, the moist chamber dried out. Another summer, it was found that occasional changes in the temperature in the room caused precipitation of moisture in the jars in a large moist chamber to such extent that some of the test blocks took up water from the accumulation below.

The last series of tests, which has just been completed, was very satisfactory in bringing forward new data and in filling in some of the gaps of former series. Enough data are at hand for a fairly complete, although perhaps not a final, article on this work. Inasmuch as it would take some time under the present conditions for the completion of such an article, however, and further as it seems desirable to run some additional series, this present note is prepared to state the results thus far obtained.

Without going into details as to methods, the general idea is the following: to add definite percentages of water, from the fiber saturation point on, to oven-dried blocks of three specific gravities—Sitka spruce sp.gr. .34, southern yellow pine sapwood sp.gr. .44, and Douglas fir sp.gr. .57; to handle these in such ways as to prevent contamination by molds and place them in sterilized jars under proper conditions for growth of the fungi and maintenance of the initial moisture contents, without sterilizing the blocks themselves; to inoculate each block and the feeder with the proper fungus; and finally to plug the jars and place them away in a large moist chamber for incubation for one year. It will be noted that while sterilization is resorted to wherever possible, the blocks themselves were not sterilized, for this would change the moisture contents of the blocks. Therefore a different technique which involved every other detail of aseptic practice possible was utilized, and it is surprising how little contamination has taken place. The fungi used were the six upon which the senior writer has spent considerable time with regard to the destructon of cotton mill roofs and kindred matters: *Lenzites sepiaria, L. trabea, Trametes serialis, T. carnea, Fomes roseus* and *Lentinus lepideus.*

The purpose of the experiments was threefold: first, to obtain some general data upon the relation of the air-moisture balance to the decay of a common light wood like spruce, with particular relation to the practical problems involved in such things as the decay of mill roofs, wood preservation, the spraying of pulp log piles to prevent fire loss, etc.; secondly, to compare the air-moisture requirements or moisture inhibition points of these six and perhaps other fungi, because, for example, *Lenzites sepiaria* is a xerophyte, and *Fomes roseus* and *Trametes carnea* show certain different predilections, especially with regard to fruiting at least; thirdly, to correlate this matter of moisture and air content and decay to specific gravity of the wood decayed.

With respect to the second of the above, the experiments are not yet sufficiently complete to draw definite conclusions. Without going into details as to individual fungi, the results are given in Table I.

TABLE I

	Upper limit of optimum growth	Inhibition point of decay
Sitka spruce sp. gr. .34	150 per cent.[2]	200 per cent.
Southern pine sap sp. gr. .44	110 per cent.	160 per cent.
Douglas fir sp. gr. .57	80 per cent.	125 per cent.

The figures are of course only approximations, because exact figures in such experiments would be impossible, but, on the other hand, it is remarkable how the figures for the different fungi in many different tests agree. The above figures are in no sense averages of widely varying water per cents.

It will be noted that the results bear out in detail those of the first preliminary experiments of an entirely different type (1). It will be noted further that they agree quite closely with Muench's results upon the sapstain fungus, *Ceratostomella coerulea.*[3] In general, the decay taking place at moisture contents from the fiber saturation point of the wood up to a falling-off point is about the same, although with some of the fungi there is a tendency to greater decay at moisture percentages higher than the fiber saturation point. But the difference is such as to be of no importance in the matter of the decay of wood, for the 20 per cent. loss of oven dry weight at fiber saturation point by *Lentinus lepideus* is just as much

[1] Walter H. Snell, "Relation of moisture contents of wood to its decay," *Paper Trade Journal,* 71, 28: 44–46, 1921; also in *Paper,* May 4, 1921.

[2] Figures refer to percentage of water based upon oven dry weight of the wood.

[3] Muench, E., "Untersuchungen über Immunität und Krankheitsempfänglichkeit der Holpflanzen," *Zeitschr. f. Forst. und Landw.* 7: 54–75, 87–114, 120–160, 1909.

destruction of the wood as is 40 per cent. loss at 60 per cent. or 80 per cent. moisture content.

The maximum moisture content at which decay can take place in any of our commercial woods is about 190 per cent. or 200 per cent. Beyond that point, the water drives out so much of the air that insufficient is left to support growth of these wood destroyers.

The relation of this problem to specific gravity is obvious, of course. Presupposing that a certain definite volume of air is necessary to support the growth of these wood destroyers, the moisture content favoring the maximum amount of decay or inhibiting decay entirely will vary inversely with the specific gravity. The incomplete series show that satisfactorily. With woods of three specific gravities, there have been obtained three points for both the limit of optimum decay and the inhibition point in terms of percentage of water. It can not of course be determined as yet whether these points form a straight line on the graph or are on a parabolic curve. Tests are now in progress not only to fill the gaps existing in the present series, but also to obtain two more points in the graph by growing certain of the fungi upon southern yellow pine of specific gravities .65 and .75. Whether these points will then form a straight line or a curve, it is expected to be able to prove that the durability of some of our heavy woods, like white oak and best southern pine, etc., is not due to tannin, resin or anything more than its high specific gravity—*i.e.*, its small lumina, and hence small amount of air available for fungous growth.

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THE AMERICAN MATHEMATICAL SOCIETY

THE thirty-first summer meeting and tenth colloquium of the American Mathematical Society were held at Cornell University, from September 8 to 12, 1925, in connection with the meeting of the Mathematical Association of America. The attendance included one hundred and forty-nine members of the society, a record for a summer meeting.

The attending mathematicians and their guests were very hospitably entertained at Sage College, on the beautiful university campus. Many enjoyable social events were arranged by the mathematics department of the university, including a reception at which President Farrand welcomed the visitors. The joint dinner of the two mathematical organizations, with Professor H. E. Slaught as toastmaster, was attended by one hundred and eighty-five persons. A hearty vote of thanks was passed to the local members of the committee on arrangements, Professors Tanner, Gillespie and Hurwitz.

The secretary reported the appointment of the following committee on nominations of officers and members of the council and board of trustees for 1926: W. B. Ford, Robert Henderson, D. N. Lehmer, E. J. Townsend and Oswald Veblen (chairman). Professor Harris Hancock was appointed to represent the society at the celebration of the semi-centennial of Vanderbilt University. The council adopted a resolution of thanks to the assistant secretary, Professor Arnold Dresden, for his able and devoted service in carrying on the additional duties of the secretary during the six months' absence of the latter in Europe.

It was announced that the next volume of the *Bulletin of the American Mathematical Society* will be printed by the George Banta Publishing Company, at Menasha, Wisconsin.

Invitations from Hunter College for the next annual meeting, from Ohio State University for the summer meeting of 1926 and from the University of Wisconsin for the summer meeting and colloquium in 1927 were accepted, with hearty thanks.

The colloquium speakers were Professors L. P. Eisenhart, of Princeton University, and Dunham Jackson, of the University of Minnesota. Each speaker delivered five lectures, which will be published by the society. The subjects were as follows:

Professor Eisenhart: *The new differential geometry.* (I) Riemannian geometry; (II) Linear connection of a space; (III) Geometry of paths; (IV) Geometry of a sub-space of a linearly connected space.

Professor Jackson: *The theory of approximation.* (I) The approximate representation of continuous functions; (II) Discontinuous functions and functions of limited variation; (III) The principle of least squares and its generalizations; (IV) Interpolation; (V) The geometry of function space.

The following papers were read at the regular sessions of the society:

Space involutions having a web of invariant rational surfaces: F. R. SHARPE.

Note on six points in a plane and the six conics determined by them: W. B. CARVER.

On the reality of singularities of plane curves: T. R. HOLLCROFT.

Self-projective plane 5-points: LOUIS WEISNER.

Plane cubic curves in the Galois fields of order 2^n: A. D. CAMPBELL.

Generalization of certain theorems of Bohl. Second paper: F. H. MURRAY.