The Intensities of X-Rays of the L Series: David L. Webster and Harry Clark, Jefferson Physical Laboratory, Harvard University. A discussion of the intensities in the case of platinum as functions of the potentials producing them.

The Use of Vasectomized Male Mice as Indicators: C. C. Little, Harvard Medical School.

Photographic Magnitudes of Stars in the Selected Areas of Kapteyn: Frederick H. Seares, Mount Wilson Solar Observatory, Carnegie Institution of Washington.

Archaeology of Mammoth Cave and Vicinity: A Preliminary Report: N. C. Nelson, American Museum of Natural History, New York. Two isolated horizons of culture have been found; one indicating an agricultural people, the other a hunting people.

The Production in Dogs of a Pathological Condition which closely Resembles Human Pellagra: Russell H. Chittenden and Frank P. Underhill, Sheffield Laboratory of Physiological Chemistry, Yale University. The abnormal state is due to a deficiency in some essential dietary constituent or constituents presumably belonging to hitherto unrecognized but essential components of an adequate diet.

The Complete Enumeration of Triad Systems in 15 Elements: F. N. Cole, Louise D. Cummings and H. S. White. There are eighty types.

New Data on the Phosphorescence of Certain Sulphides: Edward L. Nichols, department of physics, Cornell University.

The Reactions of the Melanophores of the Horned Toad: Alfred C. Redfield, zoological laboratory of the Museum of Comparative Zoology, Harvard College.

The Coordination of the Melanophore Reactions of the Horned Toad: Alfred C. Redfield, zoological laboratory of the Museum of Comparative Zoology, Harvard College.

Petrified Coals and Their Bearing on the Problem of the Origin of Coals: Edward C. Jeffrey, botanical laboratory, Harvard University. Coals containing "coal balls" are abnormal, but there is no good evidence that "coal balls" are organized from material accumulated *in situ.*

The Effect of Degree of Injury, Level of Cut and Time within the Regenerative Cycle upon the Rate of Regeneration: Charles Zeleny, department of zoology, University of Illinois.

Preliminary Note on the Distribution of Stars with Respect to the Galactic Plane: Frederick H. Seares, Mount Wilson Solar Observatory, Carnegie Institution of Washington. A comparison of Mount Wilson counts with Kapteyn's, in which good agreement is found, as compared with both the results of Chapman and Melotte are not homogeneous.

National Research Council; Research Committees in Educational Institutions; Central Committees on Research; Reports of Meetings of the Executive Committee.

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SPECIAL ARTICLES

A QUANTITATIVE METHOD OF ASCERTAINING THE MECHANISM OF GROWTH AND OF INHIBITION OF GROWTH OF DORMANT BUDS[1]

1. Each plant possesses a number of dormant buds, which may grow out when they are isolated but which remain dormant under normal conditions. The problem to be solved is the mechanism of inhibition in the latter and of growth in the former case. Former results published by the writer on *Bryophyllum calycinum*[2] indicated that both phenomena are reciprocal, inasmuch as the growth of a bud depends upon the availability of certain material, while the inhibition is due in general to the non-availability of such material, and this non-availability is frequently brought about by the absorption or withdrawal of the material by another growing organ. Thus each node of *Bryophyllum calycinum* has two leaves and in the axil of each leaf is found

[1] From the Laboratories of The Rockefeller Institute for Medical Research, New York.

[2] Loeb, J., *Bot. Gaz.*, 1915, LX., 249; 1916, LXII., 293; 1917, LXIII., 25. "The Organism as a Whole," New York, 1916, p. 153.

a dormant bud. Besides, each of the numerous notches of a leaf contains a dormant bud. None of these buds grow out into shoots in the normal life of the plant. When we cut out a piece of the stem containing a node with its two buds, remove the two leaves, and suspend it in moist air, the buds of the stem will grow out very slowly if at all. If we isolate a leaf, and suspend it in moist air, a few of its many notches will grow out into shoots. When we suspend a piece of stem with one node and with only one leaf attached in moist air the bud on the stem opposite the leaf will grow out very rapidly, but the growth of shoots in the leaf will be suppressed or very much retarded. The writer assumed that in this case substances needed for the growth of the buds in the leaf were absorbed by the stem and used for the growth of its bud; and that as a consequence the buds in the leaf were prevented from growing owing to lack of material. The writer has recently carried out a series of quantitative experiments which seem to make this theory fairly certain and a few of which shall be described in this preliminary note.

2. According to this theory, leaves of *Bryophyllum* of equal size should when isolated produce in the same time, at the same temperature and moisture, the same mass of shoots from their notches. This is only generally true when we compare leaves of different plants or of different age of the same plant. If, however, we compare the two leaves belonging to the same node of a plant (having the same size, age and history) the weight of the shoots produced by the two leaves is equal within the unavoidable limits of error of such an experiment, as the examples in Table I. show. The two leaves of a node will always be designated as *a* and *b*.

Leaves of Bryophyllum calycinum of equal size (and from the same node) produce in the same time, under identical conditions, equal masses of young shoots (although the number of shoots formed is generally different in the two leaves).

3. It followed, moreover, that if we diminish the mass of a leaf by cutting out a piece from its center while the sister leaf (from the same node) remains intact, the shoots produced by the two leaves (when isolated from the stem) should be in the ratio of the masses of the two leaves. In five leaves the center was cut out while their sister leaves were left intact. Both sets of leaves were supended in an aquarium with their apices in water. After 37 days the weight of the shoots formed in each set of leaves as well as the weight of the leaves was ascertained and it was found that each set of leaves produced shoots in proportion to its mass (Table II.).

TABLE I

Number of Experiment		Number of Shoots Produced from Leaf	Weight of Shoots Produced in 33 Days Gm.
I.	*a*	3	0.350
	b	3	0.345
II.	*a*	1	0.290
	b	2	0.306
III.	*a*	2	0.375
	b	4	0.385
IV.	*a*	5	0.594
	b	4	0.607
V.	*a*	4	0.457
	b	5	0.455

TABLE II

Leaves Dipping in Water

	Total Weight of 5 Leaves, Gm.	Total Number of Shoots Produced	Total Weight of Shoots Produced, Gm.	Weight of Shoots Produced per Gram of Leaf in 37 Days, Mg.
Center of leaf cut out	7.61	11	0.755	99
Leaves intact	13.80	9	1.405	101

The shoot production in the two sets of leaves was, therefore, within the limits of error in proportion to the mass of the leaves themselves.[3]

When the same experiment is made with leaves not dipping in water the results are not so perfect, due possibly to the fact that the leaves with their center cut out dry out more rapidly than the intact leaves (Table III.).

[3] Since the surface of the leaves is approximately proportional to the mass, we must for the present reserve the privilege of substituting the surface for weight in the expression of the numerical relation, if necessary.

TABLE III

Leaves Kept in Moist Air

	Total Weight of 5 Leaves, Gm.	Total Number of Shoots Produced	Total Weight of Shoots Produced, Gm.	Weight of Shoots Produced per Gram of Leaf in 38 Days, Mg.
Center of leaf cut out..	5.42	13	0.690	109
Leaves intact	11.81	20	1.207	102

These observations agree with the assumption that the growth of dormant buds is determined by and is in proportion to the quantity of a certain material available for the buds.

4. In the previous publications attention had been called to the fact that in an isolated leaf only a few of the numerous notches grow into shoots and this had been explained on the assumption that those notches which happen to grow out first attract all the material from the leaf and thereby prevent the other notches from growing. This suggestion was supported by the observation that if a leaf is cut into isolated pieces each possessing one notch, each notch gives rise to a new shoot (provided that the piece is not too small). The shoots in the subdivided leaf grow more slowly than the less numerous shoots of whole leaves. On the basis of our quantitative method we should therefore expect that if of two isolated sister leaves one (*a*) is left intact while the other (*b*) is cut into as many pieces as it contains notches, the ratio of the weight of shoots produced to the weight of the leaf should be equal in both leaves; in spite of the enormous difference in the number of shoots produced. If a leaf is divided into two halves *a* and *b*, and half *b* further subdivided into as many pieces as there are notches, the numerous shoots produced by the isolated notches should not weigh more than the few produced in the intact half.

These experiments encounter the difficulty that if the piece of a leaf is below a certain size its notch will fail to produce a shoot; and if the piece approaches this lower limit its shoot production is still considerably retarded so that the law of proportionality no longer holds. In spite of this and some other sources of error the results are in fair agreement with the theory.

TABLE IV

Number of Experiment	Weight of Leaf, Gm.	Number of Shoots Produced	Total Weight of Shoots Produced in 33 Days, Gm.	Weight of Shoots Produced Per Gram of Leaf Mg.
I. *a* (intact leaf).....	4.47	2	0.450	100
I. *b* (subdivided leaf)...........	3.17	15	0.300	95
II. *a* (intact leaf).....	1,866	3	0.316	169
II. *b* (subdivided leaf)	1.727	14	0.345	200
Half leaves			Total Weight of Shoots Produced in 21 Days	
III. *a* (intact half of leaf)........	1.800	1	0.072	39
III. *b* (subdivided half of leaf)...	1.586	6	0.049	31
IV. *a* (intact half of leaf).............	1.062	3	0.063	59
IV. *b* (subdivided half of leaf)...	0.920	6	0.057	62

The experiments support the view that when in a leaf shoots are formed they withdraw material from the other notches and that it is this withdrawal of material which prevents the other notches from growing.

5. By the same reasoning we should expect that the inhibition in the growth of the notches of the leaf by a piece of stem (referred to in the beginning of this note) is due to the absorption of material from the leaf by the stem. In corroboration of this assumption the writer has been able to show that the inhibiting effect of the stem upon leaves of the same size increases with the mass of the stem. It has also been possible to show by quantitative experiments that the inhibiting effect of pieces of stem of the same size upon leaves of different size diminishes when the size of the leaves increases. We may say that the stem acts upon the leaf as if it reduced the size of the latter.

But the withdrawal of material by another organ is not the only way by which the growth of a bud is inhibited. The main condition for growth is that the material reaching the bud should exceed a certain limiting quantity. If there is not enough material available or if for anatomical reasons the material can not reach a bud the latter will be prevented from growing.

6. We do not wish to discuss the nature of the substances which cause the growth, but it is important to know that the leaves will form no shoots or only very few if kept in the dark. Six pairs of leaves from the same node were suspended in moist air, one leaf of each node in the dark, one in the light. After one month the six leaves in the dark (weighing 11.65 gm.) had produced only 3 etiolized shoots weighing 0.016 gm., while the six sister leaves in the light (weighing 8.03 gm.) had produced 24 normal shoots, weighing 0.544 gm. The shoot production in the light was therefore more than thirty times as great as that in the dark. This may mean that the material from which the new shoots are produced in a leaf is itself to a large extent a product of or dependent upon the assimilatory activity of the leaf. The root formation did not seem diminished in the dark, and at first it seemed even enhanced.

JACQUES LOEB

SOCIETIES AND ACADEMIES

THE BOTANICAL SOCIETY OF WASHINGTON

THE 117th regular meeting of the Botanical Society of Washington was held in the assembly hall of the Cosmos Club, at 8 P.M., January 2, 1917, President T. H. Kearney presiding.

The program was devoted to the subject of Plant Introduction, under which the following papers were presented:

The Need of More Foreign Agricultural Exploration (illustrated): DR. DAVID FAIRCHILD.

Dr. Fairchild called attention to the need of more foreign exploration and to the fact that up to the present time a comparatively small amount of money had been expended on this important work. The most successful type of agricultural exploration is that carried on by men interested in particular crops. The need of studying the methods of agricultural production in foreign countries, some of the more important recent introductions, and the difficulty in getting people to adopt new foods were emphasized.

The Wild Relatives of Our Crop Plants; Their Value in Breeding; How to Secure Them (illustrated): MR. WALTER T. SWINGLE.

The usefulness of the wild relatives of our crop plants in securing such desirable qualities as hardiness, earliness or lateness of blooming or of ripening, disease resistance, extra vigor, etc., were pointed out. As an example, the desert kumquat of Australia, which does not resemble closely in general appearance true Citrus, was found to be a most desirable plant for the successful breeding of hardy and drought-resistant citrous fruits. Mr. Swingle stated that a properly digested technical knowledge of the wild relatives of our cultivated plants is an indispensable foundation for all efficient plant introduction and plant breeding.

The Introduction of Foreign Plant Diseases: MR. R. KENT BEATTIE.

Mr. Beattie separated all diseases of economic plants into two groups: (1) Those which have passed from native plants to the introduced hosts; (2) those which have been introduced, such as citrus canker and chestnut-bark disease. Diseases are brought in on diseased crop plants introduced for commercial use or for scientific purposes, or the spores may be carried in on plants not affected by the disease. Commercial-plant introductions are inspected usually by entomologists and fungus diseases are often not detected. The material imported by the U. S. Department of Agriculture undergoes rigid inspection and retention in case any diseases are suspected. During the year 1916 the Federal Horticultural Board found on the material imported by the U. S. Department of Agriculture 157 different diseases.

The Protection and Propagation of Plant Introductions: DR. B. T. GALLOWAY.

Dr. Galloway called attention to the rapid change in public sentiment in the matters of plant sanitation and hygiene and to the need of a constructive policy in adequately protecting our crop plants, and at the same time not closing the doors to the development of new crop industries. He also discussed a number of the problems confronting the Office of Seed Plant Introduction.

THE 118th regular meeting of the Botanical Society of Washington was held in the assembly hall of the Cosmos Club, at 8 P.M., February 6, 1917. Forty-four members and fourteen guests were present.