seeds are like the rose in having dormant embryos and in requiring a low temperature period in a germinator for after-ripening. This is true of basswood, Juniper, fall-seeding maples . . ." Chittenden (1926)[3]: "The difficulty seems to be due to the impervious seed coat and rudimentary embryo." Grimsley (1930)[4]: "Seed coats at no time appear to be a limiting factor in the absorption of water. Dormancy in *Tilia* seeds exists in the embryo or in the endosperm, probably in both." There is nothing in these papers to indicate that the authors attempted to germinate naked embryos.

The writer finds that embryos of un-after-ripened seed exhibit geotropic curvature within twenty-four hours and at least one millimeter elongation of the hypocotyl within forty-eight hours when placed on a moist substratum at room temperature. These results occur whether the embryo is entirely freed of the enveloping endosperm or merely freed at the tip by dissecting away a small portion of the endosperm.

From experimental evidence the writer concludes that the effect of the nucellar membrane on oxygen intake is an important factor in the dormancy of *Tilia*. Apparently, one of the after-ripening changes is increased permeability, whereby the seed is enabled to germinate under ordinary oxygen pressure. This change takes place readily in moist stratification at refrigeration temperatures, but in some instances it occurs also in air dry storage at room temperature.

Impermeability of the testa to moisture is a factor in prolonging the dormancy of *Tilia*. Under natural conditions it may be responsible for delaying germination several years. Such impermeability may be overcome by treating seeds, freed of their pericarps, with concentrated sulphuric acid. When so treated fresh seeds or seeds from air dry storage after-ripen perfectly and germinate over a wide range of refrigeration temperatures.

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ORIGIN OF A TETRAPLOID SHOOT FROM THE REGION OF A TUMOR ON TOMATO

IT has been known for some time that polyploid cells occurred frequently in the tumorous tissues of plants infected with *Bacteria tumefaciens*. Such conditions suggested the possibility of obtaining from these areas shoots whose chromosomal constitution would be changed should they arise from polyploid cells initiated under the influence of the bacterial parasite. In order to test this 120 tomato plants were inoculated internodally in the spring of 1931 with cultures of *Bacteria tumefaciens*. One hundred nine of these inoculations were successful and tumors were formed. When the tumors reached the size of a pea the stems were cut off about 3 to 5 centimeters above them to induce shoot formation. In many cases shoots originated from the tissue about the tumors; in 7 instances a shoot formed from the region where the tumor was developing. These seven shoots, together with a small portion of the stem and the tumor, were removed and the stem, tumor and lower part of the shoot buried in soil to induce rooting. Two of the seven shoots died. One of the five successfully rooted proved to be tetraploid. All the roots coming from this shoot three centimeters and more above the point of origin from the tumorous stem were examined and showed 48 somatic chromosomes as compared with the 24 somatic chromosomes of the plant from which it originated. Two months after rooting this shoot was separated from the tumorous stem and transplanted. The resultant plant had leaves the same size and general appearance as the stem plant, but the flowers were a little larger.

This is another instance which would seem to show that polyploidy can not be treated as a cause for the tumorous growths, as sometimes suggested, but may be a harmless sequence of the conditions initiated in the tumorous region. Explanations of the manner in which such polyploidy may be effected have been considered in earlier studies of the protoplasmic state under similar conditions.

The present method and the results obtained might prove useful in attempts to experimentally bring about an increasing occurrence of polyploidy and the production of plants with altered chromosomal constitution. Cutting itself has given rise to polyploidy in shoots arising from the callus tissue; in this instance, however, the shoot originated well outside of any region of injury. The slight injury at the inoculation point was on the opposite side of the stem and the removal of the upper portions of the stem was purposefully well above the tumorous region.

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[3] A. K. Chittenden, *38th Ann. Rpt. Mich. Agr. Expt. Sta.*, 293.

[4] G. Grimsley, *Jour. Elisha Mitchell Sci. Soc.*, 46, 73.

PHOTO-PRINTING

IN the issue of SCIENCE for May 6 appeared an article by Professor Tracy I. Storer, of the University of California, on "What is a Publication?" Professor Storer discussed a definition of "publication"

as given by Dr. C. W. Stiles and described briefly several duplicating methods other than regular type which are of sufficient character to dignify the product as "a publication." In this discussion, he did not mention the process of photo-printing as such, although it is an important process, and some of his examples which he called "mimeographing" may have been reproduced by that method.

Photo-printing has for some time been developed commercially in connection with lithography and has been used in our factory for several years, particularly in the duplication of instruction sheets and pamphlets for scientific apparatus. In flexibility and appearance, it approaches type printing and for small runs from 100 to 800 or 1,000 is considerably cheaper than the latter, being comparable in cost to that of the mimeograph or multigraph. It is exceedingly satisfactory for scientific laboratory manuals, reading courses, synopses, reports, doctor or master theses and many other publications. The process is peculiarly adaptable to the reproduction of all black and white line material such as line drawings and diagrams as well as half-tones and photographs. Rare books or editions out of print may be reproduced for short runs at comparatively small expense, and whole articles or individual pages with their accompanying illustrations appearing in any publication may be duplicated in any specific size.

The process is briefly as follows: A typewritten sheet of any desired size is made, preferably on one of the typewriters with removable fonts of type which give almost as much variety of heading and body type as a regular type process. If there are illustrations, space is allowed for them on the sheet when typed and the page is made up as it is to appear. The complete manuscript for the article or publication is prepared in this way and photographed. Negative photographic films are developed and a final positive on sheet zinc is prepared, this latter being, of course, of the proper size to fit a rotary offset press. If the book is to be printed both sides, the make-up on the zinc sheet is laid out according to the usual book methods. If the book is a one-side printing, no such layout is necessary.

It will be seen from this brief description that the method is flexible and accommodating and can be used for a variety of purposes. It is also clear that the duplication is of such positive character, no one can say with justice that an article in this form is not "a publication." I am reporting it here with the thought that scientists and educational agencies of the country should know and appreciate the many advantages of this process.

GLENN M. HOBBS
W. M. WELCH MANUFACTURING COMPANY,
CHICAGO

SCIENTIFIC BOOKS

The Nature of Physical Theory. By VICTOR F. LENZEN, PH.D. John Wiley and Sons, New York, 1931, pp. 301.

THE author of this stimulating analysis of physical concepts and theories has had the advantage of a comprehensive training in both philosophy and physics. He divides the book into four parts: (I) "Special Classical Physical Theories," (II) "Unitary Systems of Physical Theory," (III) "The Quantum Theory" and (IV) "Methodological Principles," containing seven, five, two and two chapters, respectively. As the titles indicate, the text is informative as well as critical. In fact, the reader will find here a concise survey of the whole field of physical theory in a form demanding the minimum of familiarity with mathematical symbolism.

The author's program is to describe how the concepts of physical theory are derived from experience of aspects. Some discussion of the problem of subjectivism *versus* realism and the statement that the physicist, in the last analysis, employs a subjectivistic criterion of reality, indicates that the author is less convinced of the illusory character of this metaphysical distinction than is the average physicist. However, he properly adopts an empiricistic point of view and emphasizes the fact that concepts are abstractions from experience which are reached by a process of successive approximation.

The discussion of scalars and vectors, of space, time and kinematics is lucid and penetrating, but the analysis of the concepts of dynamics does not carry the same conviction. After emphasizing the importance of the selection of the frame of reference to which dynamical laws are to be referred, the author proceeds to the definition of force. This is taken up from the statistical point of view at first, and the definition is based on the anthropomorphic concept arising from the primitive experience of exertion. After defining work in terms of force he concludes by stating that "the principle of virtual displacements defines the concept of force." This principle may be considered as defining absence of force, but surely it can not be considered to define force unless the concept of work is presupposed.

Passing on to Newtonian kinetics the author offers two alternative points of view. Proceeding from the anthropomorphic definition of force derived from