tofore in eastern Oregon have also been discovered and are being studied.

Dr. Merriam published an excellent summary of the physical geology of the John Day region in 1901. No detailed mapping of the geology had been done, however, before the present program was initiated. The region is a key area for the whole northern Great Basin Province in that a larger number of post-Jurassic formations is exposed here than at any other locality. In no other district are the great Columbia lava fields dissected so as to expose earlier Tertiary formations so extensively.

To facilitate geologic mapping the U. S. Geological Survey, under a cooperative arrangement with the Carnegie Institution, has made topographic maps of two areas: the Mitchell Quadrangle of about 750 square miles, and the Picture Gorge Special Quadrangle of about 56 square miles (on large scale). The writer has finished the geologic mapping of the latter area and has nearly completed the Mitchell Quadrangle. The areal and structural studies are as detailed as the scales of the two maps permit.

The formations exposed are: a pre-Cretaceous crystalline complex; Chico, upper Cretaceous; Clarno, Eocene or Oligocene; John Day, upper Oligocene; Columbia lavas, middle or upper Miocene; Mascall, middle or upper Miocene; and Rattlesnake, Pliocene. All the contacts excepting the Columbia lava-Mascall and perhaps the Clarno-John Day are very striking nonconformities. Both an exceedingly eventful geologic history and a very interesting series of gemorphic changes are evidenced by the results of the mapping.

The investigations in all phases of the John Day program are being continued during the summer of 1927.

JOHN P. BUWALDA
CALIFORNIA INSTITUTE OF TECHNOLOGY,
PASADENA, CALIFORNIA

SCIENTIFIC APPARATUS AND LABORATORY METHODS

THE STUDY OF RHIZOPUS IN THE GENERAL COURSE OF BOTANY

IN many botanical laboratory courses it is the custom to study bread mold as a mass of hyphae covering bread or some other medium and to mount some of the mycelial mass on a glass slide, teasing it out for further observation of the vegetative structure. This method has seemed unsatisfactory, and I wish to suggest another method which has been used with success in the course in general botany at Macalester College.

Between two glass slides (5 cm. × 11½ cm.) are placed several layers of filter-paper of the same size as the glass slides, the interior portions of which have been cut out so as to form a border of filter paper about one centimeter wide. A small piece (2 or 3 cu. mm.) of the moist bread on which the culture is growing is placed between the glass slides in the center of the band of filter-paper. The slides are then tied together with thread, the filter-paper moistened by dipping the edges of the slides in water and the whole mount placed under a bell-jar. In about two or three days the stolonifers will extend outward in various directions from the moist bread, and wherever they come in contact with the glass surface rhizoid-like hyphae and sporangiophores are produced. This may now be studied either with the compound microscope or with the binocular microscope.

This enables the student to trace the stolonifers with ease from their origin to their attachments to the glass and to study the sporangiophores and rhizoid-like hyphae in their natural positions without any disturbance of the hyphae or any danger of their drying during the study.

The above described damp chamber is practically the same as that used by Dr. R. E. Jeffs in his studies of root-hair elongation and described in the *American Journal of Botany* 12: 577–606, 1925.

W. J. HIMMEL
MACALESTER COLLEGE,
ST. PAUL, MINN.

SPECIAL ARTICLES

THE VARIABILITY OF LONG DIFFRACTION SPACINGS IN PARAFFIN WAXES

So much interest is being manifested in the polymorphism of long chain compounds, particularly the fatty acids (Piper, Malkin and Austin, *J. Chem. Soc.* 1926, 2310; deBoer, *Nature,* 119, 50, 635 (1927); Thibaud, *Compt. rend.* 184, 24, 96 (1927); Müller, *Proc. Roy. Soc.* 114-A, 542 (1927), that it seems advisable to report the results of some X-ray experiments with ordinary commercial paraffin waxes. Only one mention of X-ray studies of these complex mixtures of many hydrocarbons has been made, that of Piper, Brown and Dyment (*J. Chem. Soc.* 127, 2194 (1925) who found that the lines of the C_{28} hydrocarbon appeared alone for a paraffin wax although this fraction furnished only 16 per cent. of the mixture and other members as high as C_{32} were probably present.

In the present investigation samples were prepared from waxes melting at 135, 130, 125 and 120° F. by solidifying on glass plates and photographing in an oscillating spectrograph with copper Kα rays.

Solidification took place under identical conditions, since cooling from above the melting points to just below occupied 30 minutes. Remarkably sharp lines for 3 orders only were obtained corresponding to single long spacings, besides the "side spacing" lines. These were all measured with greatest care and checked against photometric curves. The results are as follows:

Wax m.p.	d_1	No. C atoms indicated	d_2	Side spacings d_3	d_4
135°F.	39.42A.U.	29.0	4.24A.U.	3.73A.U.	2.56A.U.
130°	38.58	28.5	4.17	3.73	2.51
125°	35.22	26.0	4.44	3.88	2.44
120°	34.38	25.0	4.23	3.93	2.33

Particular care was taken in the measurement of the side spacings in order to discover any possible regularity in the slight variations running parallel with the change in the principal spacing. These were further studied with pinhole diagrams and molybdenum Kα radiation. There is apparently no such regularity.

Some experiments demonstrated that the rate of cooling of the liquid wax film was a determining factor in the spacings. The 135° wax was studied further in this respect with the following results:

Cooling	d_1	d_2	d_3	d_4
Instantaneous	36.64A.U.	4.12A.U.	3.82A.U.	2.58A.U.
2 min.	37.84	4.16	3.82	2.60
10 min.	38.24	4.21	3.86	2.63
30 min.	39.42	4.24	3.73	2.56
60 min.	40.20	4.13	3.82	2.60

It is evident that the longer the time given the molecules for orientation the greater the spacing for the *same* wax.

The presence of addition agents in small amounts also affects the spacings, when the solidification conditions are kept constant, as shown by the following results on 135° wax with cooling during 10 minutes:

	d_1
Wax alone	38.24 A.U.
" +1 per cent. α-naphthylamine	38.315
" +1 " " diphenyl oxide	39.75
" +0.5 " " indigo	40.70
" +1 " " Pb oleate	37.5

It is interesting to note that the translucency of the films measured with a Martin polarizing photometer varied directly with the spacings, a property of practical importance in the manufacture of transparent waxed paper. The single exception is the wax containing soap. Lead oleate itself has a spacing of 37.5 A.U. and when added to paraffin wax, even in so small amount as 1 per cent., seems to impress its own spacing upon the layers. It is still a matter of astonishment, not only that the principal spacing of a paraffin wax may be varied within limits almost at will, but also that these mixtures of as many as 18 hydrocarbons with widely differing molecular lengths form equidistant parallel diffracting layers at all. The explanation of the variability of the long spacing for the same wax is complicated by the fact that under different conditions different molecular lengths in the mixture predominate and also varying tilts of the molecules to the diffracting layers are possible.

GEORGE L. CLARK
MASSACHUSETTS INSTITUTE OF TECHNOLOGY,
CAMBRIDGE, MASS.

CROPS NATURALLY INFECTED WITH SUGAR BEET CURLY-TOP

CURLY-TOP of sugar beets, transmitted by the beet leafhopper (*Eutettix tenella* Baker), has caused enormous losses to farmers and beet-sugar companies in the western part of the United States. In California and other western states many beet-sugar factories have been dismantled and moved out of the state, while other mills have been closed permanently or have remained idle during disastrous outbreaks of the disease. Unless efficient parasites of the beet leafhopper can be imported and established or a beet resistant to curly-top can be developed, the industry in many localities of the western part of the United States will perish.

In years when a severe outbreak of sugar-beet curly-top occurs, other crops are seriously damaged by the same disease. During the outbreak of the beet leafhopper in 1919 in California, cantaloupes were a failure in the San Joaquin Valley. During the past two years cantaloupes have been demonstrated to be naturally infected with curly-top in the Salinas Valley, and the symptoms resembled those observed in the San Joaquin Valley in 1919. Spinach was also found to be naturally infected in 1919, and in many localities in later years.

A simple method was adopted in testing plants to determine whether they had been naturally infected.