progress. This work, an enlargement of the preliminary experiment, is intended to cover certain phases of photoperiódism as it affects varietal adaptation and drouth resistance of both winter and spring wheats.

Whatever may be the final outcome from the standpoint of direct application in practical crop production, there can be no doubt that the present studies throw an entirely new light on crop and especially varietal response in a given locality, and that a knowledge of these factors will make possible a better and more logical interpretation of investigations in both crops and soils and will as well give a more sound basis for future work in crop adaptation and breeding.

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IMPROVED METHODS IN NEAR INFRA-RED ABSORPTION STUDY

SOME twenty or more years ago Julius, Donath, Puccianti, Iklé, Coblentz and others were interested in the study of infra-red absorption in organic compounds. The apparatus they had to work with at that time made the study very tedious, and as Coblentz[1] has said, "usually after investigating half a dozen compounds the results have been given to the public" by the investigator. Using the electric arc, Nernst lamps and Zircon burners as sources of radiation, rock salt or quartz prisms for dispersion, and bolometers and radiometers for the detection of the radiation, these men succeeded in studying the absorption spectra of a great many organic compounds even far out into the infra-red. In fact, the biggest part of the work was done in the field beyond the so-called near infra-red, that is, beyond 30,000 Å.

But with such comparatively weak and unsteady sources of radiation, small dispersion, and unsatisfactory methods for the detection of this radiation, no high degree of accuracy in the measurements of absorption bands has been claimed. During the last twenty years very little work has been done in this field. Coblentz[2] has recently published a bulletin in which he gives certain data and curves for the absorption spectra of certain organic oils, both animal

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[1] W. W. Coblentz: *Astrophysical Journal,* 20, 1904.

[2] W. W. Coblentz: Scientific Paper of the Bureau of Standards, No. 418.

and vegetable oils, in the region of the near infra-red. In this paper he shows that because of the great similarity in the spectral curves of these oils, a study by means of infra-red absorption does not lead to a detection of adulteration of one oil with another.

But the region of the spectrum between the visible and 30,000 Å is filled with characteristic absorption bands in the case of organic compounds, and consequently makes a very interesting part of the spectrum to study. The writer is at present studying the absorption of many carbon compounds in this region by means of a spectro-thermograph designed by Professor E. P. Lewis of the University of California, under whose supervision this work is being done. There are certain advantageous features in the construction and use of this instrument.

The source of radiation is a 108 watt lamp made with a helix of tungsten wire for a filament. It has been found that the intensity can be increased by as much as forty per cent. by placing a concave mirror of about a ten centimeter diameter behind the lamp and focussing the rays on the slit through the lamp itself.

For dispersion two 30° flint glass prisms were used. Now flint glass gives a greater dispersion in this region than does quartz which is usually used in near infra-red work. Furthermore, it is almost as transparent as quartz, the limit of transmission for each being around 30,000 Å. The back of the second prism was silvered and the radiations caused to pass twice through each prism, thus doubling the dispersion. This gives a dispersion of between two and three times that obtainable with a single 60° quartz prism and between four and five times that obtained from a similar rock salt prism. The silvered prism was capable of rotation about the first prism so that the angle between these was equal to twice the angle of incidence necessary for minimum deviation of radiation falling upon the thermopile, which was used in series with a sensitive Leeds-Northrup galvanometer to detect the radiation. This rotation was accomplished by means of a small thumb-screw which projected through the black box which enclosed the system of mirrors and prisms. Thus it was possible to focus the eye upon the galvanometer scale and, turning the prism, make an approximate analysis of a given substance in a few minutes.

This rapidity of locating either absorption bands or emission lines proved to be very helpful in the process of calibration of the instrument. Since no indices of refraction were obtainable for the glass prisms, the instrument was calibrated by observing certain metallic emission lines and solar absorption bands determined largely by Paschen with a grating. Coblentz states that emission lines may be used in calibrating up to 10,000 Å, but it was found that the following lines could also be detected when the proper salts were introduced into the carbon arc: Tl, 13,010 Å; Na, 18,460 Å; Ca, 19,800 Å. In locating the positions of the solar absorption bands, sunlight was reflected in from the window and focussed upon the slit. As the prism was rotated the galvanometer deflection would decrease to a minimum in the neighborhood of an absorption band. By approaching from both the long and the short wave-length sides a set of quite consistent values for the corresponding dispersion could be obtained. The highest calibration point was for the solar absorption band at 25,000 Å.

It has been mentioned in the earlier literature of the subject that all compounds that have a carbon atom united directly to a hydrogen atom have characteristic absorption bands in the neighborhood of 17,000 Å. In this present work this same band is found, and two others, at about 11,500 Å and 13,800Å, appear in every compound in which there is a C-H group. Twelve compounds have already been carefully analyzed, and an approximate determination of the positions of the absorption maxima has been made for some fifteen more. There are very prominent displacements of these absorption maxima in certain compounds. In some cases these shifts are toward the shorter wave-lengths and in other cases toward the longer wave-lengths.

The mapping of the spectral curves of certain groups of compounds is being continued, and an attempt will be made to ascertain whether the shifting of absorption maxima follows any definite laws.

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