

of external agents is an indirect one, first altering the nuclear constituents. These in turn have their effect in the usual way. This seems probable in view of the fact that many heritable growth variations are similar to the induced changes and these naturally arising variations can be recombined with other heritable characters whose determiners are known to be located on the chromosomes.

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MEASUREMENTS OF FOREST FIRE DANGER

ALTHOUGH the annual destruction of life and property attributable to forest fires is enormous, scientific methods of forest fire control in the United States are of comparatively recent origin. In one important phase of control, that of determining how large a network of observers is necessary for the purpose of discovering forest fires in their infancy, accurate means of determination have been largely lacking. As a result of this uncertainty, lookout points have been excessively manned in some years, thus introducing unnecessary costs, and under-manned in other years, resulting in excessive fire damage.

The problem presented here is actually one of determining the burning conditions in the forest, *i.e.*, the relative ease with which fires will start, spread and do damage. Fire danger, as the sum of these conditions is termed, has interested research foresters for several years. Beginning fire danger measurements in 1922, the Northern Rocky Mountain Forest and Range Experiment Station of the U. S. Forest Service has recently devised a method which is achieving considerable success in the field. This method depends upon a knowledge of the important factors contributing to fire danger, methods of measuring these factors and integration of measurements into single numerical results.

Important factors contributing to fire danger vary from one forest region to another, but in the northern Rocky Mountains these factors have been determined. They are:

(1) *Season of year*: In spring and early summer the green moist growth of herbaceous plants and shrubs actually hinders the progress of fires. Later, as these plants mature, they accelerate forest fire spread and intensity. At the same time hours of daily sunshine decrease with advancing season, and finally this latter process largely offsets the increased danger from maturing plants.

(2) *Fuel moisture*: The moisture content of tree needles on the forest floor and dead branchwood on the ground and just above it is largely dependent upon meteorological conditions. Its influence upon inception of fires and later behavior is considerable.

(3) *Relative humidity*: The moisture content of all forest fuels is influenced by atmospheric humidity. This relationship is especially important in the case of fine forest fuels such as tree moss, dead grass and weeds.

(4) *Wind velocity*: Rate of spread and the character of an advancing fire, as well as the rate at which forest fuels lose moisture, are dependent to a considerable degree upon wind velocity.

(5) *Visibility*: The distance at which small puffs of smoke can be detected under various stages of atmospheric transparency influences the number of lookout points that must be manned under any set of fire conditions.

(6) *Activity of fire-starting agencies*: In the northern Rocky Mountains lightning causes 72 per cent. of the forest fires. Man is a subordinate cause, although in other regions he may be of paramount importance.

To measure wind velocity and relative humidity, standard types of anemometers and psychrometers are used. For measuring fuel moisture and visibility, however, new methods had to be devised. A visibility meter, employing a glass prism and binoculars, permits a determination of the distance at which a dark ridge can barely be seen. Since this bears a definite relationship to the distance at which a small puff of smoke can be seen, a visibility distance useful to the fire observer is calculated. Two methods are used for fuel moisture determinations. An instrument called the duff hygrometer measures moisture content of forest duff; it depends upon the principle that a strip of rattan increases in length by definite amounts as it absorbs water and decreases in length by corresponding amounts as it dries. The second method is simply a weight determination of cylinders of wood; the fluctuations in weight are indications of fluctuations in moisture content.

For integrating measurements into numerical results, the fire danger meter has been employed. This is a pocket-size cardboard device somewhat similar to the Harvey exposure meter used in photography. The meter is easily adjusted to register whatever measurements of fire danger factors have been obtained. Through a small window in the meter, current fire danger is indicated. Until this year only seven classes of danger were used, but at the beginning of the present fire season, 65 classes of danger went into effect, ranging from 1.0 to 7.4.

Each class of forest fire danger indicates how many observers are necessary to provide adequate protection to the forests. Class 1 requires no men to be detailed to fire control; class 4 requires the "average season" protective organization; class 7 calls for measures to meet the most extreme danger.

So successful is the system of classifying fire danger

in the forests of the northern Rocky Mountains that all national forest regions have been instructed to develop similar methods of measuring fire danger.

LEO SHAMES

FILMY FERNS IN THE CAROLINAS

No species of the interesting and peculiar group of ferns known as the filmy ferns (*Hymenophyllaceae*) has ever been found in the Atlantic States north of Georgia. We can now report the occurrence of three of them in the Carolinas, one new to the North American continent. They are: *Hymenophyllum tunbridgense* (L.) J. E. Smith and *Trichomanes Petersii* A. Gray from Pickens County, northwestern South Carolina, and *Trichomanes Boschianum* Sturm from Macon County, southwestern North Carolina. The former is new to North America. The station for *T. Boschianum* near Highlands, N. C., was discovered by Dr. Herbert Hechenbleikner, who was working at the Highlands Laboratory with W. C. Coker. The two South Carolina plants were found by Mrs. Bayard Taylor several years ago. With her and Dr. Taylor, W. C. Coker visited the stations on October 9 of this year and found populous colonies of both of them. All three species were found on granitic gneiss, not on sandstone, as was to be expected.

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THE WOODS HOLE MARINE BIOLOGICAL LABORATORY

BIOLOGISTS are reminded that one of the sources of income upon which the Marine Biological Laboratory depends for its maintenance is the sale of biological

materials by its supply department to educational and scientific institutions.

In spite of the extensive damage to laboratory property caused by the recent storm, the supply department is prepared to fill orders promptly. It will appreciate at this time the opportunity of serving the members of the corporation and other biologists.

By placing your orders for material with the supply department you will, in a substantial way, help the laboratory to repair its very considerable losses.

The damage to the buildings of the Marine Biological Laboratory, caused by the storm of September 21, was almost wholly due to water. The tide in Buzzards Bay rose about 10 feet above the normal high water mark, overflowed the Eel Pond, poured into the supply department building through the windows and doors, and filled the basement of the brick building to a depth of 4 feet. Before the flood abated it had put out of commission the great storage battery and the switchboard, covered microscopes and other apparatus with mud, leaked into many stocks of chemicals, and had ruined cabinets and drawers where much small scientific material was stored. The loss to the supply department was fortunately not large.

Due to the unremitting efforts of those in charge of the various departments, the damage was kept at a minimum. But extensive repairs and replacements will be necessary. This work is already under way. It is confidently expected that the laboratory will soon be completely restored, and that research and instruction will be carried on as usual during the summer of 1939.

CHARLES PACKARD,
Associate Director

SCIENTIFIC BOOKS

LIGHT

Light. Principles and Experiments. By GEORGE S. MONK. Pp. xi + 477, figs. 265. McGraw-Hill Book Company, New York, 1937. Price, \$5.00.

THIS text-book gives a combined treatment of three branches of optics which are too frequently separated, namely, geometrical optics, physical optics and laboratory work in both these fields. The first quarter contains a very good summary of geometrical optics: thick lenses, optical instruments, apertures, photometric principles and prism instruments. The principal section on physical optics contains chapters dealing with spectra, optical properties of media, effects of electric and magnetic fields, as well as the usual topics of interference, diffraction and polarization.

It is a pleasure to see that some spectroscopy is included, as this is one of the most important parts of applied optics. Additional experiments might have

been outlined, such as those dealing with some of the uses of the quartz spectrograph and infra-red spectrometer. Such work would give valuable experience to the student, especially to one who is majoring in physics or chemistry. In order to provide a better background for such work, it would be advisable to give even more material on spectroscopic theory and nomenclature. In passing it might be noted that the author makes the mistake of saying that Rydberg's constant varies as the square of the atomic number of the element, whereas perhaps the most important contribution by Rydberg to spectroscopy is the demonstration that this constant is nearly the same for the arc spectra of all elements.

The diffraction grating could have been discussed more fully. The author considers that the theory is so involved that it obscures the final results. However, in this case the vibration polygon method, in which one