

of the plant. Inasmuch as publication of the details of these investigations has been considerably delayed it seems desirable at this time to briefly indicate the principal conclusions reached. The duration of the daily illumination period not only influences the quantity of photosynthetic material formed but also may determine the use which the plant can make of this material. In general, there is an optimal light period for maximum upward or apogeotropic elongation of the stem which for some species corresponds to the long summer days of higher latitudes, while for other species the intermediate length of day of spring and fall (or the equatorial day length) is optimal. Changes in the light period to sub-optimum conditions for stem-elongation, resulting from appropriate increase or decrease in length of day, as the case may be, may initiate a series of characteristic responses which are definitely associated with periodicity in plant behavior. Reference has already been made to flowering and fruiting. There seems to be an optimal light period for sexual reproduction which tends to direct the energies of the plant more or less quantitatively toward flowering and fruiting. Again, departure in day length from the optimal for increase in stature causes loss of dominance of the apical bud, thus promoting various types of branching. Leaf-fall and entrance upon the rest period, also, result from exposure to a certain length of day which is unfavorable for stem-growth. It has been found that there may be an intermediate length of day especially favorable to dormancy or death while under both longer and shorter days activity of the plant may continue. Further changes of the light period by a sufficient increment or decrement away from the optimal for increase in stature and beyond the optimal for sexual reproduction tend to induce intense tuberization, a feature marking the final stages in reduction of stem-elongation. Formation of bulbs is induced by excessively long days while formation of tubers commonly results from excessively short days. This deposition of carbohydrate in relatively condensed or dehydrated forms as a result of an unfavorable light period indicates marked loss of power to utilize the products of photosynthesis in elongating the stem or in developing flower and fruit, a con-

dition well exemplified in the stemless or leaf-rosette form of foliage development. The opposite change toward the optimal day length for stem-elongation may rescue typical annual plants from impending death and effect more or less complete rejuvenescence. The evidence indicates that the degree of hydration of the living cell content is brought under delicate control by the ratio of the number of hours of sunlight to the number of hours of darkness in the 24-hour period. Well defined correlation has been established between the hydrogen-ion concentration of the cell sap and the observed responses of the plant to change in the length of the day. Thus, change from the purely vegetative to the flowering and fruiting stage may involve marked change in hydrogen-ion concentration in the apical bud and even a reversal of acidity relations between the apex and the base of the stem. Correlation also has been found between the content of "available" carbohydrate (the simpler sugars) and the responses of the plant to differences in length of day. Causal relationships, however, have not been definitely established. It seems probable that the annual cycle of length of day, affording as it does a consistently rhythmic feature of the external environment, is a dominant causal factor in phenomena of plant periodicity, subject, of course, to the modifying influences of temperature and other environmental factors.

W. W. GARNER

H. A. ALLARD

BUREAU OF PLANT INDUSTRY,
U. S. DEPARTMENT OF AGRICULTURE

FISH PARASITISM IN ITS RELATION TO BIOLOGICAL PROBLEMS OF THE NORTHWEST¹

IN this great Northwest of ours fish afford a natural resource of importance to the welfare of a good many citizens. Not only do the commercial interests utilize fish for market purposes, but the sportsmen derive infinite

¹ One of the papers in a *Symposium* on "Biology in Its Relation to the Development of the Northwest," presented at the meetings of the Western Society of Naturalists at Corvallis.

pleasure from angling them in every stream and lake which they can conveniently approach. And yet, it is no exaggeration to say that aside from some limited fish-hatching operations, we have done practically nothing to intelligently conserve these creatures for future generations.

Although there are a good many sides to the program of fish conservation, yet this evening I wish to bring to your attention only one phase of it, namely, fish-parasitism and point out some of the biological problems with which it is intimately linked up.

During the last few years I have been devoting a good deal of attention to fish-parasitism in the Northwest and can say that this is a field which has hardly been touched. There are great numbers of fish parasites in this region: *bacteria*, *protozoa*, *cestodes*, *trematodes* and *crustacea* which are infecting the fish and killing off great numbers of them. These afford many fields of investigation which are not only thoroughly scientific, but of great practical value. We need good taxonomic keys of these parasites, their life histories and their effects on the various hosts.

Furthermore, this knowledge should be supplemented by a careful study of the conditions within our lakes and streams which are conducive to fish-parasitism. At present we are working entirely in the dark, and as a result of it much of our good time, effort and money are wasted. I will cite but one instance along this line to make my point clear.

It is a common practice among our game commissioners to stock a body of water with fish and then to close it down for purposes of allowing the fish to multiply, with the view of obtaining a plentiful supply of spawn for hatching operations. My observations along this line have convinced me that this is an erroneous practice. In the first place, closing down a stream makes for a rapid multiplication of fish so that the available food supply soon becomes inadequate to maintain all of them. A fierce struggle for existence ensues in which many of the weaker, but nevertheless desirable fish are killed off. Even those that remain appear to be starved for lack of food. In the second place, the congested conditions within

the stream make possible a rapid spread of any parasitic infection which happens to make its appearance among the fish. And lastly, when a stream is closed down for any length of time its shores afford an ideal, undisturbed habitat for many fish-destroying birds and other animals. These not only kill off large numbers of fish, but they may also be the means of disseminating various parasitic organisms among them.

It seems to me that before we can even talk of cure and prevention, we must know the parasitic organisms as well as the conditions which make parasitism possible. But, without these facts we are powerless to do any good. What is greatly needed in this Northwest section is a number of biological surveys for the purpose of studying and mapping out the various ecological factors of the regions in which fish or game are to be planted. We ought to know a good deal about such factors as available food supply, oxygen content, temperature variations, predatory and parasitic organisms, etc., of a place before any kinds of animals or plants are introduced into it. Knowing these conditions we can then intelligently fit each organism into that particular environment where it will thrive best. While the initial expense involved in the establishment of such surveys will be considerable, yet the benefits derived in the long run will more than repay us for our efforts.

NATHAN FASTEN

OREGON AGRICULTURAL COLLEGE

THE THIRD ASIATIC EXPEDITION OF THE AMERICAN MUSEUM OF NATURAL HISTORY

THE Third Asiatic Expedition of the American Museum of Natural History, in cooperation with the American Asiatic Society and *Asia Magazine*, will leave Kalgan on the nineteenth of April for the continuation of its work in Mongolia.

During the last six months field operations have been conducted in various parts of China which have been extraordinarily successful. All the members of the expedition's staff have now arrived in Peking and the final preparations