BIOLOGY

Time For A Change

Length of day and night is nature's signal for plant flowering, animal migration, and other seasonal changes of living things. Studies show unsuspected effect of sun on life.

By HORACE LOFTIN

▶ AS SPRING approaches, pushing back the icy winter in its march, a biochemical reaction within the Arctic hare causes him to lose his snow white pelt in exchange for a summer coat of brown. When winter returns, the Arctic hare will be found in his white pelt again.

What force triggers these reactions with the changing of the seasons? Temperature increases and decreases?

Before the first leaves have fallen in autumn, many northern birds suddenly, impetuously fly towards winter quarters in lower latitudes. What factor tells them when to leave? Cooler weather? What tells them when to stop? Warmer weather?

No. Temperature change alone does not spark these and similar seasonal manifestations of life—like molting, migration and time of oestrus in animals, or time of seed germination, the switch from growth to flowering and, perhaps, the color changes of leaves in the fall in plants.

The physiological changes leading to the loss of the Arctic hare's white pelt for a more appropriate summer coat of brown begin while the winter cold is still at its height. Many birds begin their southward flight long before autumn cold arrives; while birds wintering in the tropics somehow know when it is time to fly back home, though they experience little temperature change in their tropical quarters.

Triggers Seasonal Variations

Scientists working all over the world have taken this riddle to the laboratory, and as the results of their work pour in, this vital fact keeps turning up:

The periodicity of light—the changing lengths of day and night—is the trigger mechanism of many, if not most, of these seasonal variations of animal and plant activity.

Thus a new role has been discovered for the sun, father of life. Besides being the supplier of warmth and energy to life on earth, now the light of the sun is seen to be the initial link in the chain reactions of many of life's most intimate processes in a way never before suspected.

And a new significance has been discovered for the darkness of night to living things. Length of night may be more directly involved in these seasonal variations of life than is length of day! Daylight, in many cases, may work in this trigger mechanism only as a temporary halt to the biochemical reactions set off by absence of light during the night.

The first clear-cut recognition of photoperiodism under laboratory conditions was made by two scientists of the U. S. Department of Agriculture, Drs. W. W. Garner and H. A. Allard, in 1920. They discovered that a tobacco variety, Maryland Mammoth, did not flower until the days had grown shorter (and nights longer). By putting tobacco plants in the greenhouse and artificially shortening their daily exposure to the light—actually they increased length of night—Drs. Garner and Allard forced the tobacco to bloom much earlier than it would in nature.

In the wave of experimentation that has followed this pioneer work on photoperiodism, the significance of their discovery has been greatly extended. Photoperiodism is not only concerned with flowering of plants, but also with germination of seed, rate of growth, type of growth and other such seasonal manifestations of plant life.

There is some kind of photoperiodical response in every higher plant at least, and probably similar responses will be found among the lower plants.

Animals, too, have been found to be subject to photoperiodism. Molting, migration, seasonal fattening, oestrus, ovulation and growth of many animal forms depend on light changes to set them going.

Photoperiodism in Animals

Among the higher animals, light and darkness are perceived generally through the region of the eyes, the light stimulating the optic nerve, which through cerebral centers then stimulates the hormone-producing pituitary and perhaps other hormonal glands. Broadly, this is the way that light change triggers the mechanism of seasonal changes in these animals. With lower animals, light may again be perceived through the optical region, or in some cases through the thin body wall, to activate hormonal responses.

In plants, the action of light and dark changes seems to do its biggest job on the leaves. Experiments now under way indicate that light and darkness act on a pigment, as yet not isolated chemically, in the

MAN-MADE ENVIRONMENT—The length of day and night is controlled at the will of researchers in the world of these experimental plants. Their sun is the giant carbon arc lamp about which they are huddled. Changes of as little as 15 minutes of sunlight a day can cause flowers to bloom, or birds to migrate. Scientists have found that the stimulus of light or darkness can lead to different phenomena in different species. Some plants are "short-day," some are "long-day," and some are "day-neutral."

leaf to produce many of the photoperiodical efforts observed.

Differences in day or night length as small as 15 minutes can be the signal for birds to fly thousands of miles, or for plants to cease growing and begin to flower.

The relative length of night to day has effects on plants and animals, the outcome of which we call photoperiodism. But this relation of night to day and its effects on living beings is complicated by the fact that the same stimulus of light or darkness can lead to opposite or totally different phenomena in different species.

Some Plants "Day-Neutral"

Thus, "short-day" plants, like sugar cane, will not flower until the daily dose of sunlight has decreased. Wheat, on the other hand, is a "long-day" plant. It will not flower except with the long days and short nights of summer—unless, of course, you artificially illuminate it during winter.

Then, there are "day-neutral" plants, like Connecticut Broadleaf tobacco, that seem independent of day-length for flowering.

It may help to think of the light-darkness relationship as a trigger, or initiator, that sets in motion various chemical reactions inherent in a given species of plant or animal. The reactions to the light-darkness stimulus differs according to the special nature of each species.

Some of the most advanced and exacting work on photoperiodism is now going on at the Agricultural Research Center of the U. S. Department of Agriculture, Beltsville, Md. Scientists there are examining the responses of plants to the different colors of the light spectrum. The most effective part of the spectrum in producing the effects of long days on plants is red light.

Then as you go down the color spectrum from red to violet, it takes increasing amounts of each pure color to duplicate the effects of the preceding color. A narrow band of invisible infrared light has been found to have the effect of a long dark period.

Knowledge of the workings of photoperiodism holds many practical rewards for plant breeders, farmers and animal husbandmen. By correct use of artificial light it may be possible to introduce plants to new areas, have flowers all during the year, breed animals throughout the year.

But the real reward of research in photoperiodism will be in the opening of many previously closed doors to the secrets of life and nature.

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GENERAL SCIENCE

Standards' Cuts Disturb

➤ MANUFACTURERS ARE disturbed by cuts in funds for testing services by the National Bureau of Standards. They are used to relying on the Bureau as the final judge when there is a dispute over testing methods, or when precision instruments must be matched against precise standards.

But with the Bureau's budget for research and testing cut to $3,000,000, this is no longer possible. Some of its usual services must be cut down or eliminated. About 50 representatives of manufacturing concerns using the Bureau's testing facilities met in Washington on Aug. 3 to discuss the problems raised by such cuts.

The feeling at the meeting was that the conferees were gathered at the wrong time and the wrong place. As one manufacturer pointed out, they should have been meeting "a few months earlier in a different part of the city—about five or six miles southeast of here," that is, on Capitol Hill, where they might have been able to persuade Congress not to make such drastic cuts in the Bureau's budget.

To help solve the problem of getting adequate and unbiased testing services, the conferees set up a special committee, headed by G. M. Hickey of the J. Bishop and Co. Platinum Works, Malvern, Pa.

Manufacturers represented at the invitational meeting included General Electric, Radio Corporation of America, Bendix Aviation, Allis-Chalmers, Kimball Glass, Pratt and Whitney, and the American Instrument Company.

There was some discussion among the conferees on the possibility of Massachusetts Institute of Technology taking over some of the Bureau's previous testing services.

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TECHNOLOGY

Atomic Radiation Makes Plastic Heat-Insulating

➤ MANUFACTURE OF heat-insulating material by subjecting methacrylate plastic to atomic radiation is suggested by experiments at Britain's Atomic Energy Research Establishment at Harwell.

When polymethyl methacrylate plastic was tested in the atomic reactor or exposed to a pure gamma radiation from a cobalt-60 source, it bubbled and took on an expanded form. In some cases after radiation, the material expands on heating.

Dr. A. Charlesby and M. Ross, reporting their experiments in *Nature* (June 27), suggest that this plastic, called Plexiglas and Lucite in the United States and Perspex in Britain, could be placed inside containers after being irradiated, and then expanded by heating to give a complete filling with the bubble material of the required space.

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