TIME CLOCKS IN BIRDS? PERIODIC FORCES IN LIFE CYCLE

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TO THOSE of us who grew up in a northern country the importance of the slow climb of the sun in the heaven from the winter solstice of December to the summer solstice of June is an old story. Our pagan ancestors marked the sun's climb and celebrated it with fire festivals. One of the functions of Stonehenge was to record the summer solstice, whence the fact was flashed across the countryside by a system of bonfires.

The returning sun loosened nature from the dead grip of winter and started life anew, a resurrection once symbolized by pagan rites that in Christendom were replaced by Easter.

The returning sun and spring start birds nesting. The different kinds respond differently. The great-horned owl may nest in February when the northern woods are deep in snow and the temperatures dip below zero, but when its slow-growing young are on their own, they will find young rabbits plentiful. The bluejay may wait until May when food for its young is most plentiful, and the goldfinch may wait until August when the thistle seeds on which it feeds its young will be ready. But all seem to depend on the return of the sun.

LIGHT'S EFFECT PROVED

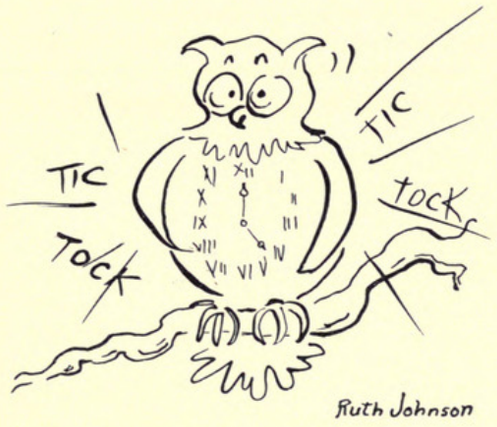
The actual effect of the sun's seasonal climb, through lengthening daylight, on the breeding condition of birds became known to scientists only in the 1920's. Then, experimentally, Dr. William Rowan, of the University of Alberta, showed that juncos, kept captive in Alberta, could be brought into breeding condition in winter by giving them increased illumination. Further work corroborated the discovery. The amount of light actually does affect the birds' system, bringing on a breeding condition, molt, and presumably migration.

Some extreme students even hold that this is the timing of all breeding seasons. But as we go farther afield, out of our northern clime with only a spring and summer suitable for breeding, we find this wouldn't hold. Consider the birds of tropical East Africa. It's a rather arid land, but twice a year the rains bring a season of growth to the vegetation, when insects can prosper. And here we find that many kinds of birds have two breeding seasons a year. It seems that the rains, rather than the sun, furnish the timing device. But a puzzling feature is that some birds may come into breeding condition before the rains start, anticipating their arrival, which suggests that some other timing factor is involved.

If we transfer our attention to the vast equatorial forest of Central and West Africa where rain, temperature, and daylight are uniform throughout the year, we find that under these uniform conditions some kinds of birds breed throughout the year. It seems that without variation in daylight or rainfall, there's nothing to cause an annual cycle.

SOOTY TERNS HAVE OWN CYCLE

But the sooty terns of Ascension Island, in the Atlantic Ocean about seven degrees south of the Equator, provide a disturbing note. Here the breeding terns enjoy a climate uniform throughout the year, but they breed once every 9.6 months, reports Dr. J. P. Chapin of the American Museum of Natural History. Without apparent external control, there is a breeding cycle of less than twelve months. It makes one wonder whether or not there is an inherent fixed rhythm in the birds themselves, perhaps only modified locally by changing daylight or by rains. These sooty terns are the most interesting as a species in that with their widespread, pantropical range they show three types of breeding rhythm or cycles: some, such as the population breeding on the Dry Tortugas off Florida, breed once a year, in the spring; some, on certain Pacific islands, breed twice a year; and, as we've just said, the Ascension Island birds breed once every 9.6 months.



In a search for further collateral evidence I came on Dr. Frank A. Brown's work on fiddler crabs at Woods Hole Biological Station in Massachusetts. Fiddler crabs have a daily 24-hour color-change rhythm, becoming pale at night and, presumably as a protection against sunlight and against predators, dark during the day. Superimposed on this they have another shorter color-change of 12.4 hours. Though dark in color during the day they assume a maximum darkness at the time of low tide, when presumably they would be most vulnerable to sunlight and to predators. The tides, which do not correlate with the solar day but with the moon, fall behind 50 minutes a day. The crabs' tidal (or lunar) cycle of color-change coincides in phase with the diurnal 24-hour cycle only once every 15 days. This is interesting, but the astonishing thing is that crabs kept for two months in complete darkness, in a photographic darkroom, continued to show these two cycles of color-change. An innate time-sense or an innate rhythm seemed one possible explanation. Such things have been postulated before. The most popular explanation has been that such rhythms are determined by metabolism, with hunger, fatigue, or rest from fatigue being postulated as the the factors involved.

But this is ruled out in the case of the crab, for the crab is cold-blooded. Its body temperature tends to be that of its environment. And with temperature changes, the metabolism changes: it speeds up with warmer temperatures and slows down with colder ones. Yet Dr. Brown found that keeping these crabs at various temperatures from 6 degrees to 26 degrees Centigrade did not affect either of their time-rhythms. Evidently they are not controlled by metabolism.

But let us not speculate on a time clock or a calendar clock in our animals similar to the alarm clock that Sir James Barrie's crocodile swallowed and that warned Captain Hook of the crocodile's predatory approach by ticking. Rather it seems that in addition to light, which may be the factor at times and which can be a modifier at others, we must keep in mind that there may be other periodic or cyclic forces operating in the world to which some animals respond.

TWO LECTURE TOURS DAILY OFFERED IN SUMMER

During July and August, lecture tours of Museum exhibits will be offered in both the mornings and the afternoons of weekdays, Mondays through Fridays inclusive; on Saturdays and Sundays tours will be omitted.

Except on Thursdays, the morning tours will be devoted to the exhibits in one specific department. The afternoon tours (and Thursday morning) will be comprehensive in scope, touching on outstanding exhibits in all departments. Following is the schedule that will be followed weekly:

Mondays: 11 A.M.—The World of Plants
2 P.M.—Highlights of the Exhibits

Tuesdays: 11 A.M.—Records from the Rocks
2 P.M.—Highlights of the Exhibits

Wednesdays: 11 A.M.—Animals Around the World
2 P.M.—Highlights of the Exhibits

Thursdays: 11 A.M. and 2 P.M.—Highlights of the Exhibits

Fridays: 11 A.M.—People and Places
2 P.M.—Highlights of the Exhibits.