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DISCUSSION AND CORRESPONDENCE CONCERTED FLASHING OF FIREFLIES

ON a hot and dark evening in the summer of 1915, a camping party sought the rocks near the waters edge on the north shore of Sloop Bay, Valcour Island, Lake Champlain. An intermittent flashing of diffused light was soon noticed in the northwestern corner of the bay between 300 and 350 meters distant. This flashing was somewhat similar to that ordinarily called "heat-lightning," but as it appeared against the base of a cliff something over ten meters high an investigation of the phenomenon was decided upon.

On approaching in canoes, a scene of wondrous beauty presented itself. The light was due to the miniature lamps of several thousands of fireflies which were holding festival over what appeared to be a breeding ground. The area involved was about 100 meters in length and extended from near the water's surface to a height of about seven meters. At this locality the bare rock faultscarp which formed a portion of the north wall of the bay was covered with a steep sloping bank of glacial and postglacial deposits and these were well supplied with water through seepage. Moving southwesterly one left the bare portions of the cliff and rapidly passed through various plant communities from lichens and mosses to a small grove of white pines. Above this locality there was also a forest clearing used as a meadow.

At no time over the limited area at the base of the bank could one notice an utter absence of illumination but the lighting of a small cluster of lamps seemed to awaken immediate response from a thousand others, and the illuminated area thus spread from one or more centers until the bank was brilliantly ablaze and suggestive of the myriad lights of some city of fairyland. It was these periods of intense illumination that had attracted the attention of the camping party at a distance so great that the lights from a few scattered

lamps seemed to leave the bank in absolute darkness. The same phenomenon was also observed on the following evening.

After reading Dr. Edward S. Morse's "Fireflies Flashing in Unison"¹ the writer determined to make another visit to this locality and observe the phenomena more critically. On the evenings of July 11 and 12, 1916, the display was repeated and observed by several visitors. It was impossible to count the number of lamps which were aglow at one time, but the space involved was about 700 square meters in cross section and in some bush-covered places there must have been at least 50 fireflies to the square meter. We should judge that about 10,000 of these insects were present. During these visits we noted that the illumination was never due to a truly synchronous lighting of the lamps of those fireflies engaged in the display but was always of the nature of wave motion spreading out from one or more centers. This spreading moved swiftly from one end of the bank to the other and was particularly beautiful when the light from several centers became confluent, for at that instant the whole bank was very brilliantly illuminated. Strictly speaking there was no *measured* regularity in this concerted response and therefore no *true rhythm*,—such as one may note in the concerted music of certain orthoptera. The repetitions were hardly more regular than the cloud illuminations of a distant thunderstorm. There was present the influence of suggestion on what may be called a "mob-psychology" but there was no *special leader*. Any small group could excite a discharge from thousands who were ready to respond. As recovery was rapid, the repetitions of the wave-like responses were also rapid.

It is probable that the phenomenon is by no means a rare one and that, in this locality, it is repeated yearly—though the display of 1916 was not quite so brilliant as that of 1915. A display in any place would be compellingly attractive to a passing person only if the festival period occurred during very dark, cloudy or moonless nights. The observer

¹ SCIENCE, February 4, 1916.

therefore must happen to be in some lone-some spot without other light, at the proper time of year, under the conditions noted above, and at least after 10 P.M. Even then his observations unless published would not be likely to reach students.

In *SCIENCE* for July 26, Dr. E. S. Morse gives a brief review of the subject,—with reference to its meager literature. There we find mention of such conditions as “very warm and humid” a “profound calm” following a thunderstorm, “a small clearing” and “stumps” or “trees.”

The excessive abundance of fireflies at any one date is no doubt due to climatic conditions that have at first retarded and then hastened emergence from the pupa state. The fact that so many of these insects should occasionally be crowded into limited areas may be due to favorable ground conditions involving moisture; open spaces (where the light signal may be seen at a distance); favorable places (trees, bushes, or stumps) for rests from flight;—shelter from winds;—and perhaps the antecedent direction and strength of such winds. The Valcour Island locality seems to fulfill these conditions and in addition has a large sheltered area, the waters of the bay, across which the light may be seen but on which there is no resting place.

Whether or not the flashes occur in strict unison and whether or not the sequence of recurring responses is a measured one, and so strictly rhythmic, are questions which must be answered through more careful observation of the phenomena. Mr. Nylander, quoted by Dr. Morse, says “The flashes were not so regular as an army officer would like to see in regimental drills but were so rhythmic that any one would take note of their action.” In other words, the concerted flashes did not recur with measured regularity but the repetitions were frequent enough to attract attention. How loose a meaning in this discussion do we wish to give the word “rhythm”? Dr. Morse quotes Mr. Purssell as stating “To the best of my recollection the illuminated period lasted about two or three seconds and the dark period perhaps twice that long.” A space between

the beginning of one flash and the next which could vary from six to nine seconds would in no sense be rhythmic and even if the repetitions occurred with regularity, once every six seconds (the shortest time Mr. Purssell’s “recollection” allows), the rhythm would be in very slow, “largo” tempo. Note however in Mr. Morse’s quotation that the “several thousand insects in each” of two trees “perhaps a hundred feet apart,” “flashed in synchronism. first one tree lighting up and then the other.” Here we have the element of response which was so marked in the Valcour Island display. In the latter locality there were several trees and bushes on which rested groups which responded to each other and, at close range, the intervals between group flashings were usually but fractions of a second. The brilliant blazing of the whole bank occurred at intervals varying from a few to many seconds in length—hence the similarity, when seen from a distance, to heat lighting.

If it is desired to get a body of men to sing or play together in perfect rhythm they not only must have a leader but must be trained to follow such a leader. Imagine the difficulty of keeping together on “Old Hundred” if the notes were started with an interval so long as six or nine seconds between each. Do these insects inherit a sense of rhythm more perfect than our own?

Would not a more critical observation of one of Mr. Purssell’s trees have shown him that one or more leaders started the flash and that the others “fell in” as in applause;—that the lighting of a tree gained at first in brilliancy and that the light also faded away gradually and not at once. At least this is what was noticed in the four different displays on Valcour Island.

We would ask observers to note the conditions resulting in such local congregations of these insects; to note critically whether the flashings are of the nature of exact unisons, or whether they spread out from small centers, first lighted, and so partake of a rapid but wave-like response to an initial stimulus; and to note also if the sequence of the flashings from the same group is one involving equal

time intervals and so strictly rhythmical in character.

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ALLEGED REDISCOVERY OF THE PASSENGER PIGEON

IN SCIENCE for November 1 is a communication under the caption "Alleged rediscovery of the passenger pigeon," in which the statement is maintained that a flock of this supposedly extinct bird was recently seen in New York state. Among other observations offered in support of the identification, mention is made of "the whistling sound of their wings." During the seventies and early eighties it was my privilege to form an intimate acquaintance with the passenger pigeon, seeing many thousands of them, shooting hundreds of them and finding numerous scattered nests in the vicinity of Minneapolis, Minn. The wings of this bird never "whistled," the sound made in taking flight being a flapping or fluttering noise similar to that made by the tame pigeon. A flock in rapid flight made a rustling or swishing sound as it passed through the air. On the other hand it is a well-known fact that the wings of the mourning dove produce a loud characteristic "whistling sound" as it launches itself into the air and until it gets well under way. Among pigeon hunters in the old days, this was a commonly recognized distinguishing feature between the two species when other means were obscured.

In and about a "buckwheat field" is an ideal place for an assemblage of mourning doves. Passenger pigeons also fed on grains of various kinds, chiefly wheat and oats, but their favorite food was thin-shelled nuts, largely acorns here in the north.

In view of the fact that no reports of the passenger pigeon from experienced ornithologists have been received for a considerable number of years, in spite of persistent search, it would seem as though this bird must be regarded as an extinct species.

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DEMONSTRATIONS OF VISUAL PHENOMENA

PURKINJE EFFECT

IF a color wheel with a reddish and a bluish color be spun in the light of a strong lantern, and then slowly have its plane turned until the incidence of the light is just grazing, the Purkinje effect is at once demonstrated to a class. As the angle of incidence changes from normal to grazing, the intensity of illumination is reduced to zero, and the red becomes invisible. The effect of this is in general to change the apparent color of the disc through a series of very pretty shades.

PERSISTENCE OF VISION

This is easily shown to a class by means of a lantern, with a slide bearing some letters. Instead of imaging the slide on a white surface, the image should be absorbed by black velvet or the image may be formed in an open doorway. Now move a fairly white stick vertically down in the plane of the image. Different portions of the image can then be seen on the stick, and if the stick be moved fast enough, the eye sees the entire image easily.

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USONO

TO THE EDITOR OF SCIENCE: In connection with the discussion in your columns as to a more specific name for our country than "America," it may be interesting to note that the advocates of the international language, Esperanto, solved this problem so far as they were concerned quite a while ago, by the adoption of the name "Usono." This is the substantive form of the expression *US o NA.*, composed of the initial letters of this nation's full designation. *Usona* is, in Esperanto, the adjectival form.

In a rather hasty and superficial glance through the back files of Esperanto publications, I find the word used, either in the text or in date lines, titles, etc., in various magazines, books and pamphlets issued in England, France, Germany, Poland, Switzerland,