taxonomist, large numbers of names present little difficulty because he uses them frequently, but for others it is different. Thus probably not less than 90 per cent. of science workers are "beginners" and the others, outside of their special fields, are also. The writer believes in the recognition of small groups but doubts the necessity of forcing them upon every one. Would it not be feasible to have our floras and faunas in two parts, the first leading to collective groups, the second continuing through the smaller groups?

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FIREFLIES FLASHING IN UNISON

To the Editor of Science: I was much interested in Mr. Fremont Morris's letter regarding the "Fireflies Flashing in Unison" on page 418 of the last volume.

I was employed by the Philippine Bureau of Forestry during 1902 and 1903. In the spring of 1902, I was stationed for some weeks at Pagbilao, Tayabas Province. It is on a small tidewater river about half or three quarters of a mile from Lagimanoc Bay. I had occasion to go across this bay on February 22 and did not return until after dark. As the banca in which I was travelling entered the mouth of the river, I was attracted to the flashing of the flies which appeared in great numbers a short distance above the mangroves which covered both banks of the stream.

The majority of the fireflies were flashing in unison but there were some which did not time their flashes with the majority. The light from the fireflies with the reflection of the light from the water made a very distinct illumination and one never to be forgotten by one who has seen it.

P. T. Barnes
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NEGATIVE RESULTS FROM ATTEMPTED QUEEN BEE MATING IN A DOUBLE TENT INCLOSURE

Following out suggestions from previous work of Cole and Miller, Rhode Island, and from bee behavior observations in an artificially lighted double tent at University of Wisconsin, by the writer, an attempt was made the past season to mate a Virgin queen bee in an available double tent inclosure.

The tent was made of double canvas, 4 feet in diameter, 7 feet high at peak, with about 8 inches space between the canvas walls.

A nucleus, containing workers, drones and a five-day-old virgin was placed in the tent and observations taken.

No natural mating flights occurred. The virgin appeared to fly naturally in the tent, returning unaided to the hive, when removed from the nucleus and thrown into the air. The drones appeared to fly naturally, more so at first than after several days confinement in the tent.

The queen failed to mate.

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SPECIAL ARTICLES

SPECTRUM PHENOMENA DUE TO MOVING MOTES

In connection with my regular work I incidentally came upon a curious phenomenon which seemed to repay special investigation. To describe it, it will be advantageous to first indicate the disposition of apparatus used, as is done in Fig. 1. Here L is a pencil of white light (preferably from a collimator and wide slit) impinging on the thin cylindrical glass shell G, about 10 cm. in diameter and containing a solution of mercury-potassic iodide, about half an inch deep and not quite concentrated. The rays are thus both refracted and dispersed, and on emerging enter the strong objective of a short-range telescope (magnification above 15) of which PP' is the principal plane and $r'b'$ the narrow spectrum seen in the ocular of the telescope. Properly focusing the latter, the spectrum may be contracted to a vividly colored vertical line.

If now a strong direct-vision grating g is inserted in front of the objective, and the telescope is focused anew, a *sharp* solar spectrum may be obtained. This was a surprise to me, as the cylinder[1] G, though thin and clear, was

[1] The present use of a cylinder as a collimator is well worth noting.

obtained from samples of ordinary glass shades, such as are prized by the lovers of stuffed birds. In other words, the cylinder supplies its own slit within, as at *r* or *b* in the figure, by refraction. With a narrow beam of sunlight no collimator is needed.

The spectrum will now be found to be filled with short, slender, horizontal shadows moving endwise in a common direction, but at different speeds. On pushing the ocular in somewhat further, these shadows become sharply defined lines, all nearly horizontal, of all lengths from mere points to black lines half the length of the spectrum or more. On attentive observation the black lines are seen to

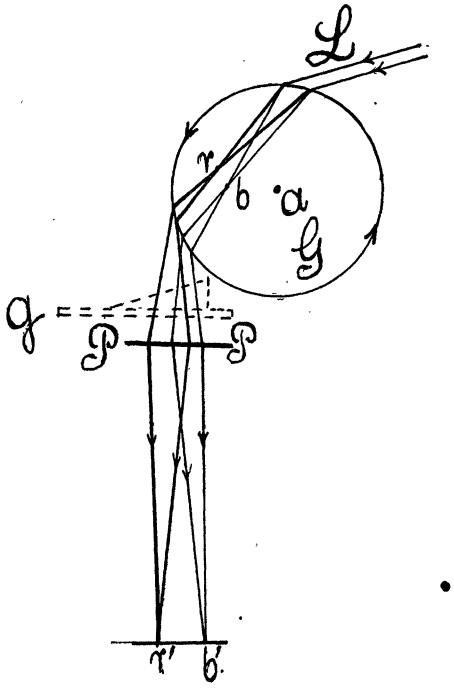

FIG. 1.

be associated with narrow areas of accentuated brightness, so that diffraction patterns are in question. Occasionally a beautiful complete slender spindle-shaped black body with a brilliant narrow frame of light around it, will appear. Arrowheads holding patches on their notched sides, are not infrequent; but as a whole the spectrum has the appearance of being intersected with an interminable array of slow horizontally flying arrows, shot in a common direction from end to end. With regard to the motion, this is more usually horizontally from red to blue; in the lapse of time and in the middle layers always so and not permanently from blue to red. Sometimes both motions were seen to occur together in different levels, the retrograde motion being relatively slow, less pervasive and confined to the top or the bottom layers of the liquid. All degrees of speed occurred from a passage through the spectrum in a fraction of a second, to passages lasting over a minute. Under the latter conditions it may happen that the particles actually stop and then begin a retrograde movement soon to be accelerated in turn. During this period of transition, particles may be seen also to rise and fall, but with relatively great slowness as compared with the usually horizontal motion. Some of the arrows are somewhat oblique to the horizontal. Under rare conditions I noticed a line of light instead of shadow. Breadths differ greatly and would naturally depend on focusing.

Usually the motion persists with apparently undiminished small velocity for hours, so that it much outlasts one's patience. Often a single particle can be observed for a minute or more; but after 10 or 20 hours all particles disappear and the spectrum is clear. From this I concluded that the diffractions are not due to local difference of density, etc., of the solution, as I first supposed, but actually originate in minute solid particles (or in case of other liquids in minute air bubbles) entrapped in the liquid. The slow subsidence and persistence of particles indicates this state of things.

Moreover I found that the initial motion of particles as a whole from red to blue or blue to red, could be controlled by *rotating* the cylinder *G* on its axis *a*, either counter-clockwise or the reverse, respectively. Brownian motions are excluded, since these are promiscuous and since the magnification is inadequate. It is difficult to conceive how the angular momenta impressed on this solution can persist for hours within it, after the solution is apparently quite at rest, even if the solution is of large

density (dense enough to float glass). Probably since the internal friction of liquids vanishes with the relative velocity of layers, and since the apparent motions are magnified, there are eventually no frictional torques left to absorb whatever angular momenta may be renewed. The occurrence of direct and retrograde motions at the same time, separated sharply by a plane of demarcation suggests vortices. Above this plane particles move with about the same speed in one direction, below the plane with a very different speed in the opposite direction. A particle which happens to be in the plane in question does not move at all. After a long interval the direction of the motions above and below a plane of demarcation may be found to have reversed, respectively. If a solution is cleared of particles by the lapse of a sufficient time for subsidence, they may be restored by brisk rotation. The number, size, density of color and speed of the particle naturally increase with the violence of rotation.

To conclude: After the cessation of the initial disturbances, the liquid, left to itself and owing to the presence of motes, shows a persistent motion of its middle layers in the general direction of the impinging beam of light, while the motion of the relatively thin layers at the top or bottom (one or both) is usually persistently retrograde, but slow in comparison. This continues, until after the lapse of hours the particles have practically subsided, when the retrograde motion seems to be equally prominent. Even when the liquid is manually rotated clockwise with violence, this impressed motion ceases in a few minutes whereupon the counterclockwise, red-blue motion, in the direction of the impinging beam, sets in vigorously.

It suffices to add a few statistical remarks. The telescope may be adapted for small distance by placing 3 diopter spectacle lenses in front of it. Its external focal plane is then only about a foot off and within the liquid. The rays seen in the ocular of the spectrotelescope may be regarded as coming from a virtual slit within the cylinder; or else, on narrowing the incident beam L to within a centimeter (in case of a cylinder 10 centimeter in diameter), the diffuse internal caustic has already been similarly narrowed down to a short internal spectrum rb in the figure. Hence if the solution rotates slowly about the axis a, particles enter the red (r), and leave the blue (b) end, and are therefore seen sharply in the spectrum travelling from red to violet. The reverse is the case if G rotates in the clockwise sense. The small distance rb is the virtually magnified by the immense dispersion of the grating (15,000 lines to inch) G. Since the rays cross *within* the cylinder, G, the motion from red to blue will also characterize all particles distinctly seen and rotating counterclockwise. Finally, this rotation corresponds in a general way with the direction of advance of the light transmitted through the cylinder.

It would be simplest to refer the cause of persistence to a case of vortical motion in the wake of the beam of light traversing the solution. But the invariable occurrence, in the lapse of time, of motion in the middle layers of the liquid in the direction of the impinging light, no matter how the liquid is artificially rotated in the beginning, leaves this explanation unsatisfactory. Such vortices would not be orderly and persistently equivalent to the effect of a pressure in the direction and of the beam of light. In case of a black body and a solar constant of 3 gram-colories per minute, the energy per unit of volume or the light pressure in question may be roughly estimated at 7×10^{-5} dynes per square cm. Even if but a part of the energy is absorbed by the liquid, this is by no means an insignificant pressure in a medium whose internal friction vanishes with its motion. In fact if the given estimate be treated as a tangential force relative to the surrounding dark liquid, of about .01 viscosity, a speed of 7×10^{-3} cm./sec. (under normal conditions) would correspond to the shear. One may therefore infer that speeds within a tenth millimeter per second, about of the order observed, are not impossible. The very slow but persistent regressive movement at the top and bottom of the layer of liquid remains unexplained. Furthermore I was unable to find any adequate corre-

spondence between the swiftness of the motion and the intensity of the impinging beam. Again, the molecular radiometer, in which the thermal gradient is at the same time a pressure gradient would fall under the same objections. I can only conclude vaguely, therefore that in some way the local vortices evoked by thermal distribution resolve themselves into a persistent ordered rotation[2] of the cylinder of liquid around its vertical axis, with the regressive motion specified confined to one or two relatively thin layers.

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AMERICAN SOCIETY OF NATURALISTS

THE thirty-sixth annual meeting of the American Society of Naturalists was held at Johns Hopkins University, Baltimore, December 28, 1918, Vice-president Guy N. Collins in the chair. In affiliation with the society at this meeting were the American Society of Zoologists and the Botanical Society of America.

Illness having prevented the attendance of the treasurer the auditing committee was directed to examine his books and report at the next meeting of the society.

The executive committee recommended that sections 1 and 2 of article III. of the constitution be changed to read as follows:

Article III., Section 1. The officers of the society shall be a president, a vice-president, a secretary and a treasurer. These, together with three past-presidents and the retiring vice-president, shall constitute the executive committee of the society.

Article III., Section 2. The president and vice-president shall be elected for a term of one year, the secretary and treasurer for a term of three years. Each president on retirement shall serve on the executive committee for three years. Each vice-president on retirement shall serve on the executive committee for one year. The election of officers shall take place at the annual meeting of the society, and their official term shall commence at the close of the meeting at which they are elected.

This recommendation was referred back to the executive committee by the society with the suggestion that they consider further the form by which continuity of policy may best be attained.

There were elected to membership: William T. Bovie, Harvard Medical School; Walter B. Cannon, Harvard Medical School; Otto Glaser, University of Michigan; Donald F. Jones, Connecticut Agricultural Experiment Station; Lewis R. Jones, University of Wisconsin; Horatio H. Newman, University of Chicago; Victor E. Shelford, University of Illinois; Theobald Smith, Rockefeller Institute; Alonzo E. Taylor, University of Pennsylvania; Edgar N. Transeau, Ohio State University.

The following program was presented:

Parthenogenesis and sex determination in the white fly: A. F. SHULL and N. R. STOLL.

The evolution of nuclear conditions in Ciliata: M. M. METCALF.

The genetic interrelations of two dwarf perfect-flowered types of maize: R. A. EMERSON and S. H. EMERSON. (Read by title.)

Crossing-over and allelomorphism in the grouse locusts: R. K. NABOURS.

The evidence in favor of a linear order of the genes: T. H. MORGAN.

Reversal of dominance in a meal-moth producing some new phenotypic ratios: P. W. WHITING.

The globe mutation in Datura: A. F. BLAKESLEE.

Some factors in growth correlations: E. W. SINNOTT.

On some growth-changes in the body-form of Mellita: W. J. CROZIER. (Read by title.)

The effects of inbreeding on guinea-pigs: SEWALL WRIGHT.

Quantitative relations between chromatin and cytoplasm in the genus Arcella, with their relations to external characters: R. W. HEGNER. (Read by title.)

The Naturalists' dinner was held on the evening of December 28 at the Hotel Emerson with sixty-five in attendance. Following the dinner Professor A. O. Lovejoy led a round table discussion by members of the American Association of University Professors of the work of certain of its committees.

The officers of the society for 1919 are:

President—Edward M. East, Harvard University.

Vice-president—John H. Gerould, Dartmouth College.

Secretary—Bradley M. Davis, University of Pennsylvania (1917–19).

[2] In other words, the conditions of hydrostatic equilibrium imply an inclined surface of the liquid with its maximum head in the region of the illuminated part. But such a structure is gravitationally unstable. It is difficult to see, however, why the flow should be an orderly rotation of nearly the whole cylinder of liquid.