was supported by the delegates of Denmark, Great Britain, Holland, Italy, Norway, Sweden and Switzerland. It was then pointed out (as any reader of our protest could have foretold) that such a resolution was contrary to the statutes of the "International Research Council," under which the congress had been convened. In these circumstances no resolution could be carried, but it was agreed that the attention of the council should be called to the discussion; and the official proposal that the next congress should be held in Brussels, under the present regulations, was withdrawn.

It is safe to say that the Toronto congress was the last "boycott" congress of mathematics. It is possible that the International Research Council will themselves remove the ban when they meet next year. If they do not, the Union of Mathematics will collapse, or degenerate into a purely Franco-Belgian affair, and the way will be clear for the revival of a genuinely international congress.—Professor G. H. Hardy in *The Scientific Worker.*

SPECIAL ARTICLES

THE BRIGHTNESS OF MARINE LUMINESCENCE

IN 1922[1] the present writer published a comparison of the brightness of several luminescent substances, including that of a sample of luciferin kindly presented to him by Professor E. Newton Harvey. More recently there have been opportunities to estimate the brightness of luminescence of several marine forms.

In the former experiments[1] use was made of an optical pyrometer of the type in which an incandescent filament is superimposed upon the glowing surface, the brightness of which is to be measured. This instrument was calibrated to read in millilamberts instead of degrees of temperature.

When it comes to the measurement of the light given out by marine forms in the open sea it is almost impossible to use the pyrometer because of the difficulty of bringing these fleeting patches of light into the field of the instrument. It was found possible however by looking at the image of the filament with the right eye, while the left eye was free to observe whatever gleams of light came into the field of unobstructed vision from the water toward which the observer was looking, to adjust the filament to equality of brightness with the luminescence thus observed. Readings made in this manner do not possess quite the degree of certainty of observations made in the usual way upon a fixed and steady source of light, but it was found that they were rather surprisingly consistent and satisfactory and really afforded a quite reliable estimate of the brightness of the luminescence which was to be measured.

[1] Nichols: SCIENCE, lv, p. 157 (1922).

Calibration of the instrument when thus used with two eyes is readily made by setting the filament to match the brightness of any convenient surface alternately by the binocular and the monocular method.

The following is a summary of the studies made by the method above described.

1. *At Sanibel Island, Florida:* Although this locality is noted for its marine "phosphorescence," the accounts of brilliant displays given by Rowland Ward[2] being abundantly confirmed by those who are acquainted with the surrounding waters, only the most meager exhibits were in evidence either in the passes of the Caloosahatchie River or along the shore of Sanibel Island during the fortnight in April (1924) when the writer was present. Occasional star-like sparkles and the diffuse luminescence of breaking waves were observable, however, from a fishing stage on the gulf shore of the island. These, which were presumably due to dino-flagellates, were measured.

2. *From Shipboard off the Carolina Coast:* During a trip from Jacksonville to Baltimore a few days later measurements were made of the luminescence of the bow-wave of the steamer and of the glow observable in the wake. In this case as at Sanibel Island the nights were without moon and partly cloudy.

3. *At Woods Hole:* In August of the present year, also during the dark of the moon, measurements were made from the float of the Marine Laboratory. To the members of the laboratory for this privilege and in particular to Professor Harvey, who identified the luminescent organisms, the writer wishes to express his indebtedness.

LIST OF OBSERVATIONS

Locality	Source	Brightness in millilamberts
Shipboard	A diffuse glow in the wake	.0007
"	Diffuse glow of bow wave	.0063
Sanibel Island	Diffuse glow of breaking waves	.0063
" "	Individual flashes of dino-flagellates	.116
Woods Hole	Individual flashes of dino-flagellates	.116
" "	Colonies of hydroids	.033
" "	Mnemiopsis Leidyi	.11 to .30

It is interesting to note that the diffuse glow of breaking waves, as observed at Sanibel and on shipboard, were of the same order of brightness and that

[2] Ward: "The English Angler in Florida," London, 1898.

the same is true of the flashes of light from dinoflagellates at Sanibel and at Woods Hole. In both localities the measurements were made at quite close range, the excitation of these minute organisms being apparently due to the swirl of water around piles and submerged timbers.

The colonies of hydroids, which were attached to the supporting timbers of the float at Woods Hole, were excited to momentary luminescence by rubbing with the fingers, a procedure suggested by Professor Harvey.

The finely luminescent jellyfish at the foot of the list (Mnemiopsis Leidyi), although rarely seen at Woods Hole, appeared in abundance during the writer's visit. When excited spontaneously by the swash of a quiet sea the brightness was quite uniformly .11 ml. to .12 ml. After lying at rest in a tub of sea water a sudden agitation of the organisms (as by strongly tapping the tub or stirring the water) produced an initial brightness of .30 ml., which could not be immediately repeated by the application of further excitation.

Even the dimmest of the intensities noted above, that of the faint glow observed in the wake of a steamer at sea, is about ten times what would result from the illumination of white objects by a clear but moonless sky. The foam of a breaking wave is not suitable for such a comparison, since one can not be sure of the complete absence of luminosity. A measurement of the very white shell-beach on Sanibel Island at night, which was probably comparable to sea-foam in reflecting power, was therefore selected. It was found to have a brightness of only .00008 millilamberts.

When one contemplates the vast range between such intensities and that, say, of the same beach under the noonday sun, one calls to mind Langley's classical memoir on the least quantity of light necessary to vision.

E. L. NICHOLS

PHYSICAL LABORATORY
CORNELL UNIVERSITY

EXPERIMENTS ON THE CULTIVATION OF THE ACTIVE AGENT OF MOSAIC DISEASE OF TOBACCO AND TOMATO

THE experiments here reported relate to the problem of the cultivation of the microbic agent of mosaic disease of tobacco (*Nicotiana tabacum*) and tomato (*Lycopersicum esculentum*).

It was determined as a preliminary that the active agent was readily filterable through Berkefeld filters, sizes "V" and "N." Also the disease was transmitted from the affected tobacco to previously normal tomato plants and similarly from the tomato to tobacco, thus effecting a cross-passage. Furthermore, the signs of the mosaic disease in the tobacco and tomato plants of the initial stock and in those to which the affection was transferred experimentally were identical with those described by other investigators, notably by Allard.

The medium employed in the cultivation tests consisted of an aqueous extract of carefully selected fresh young stems, leaves and shoots from tomato plants which were shown by experiments to be free of the disease. The extract was centrifuged at high speed and filtered twice through Berkefeld "N" filters. The filtrate was retained for use if its final pH was 5.3 — 6.0 (for no artificial adjustment was made by adding acid or alkali), if no evidence of contamination existed and if none of its contained albumins or globulins were precipitated.

Materials for culture were obtained from stout tomato stems or large tobacco leaves which were cut from the plant with a razor. The cut end of the stem or the leaf was sterilized by searing in a flame and a sterile capillary pipette, connected with a small rubber bulb, was inserted into the stem or into the midrib of the petiole of the leaf, in the direction of the long axis. About 0.01 cc of liquid containing the active agent was then aspirated directly into the pipette and inoculated into 3 to 5 cc of the medium, which was then placed in a dark cabinet in the greenhouse, at a temperature of 28 to 30° C.

After seven to ten days or longer, the medium containing mosaic materials showed as a rule a faint, uniform, translucent, almost imperceptible haze. In some instances, no changes could be made out by inspection with the naked eye on comparison with the controls. Stained specimens, however, revealed more granular material than in the latter. Nevertheless, by the available tinctorial methods, by darkfield examination, by supravital and unstained preparations studied with the ordinary microscope, we failed to differentiate formed elements as distinct from the granules or precipitate which were to be found in the uninoculated medium as well.

To determine whether the agent of mosaic disease had multiplied recourse was had to the inoculation of plants. Since the agent is known to be extremely active, even in high dilutions (Allard, Doolittle), careful attention was given to the possibility that a mere transfer of the original active material from tube to tube might be responsible for the results. As will be shown in a more detailed communication to appear shortly, our tests indicated that no interpretation could be made regarding the power of a subplant in artificial media to induce mosaic disease unless the original inoculum in this subplant is diluted at least one part to a million. Under the conditions of our