Date.	Time of observation. h. h.	Actual length. hrs.	Meteors seen.	Perseids.	Radiant. α δ
Aug. 9	10¼–12¾	2	38	26	44° + 57°
10	10 –13½	3	91	72	44 + 57
11	10 –13½	3	90	68	46 + 57
12	10 –13½	3	62	43	48 + 57
13	10 –12½	2	23	10	49 + 58
14	10 –12½	2¼	29	12	50 + 56

The meteors seen on the 10th were, however, rather brighter on the whole than those on the 11th. The largest meteors were as follows:—

No.	Date.	Time.	Mag.	Path. From	To
1	Aug. 9	11 4	♃	15° + 28°	11° + 21°
2		11 32	♃	296½ + 57	278 + 36½
3		12 7	♀	239 + 60	235 + 37
4	Aug. 10	10 14	♀	293 + 60	271 + 38
5		10 54	♃	23½ + 38	17 + 29
6		11 36	♃	49½ + 37½	50½ + 32
7		13 18	♃	50 + 67	58 + 73
8	Aug. 11	11 9	♃	18½ + 51	5 + 44½
9	Aug. 12	10 16	♃	5½ + 6	1 – 6
10		10 39	♃	326 + 1½	318 – 11
11		12 1½	♀	4½ + 43	347 + 27½

No. 3 was also seen by Prof. Herschel, and No. 4 by Mr. Astbury. The majority of the remainder were seen by various other observers, and their real paths will be calculated.

On August 12 the shower had markedly declined, though it was tolerably active between 10h. and 11h. The position of the radiant point exhibited the usual diurnal motion to the eastward. On July 29–August 2, eight meteors observed at Bristol denoted the radiant at 34° + 54°, and on August 6, six meteors fixed it at 40° + 55°. On August 12 it was in 48° + 57° and on August 14 in 50° + 56°.

Several remarkable meteors with very slow motion, and leaving trains of sparks, were recorded on August 12. One of the most striking of these appeared at 12h. 31m. It was of the 1st mag., and traversed a path of 33 degrees from 341° + 81° to 124° + 64° in about seven seconds. As it fell almost perpendicularly down the northern sky the nucleus poured out a stream of yellow sparks. Probably the radiant was near the southern horizon, and it is hoped that other observers will send in reports of this curious meteor, and enable its true radiant to be found.

Altogether the display seems to have been of average importance, and to have fallen below the observed strength of the shower on August 11, 1898. Many of the minor showers of the period made themselves apparent, though they were generally very feeble. The principal of them were at 41° + 20°, 333° + 26°, 345 ± 0, 315° + 77°, 339° – 11° and 17° + 31°. It is to be hoped that at places where the photographic method has been applied the results have been successful.

W. F. DENNING.

UNITED STATES DEEP-SEA EXPLORING EXPEDITION.

THE announcement that the U.S. Fish Commission steamer, *Albatross*, would shortly be despatched on an exploring expedition to the Pacific Ocean, has already been noticed in these columns. Particulars of the main objects of the expedition, and the route to be followed, are given by Mr. H. M. Smith in the *National Geographic Magazine*, from which the subjoined account has been abridged.

The *Albatross* is the best-equipped vessel afloat for deep-sea investigation, for which work she was especially constructed for the Fish Commission in 1882, at a cost of nearly 200,000 dollars. She is a twin-screw steamer of 384 tons burden, 234 feet long and 27½ feet beam. A full account of the construction of the *Albatross* and her appliances for marine investigation has been given in the admirable work on "Deep-sea Exploration," by Commander Z. L. Tanner, U.S.N., under whose direction the vessel was built and who was in command from the date of her launching until 1894. The reputation long enjoyed by the *Albatross* of being unequalled in effectiveness for marine research will be more than ever deserved on the approaching cruise because of the extensive improvements and repairs she has recently undergone, including the installation of new boilers, ice-making machine, cold-storage plant, &c., together with the thorough replenishing of the scientific outfit.

The *Albatross* will pass through the Golden Gate on August 21 and begin her long voyage to certain groups of islands in the middle of the Pacific Ocean, both north and south of the equator, whose local fauna is almost unknown, while in the adjacent waters little or no scientific investigation has been carried on. The Society islands will be first visited, although the vessel will touch at the Marquesas islands for coal. Between San Francisco and Tahiti, a distance of 3500 miles, dredging and sounding will be carried on at regular intervals on a section of the sea-bottom almost wholly unexplored. Tahiti will be the headquarters while the Society islands and the Paumota islands are being explored. In the latter archipelago, which is about 600 miles long, six or eight weeks will be spent and important scientific discoveries should be made. In the Tonga or Friendly islands, distant about 1500 miles from the Society group, a week or ten days will be passed. The vessel will then proceed to the Fiji islands, where a short stay will be made, and thence 1700 miles to the Marshall islands, in which interesting archipelago, of whose natural history almost nothing is known, six or seven weeks will be devoted to exploration. The Ellice and Gilbert islands, lying between the Fiji and Marshall islands, will also be visited. It was originally the intention to have the *Albatross* proceed from the Marshall islands to the Hawaiian islands and thence to San Francisco, running a line of deep-sea dredgings along the entire route; but, owing to the prevalence of head winds at the time when the vessel will be ready to leave the Marshall islands, this plan has been abandoned, and instead the vessel will sail for Japan, making frequent use of the dredge and the deep-sea tow-net and setting the trawl in the moderately deep water off the Japan coast, where the fishermen are continually bringing up curious forms. The voyage of nearly 20,000 miles will come to an end at Yokohama, where the *Albatross* will arrive in April 1900, and refit for a summer cruise to Alaska to resume the systematic examination of the salmon streams begun several years ago.

The leading features of the expedition will be deep-sea dredging, trawling, and sounding, and some special appliances for such work have been constructed. A wire dredge-rope 6000 fathoms long has been made to order, and to accommodate this enormous quantity a special drum has had to be prepared. It is expected that both the dredge and the beam-trawl will be hauled in deeper water than heretofore. One of the novel pieces of collecting apparatus is a beam-trawl of unprecedentedly large size, especially designed for the capture of larger animals than can be taken with the usual apparatus.

While the deep-sea investigations will receive the most attention, surface and intermediate towing, shore-seining, and fishing trials with lines, gill-nets, and other appliances will be regularly carried on and will undoubtedly yield rich collections. The region to be visited abounds in atolls and elevated reefs, many of which will be visited and studied for the purpose of obtaining data bearing on the disputed question of the origin of coral reefs.

The *Albatross* is manned by about ten officers and seventy petty officers and enlisted men of the United States Navy. The commanding officer is Lieutenant Commander Jefferson F. Moser, U.S.N. The civilian staff on this expedition consists of Prof. Alexander Agassiz, in charge of the scientific work, who will be accompanied by his son and his personal assistants; Dr. W. McM. Woodworth and Dr. A. G. Mayer, of the Museum of Comparative Zoology, Cambridge, Mass.; Dr. H. F. Moore, chief naturalist of the *Albatross*; Mr. Charles H. Townsend, formerly naturalist, now chief of the fisheries division of the U.S. Fish Commission; Mr. A. B. Alexander, fishery expert, and Mr. H. G. Fassett, photographer, both of the U.S. Fish Commission.

Opportunity will undoubtedly be afforded for conducting a number of important collateral inquiries without detriment to the regular scientific work. Advantage will be taken of every chance to obtain for the National Museum specimens of the mammals, birds, insects, and other land animals of the various islands visited. A study of the aboriginal fishing methods, apparatus, and boats, and the collection of specimens of the native fishing appliances will be in charge of the fishery expert.

The Smithsonian Institution has specially requested that the Fish Commission make an effort to trace the origin of some of

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the ethnological specimens brought back from the Pacific islands by the Wilkes Exploring Expedition. Commissioner Bowers has notified the Smithsonian Institution that the naval and civil attachés of the vessel will be given special instructions to be on the look-out for desirable ethnological material.

There is every reason to believe that this expedition will yield valuable scientific results, and will be creditable to the United States. It is the most important marine expedition on which the Fish Commission has embarked, and one of the most promising scientific enterprises in which the U.S. Government has ever engaged. It is a matter for congratulation that, in the activity in exploration of the seas now being exhibited by various Governments, the United States will participate under such favourable auspices and be represented by a man of science of such wide experience in deep-sea investigation as Prof. Agassiz.

MAGNETO-OPTIC ROTATION AND ITS EXPLANATION BY A GYROSTATIC SYSTEM.[1]

THE action of magnetism on the propagation of light in a transparent medium has been rightly regarded as one of the most beautiful of Faraday's great scientific discoveries. Like most important discoveries it was no result of accidental observation, but was the outcome of long and patient inquiry. Guided by a conviction that (to quote his own words) "the various forms under which the forces of matter are made manifest have one common origin," he made many attempts to discover a relation between light and electricity, but for very long with negative results. Still, however, retaining a strong persuasion that his view was correct, and that some such relation must exist, he was undiscouraged, and only proceeded to search for it more strictly and carefully than ever. At last, as he himself says, he "succeeded in *magnetising and electrifying a ray of light, and in illuminating a magnetic line of force.*"

Faraday pictured the space round a magnet as permeated by what he called lines of force; these he regarded as no mere mathematical abstractions, but as having a real physical existence represented by a change of state of the medium brought about by the introduction of the magnet. That there is such a medium surrounding a magnet we take for granted. The lines of force are shown by the directions which the small elongated pieces of iron we have in iron filings take when sprinkled on a smooth horizontal surface surrounding a horizontal bar magnet, as in the experiment I here make. [*Experiment to show field of bar magnet by iron filings.*]

The arrangement of these lines of force depends upon the nature of the magnet producing them. If the magnet be of horse-shoe shape, the lines are crowded into the space between the poles; and if the pole faces be close together and have their opposed surfaces flat and parallel the lines of force pass straight across from one surface to the other in the manner shown in the diagram before you. [*Diagram of field between flat pole faces.*]

The physical existence of these lines of force was demonstrated for a number of different media by the discovery of Faraday to which I have already referred, and on which almost all the later work on the relation of magnetism to light has been founded. I am permitted by the kindness of the authorities of this Institution to exhibit here the very apparatus which Faraday himself employed, though for the various experiments I have to make it is necessary to actually use another set of instruments. [*Apparatus shown.*] Before repeating Faraday's experiment, let me describe shortly what I propose to do, and the effect to be observed.

A beam of plane polarised light is produced by passing white light from this electric lamp through a Nicol's prism. To understand the nature of plane polarised light, look for a moment at this other diagram (Fig. 1). It represents a series of particles displaced in a certain regular manner to different distances from the mean or equilibrium positions they originally had along a straight line. They are moving in the directions shown by the arrows and with velocities depending on their positions, as indicated by the lengths of the arrows. Suppose a certain interval of time to elapse. The particles will have moved in that time to the positions shown in this other diagram (Fig. 2) on the same sheet. It will be seen that the velocities as well as the positions of the particles have altered; but that the configuration is the same as would be given by the former diagram moved through a certain distance to the left.

Thus an observer looking at the particles and regarding their configuration would see that configuration apparently move to the left; and this, it is very carefully to be noted, is a result of the transverse motions of the individual particles. In another interval of time equal to the former the arrangement of particles will appear to have moved a further distance of the same amount towards the left.

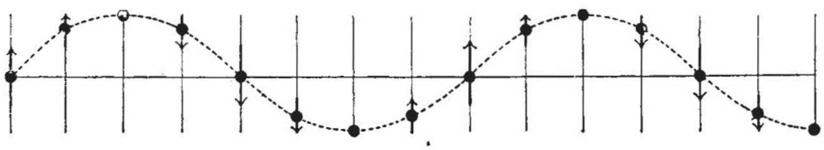

FIG. 1.

This transverse motion of the particles, thus shown displaced from their equilibrium positions, represents the vibration of the medium which is the vehicle of light, and the right to left motion of the configuration of particles is the wave motion resulting from that vibration. I do not say that the medium is thus made up of discrete particles, or that the different portions of it vibrate in this manner, but there is undoubtedly a directed quantity transverse to the direction in which the wave is travelling, the value of which at different points may be represented by the displacements of the particles, and which varies in the same manner, and results, as here shown, in the propagation of a wave of the quantity concerned.

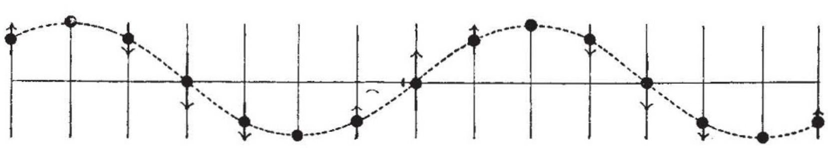

FIG. 2

In fact, we have here a representation of a wave of plane polarised light. The directions of vibration are right lines parallel at all points along the wave. Ordinary light consists of vibrations the directions of which are not parallel if rectilinear, and each vibration is therefore capable of being resolved into two in directions at right angles to one another. The Nicol's prism, in fact, splits a wave of ordinary unpolarised light into two waves, one in which the vibrations are in one plane containing the direction in which the light is travelling, the other in a plane containing the same direction, but at right angles to the former. One of these waves is stopped by the film of Canada balsam in the prism and thrown out of its course, while the other wave is allowed to pass on undisturbed.

If the wave thus allowed to pass by one Nicol's prism be received by another it is found that there are two positions of the latter in which the wave passes freely through the second

[1] A discourse delivered at the Royal Institution by Prof. Andrew Gray, F.R.S.

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