where it attained depths of from 20 to 40 metres; rising even to 60 or 80 metres on the flanks of Rakáta (corrupted to Krakatau), the southern and highest part (822 metres) of the island. Fragments the size of a fist were thrown 40 kilometres from the volcano. Between Krakatoa and Sebesi, to the north, the ashes and pumice filled the sea at two points, forming low islands (Steers and Calmeijer), which have already been much broken and degraded by the waves. The sixteen little craters reported near where these islands stand have had no existence: they were only smoking heaps of ashes.

The precise hours of the heaviest explosions were not determined directly, but were based on the self-registering pressure-gauge of the gasometer in Batavia, as there was no self-registering barometer there. Making seven minutes allowance for the time of air-wave passage from the volcano to the gauge, the most violent eruptive action occurred at 5.35, 6.50, 10.5 (maximum), 10.55 A.M., Aug. 27, Batavia time. It was these air-shocks that were felt by barometers all around the world. In the May eruption, sounds were heard 230 to 270 kilometres; but in August the noise of the explosions was audible 3,300 kilometres from the island, or within a circle of 30° radius, equalling one-fifteenth of the earth's surface. The sounds spread irregularly; and it is suggested that the wind and the ashes in the air had much to do with the silence at points near which the eruption was distinctly heard. The eruption of Tomboro in 1815 was heard only half this distance; but the quantity of its ejected material (calculated from a correction of Junghuhn's data) was eight to eleven fold that thrown from Krakatau, which Verbeek determines to be close to 18 cubic kilometres. Two-thirds of this fell within 15 kilometres of its origin, as will be shown on an ashes-map, to be published in the final report. The ashes contain from sixty to seventy per cent of silica. Under the microscope, they show, 1°, glass in small, porous, irregular fragments; 2°, plagioclase felspar, with inclusions of glass, apatite, augite, and magnetite; 3°, pyroxene, probably rhombic as well as monoclinal, with inclusions of glass, apatite, and magnetite; 4°, magnetite in grains and octahedrons; this is the oldest component, and decreases in quantity on receding from the island. The great ten-o'clock wave, which it is thought resulted from the falling-in of the northern part of the island, following the most violent explosion, rose to heights of 30 and 35 metres on some of the neighboring coasts, and destroyed more than thirty-five thousand people. Maps, tables, and drawings are in preparation for a more detailed report; and this, in connection with the report we may expect from the sun-set committee of the Royal society, will form a most entertaining addition to the already interesting literature of volcanoes.

STOKES'S LECTURES ON LIGHT.

Burnett lectures on light. First course, on the nature of light. By GEORGE GABRIEL STOKES. London, *Macmillan*, 1884. 9+133 p. 24°.

THIS little book consists of lectures delivered at Aberdeen in November, 1883. They have their origin in an interesting manner, which is, perhaps, possible only in Great Britain. Just a century ago John Burnett, a merchant of Aberdeen, bequeathed a fund to establish prizes for theological essays. These prizes, a first and second, were to be competed for once in forty years; and awards have been made on two occasions since the foundation. In 1881, however, a new direction to the foundation was given by order of the secretary of state for the home department, in which it was provided that a lecturer should be appointed at intervals of five years, to hold office for three years. The subjects to be treated are, 1°, history; 2°, archeology; 3°, physical science; 4°, natural science. Professor Stokes was chosen as the first lecturer.

The lectures are unique, as far as our knowledge extends, in the effort to present the higher portions of optics without the employment of experimental demonstrations, diagrams, or mathematical language.

Whether the knowledge assumed in the reader, which does not include any thing of the theory or phenomena of interference, diffraction, double refraction, or polarization, is sufficient to enable him to understand every thing contained in the lectures, is problematical. But, at any rate, to those better equipped, the book gives a most concise and interesting review of the history of optics. A personal reminiscence of a conversation with Sir David Brewster (p. 15), the last great champion of the theory of emission, just after his return from Paris, where he had witnessed Foucault's crucial experiment regarding the velocity of light in air and in water, is highly interesting; for it shows us the singular motive which prevented even so acute a mind as Brewster's from yielding to overwhelming evidence: "he was staggered by the idea, *in limine*, of filling space with some substance merely in order

that ' that little twinkling star,' as he expressed himself, should be able to send its light to us."

Noteworthy is Professor Stokes's opinion (p. 83) of the astonishing conclusions of Young and Forbes as to the varying velocities of propagation of different wave-lengths in vacuum; for his doubts as to their validity seem founded only upon the fact that the conclusions depend upon the judgment of the eye of a single observer.

We shall await with interest the publication of the next year's course, which is to be devoted to researches in which light has been used as a means of investigation. The third year's course will "be assigned to light considered in relation to its beneficial effects."

NOURSE'S AMERICAN EXPLORATION IN THE ICE-ZONES.

American exploration in the ice-zones (etc.), prepared chiefly from official sources. By Prof. J. E. NOURSE, U.S.N. Boston, *Lothrop*, 1884. 3 + 578 p., illustr., maps. 8°.

THE work of Professor Nourse does not profess to be, and is not in any sense, a study of the results of arctic exploration performed by Americans, or of the relation of American explorations to explorations made by the people of other nations. It is simply a collection of narratives of the different expeditions, — gotten up, like the stock compilations, by hack-writers, — which are published on various subjects from time to time. It is a book undeserving of high praise, either in its contents or its make-up. The only thing which redeems it from perfect mediocrity is the fact that it contains some data in relation to the North Pacific exploring expedition, under Rodgers, the report of which still remains unpublished, and a few facts from Hooper's report of his voyage in the Corwin in 1881, the original of which has not been made public.

The record is complete only for the naval and military expeditions. Those of the telegraph explorers, 1865–68, are not even mentioned, though much of their work was in really arctic regions; and the indirect results of their explorations have added one-seventh of its area to the present United States, and have contributed at least one hundred titles to geographical bibliography. The travels of Kennicott and others in the Hudson-Bay region, of Nelson in northern Alaska, the work of the coast-survey in and north of Bering Strait in 1880, are left to other chroniclers. We presume this may be accounted for by the fact that the investigations referred to, and their value, are familiar only to students, specialists, and geographers, and not easy of access to the mere compiler.

From a literary point of view, the work is open to severe criticism. The thread of the narrative is frequently broken for the most trivial digressions, which are pursued at great length. The misprints are numerous, and generally of that objectionable kind which confuses the sense, without being obvious to the ordinary reader. Trifling matters are detailed at length, while more important ones are omitted.

In spite of all this, the book will be attractive to youthful readers who are not critics, and enjoy unfamiliar details, and to whom the really weightier matters are not important. It is fully illustrated by cuts drawn from Rink, Bessels, Hall, Hayes, and various government publications, and is accompanied by the worst map of the circumpolar regions which we have ever encountered.

INTELLIGENCE FROM AMERICAN SCIENTIFIC STATIONS.

GOVERNMENT ORGANIZATIONS.

U. S. geological survey.

Paleontology. — Mr. C. D. Walcott has prepared the manuscript for a report on the St. John fauna of New Brunswick, contained in the Hartt collection. It is ready for publication as a bulletin of the survey, and only awaits the completion of the drawings illustrating it to go to press.

During April the collection of Devonian fossils from the Hamilton group of New York was transferred to the U. S. national museum, and recorded. The collection was made about Moravia, N.Y., by Mr. Cooper Curtice, during a portion of the field season of 1883. It also included a quantity of specimens collected by Mr. Curtice prior to his becoming a member of the geological survey. The collection consisted of fifteen hundred and seventy-seven specimens, containing sixty-two genera and a hundred and eighteen species.

Dr. C. A. White, during May, was occupied mainly with the examination of fossils forwarded from California by Mr. G. F. Becker, and in preparatory study for his proposed work in the mesozoic and cenozoic areas of California during the coming season. Dr. White started for California the 2d of June, and will probably take the field first in the Clear Lake region, and make a section towards the coast.