to the Rocky Mountains, where they found old Hino. All live there in the caves of the rocks."

Models of the Ocean's Bed.

The Hydrographic Office has sent to the Cincinnati exhibition a collection of charts, photographs, etc., illustrating the work of the office and the modes of doing it. These will be interesting to scientific men, teachers and students, but, except the photographs, are not likely to arrest the attention of the average visitor. But there are two plaster-of-Paris models in the collection that are certain to be examined with curiosity, and studied with profit, by every one who stops to look at them. They are models of the bed of the Atlantic Ocean and of that of the Caribbean Sea. These have been made by Mr. E. E. Court, of the Hydrographic Office, and the charts from which they were constructed have been carefully revised by Commander J. R. Bartlett and Lieut. J. L. Dyer, respectively former and present hydrographer.

Each of these models shows the contour of the bottom of the sea, that of the Atlantic embracing the whole ocean from latitude 60° north to latitude 40° south, or from Greenland in the north to the unknown region in the south, and includes the Mediterranean Sea on the east, and the Caribbean Sea and a part of the Gulf of Mexico on the west. The chart from which the necessary data were plotted in order to make the model was compiled on a very large scale from the charts of the United States and all foreign hydrographic offices, the very latest deep-sea soundings having been utilized. The contour-lines are drawn according to these soundings. This chart, while it tells the whole story to the experienced hydrographer, — the figures with which it is covered possibly conveying to his mind a picture of how the bed of the Atlantic would look if spread out before him so that he could get a bird's-eye view of it, — is entirely meaningless to the great mass of people. But in the model that is constructed from the chart every depression of the ocean is represented by a corresponding depression in the plaster-of-Paris; so that even a child, with a few words of explanation, can obtain from it a clearer, more vivid, and more correct idea of how the bed of the ocean looks than the man of science could obtain from a chart.

The horizontal scale of the chart and model is sixty nautical miles, or one degree of longitude, on the equator, to each six-tenths of an inch; and the vertical scale is fifty times as great as the horizontal.

The original model was made of wooden boards, one-eighth of an inch thick, each layer representing 250 fathoms of actual depth of the sea. The intermediate soundings are also very carefully represented by carvings of the boards. When the entire contour had been fully represented in the wooden model, a plaster-of-Paris cast was made from it, and this was carefully painted so as to represent in their actual colors, as shown by deep-sea soundings, the mud at the bottom of the sea. As the depth increases each thousand fathoms, the shade becomes darker and darker, the darkest being in the deepest place known, — 4,561 fathoms, or about 5.2 statute miles.

There are many things shown by this model that will be surprising to almost everybody except the expert hydrographer. One of these is the great height of many of the small islands from the ocean's bed, when compared with their area either above the surface of the water or where they rest upon the bottom of the sea. Of course, this height is exaggerated in the model by making the perpendicular scale fifty times as great as the horizontal scale; but, even allowing for that, these islands stand up like tall, narrow, truncated cones, many of them not being more than twice as far across at the base as at the top.

The model of the bed of the Caribbean Sea was designed by Commander J. R. Bartlett, and the chart was compiled from deep-sea surveys made by himself and by Lieut.-Commanders W. H. Brownson and Z. L. Tanner. The latest soundings are embodied in it. In this model, of which the horizontal scale is thirty-three miles to an inch and the vertical thirty-three times the horizontal, the topography of the land is given in the same proportion as the depths of the sea.

Duplicates, or even photographs, of these models would be of very great value in the teaching of physical geography. That of the bottom of the Atlantic Ocean would give a pupil more actual instruction in a quarter of an hour than a week's study of descriptive text.

ELECTRICAL SCIENCE.

Continuous and Alternating Currents.

IN the last few months discussions have taken place, both in England and this country, as to the relative value of continuous and alternating currents for the distribution of electrical energy. In England the employment of storage-batteries with the continuous current has been advocated: here the simple direct system has been pitted against the alternating. We have noticed these discussions from time to time: now that they are finished, it will be well to sum up the results.

The alternating system, employing induction-coils or transformers, has the advantage of allowing the current to be distributed at a high potential to the points of consumption, and therefore it requires distributing-wires of comparatively small section. There seems little doubt, as matters now stand, that it is best for scattered towns, or even in cities if the lighting is mainly confined to theatres, clubs, stores, etc., which are at a considerable distance apart, and which are to be supplied from a central station. When it comes to domestic lighting, however, where we wish to supply entire districts in cities with electric lights instead of gas, the case is different. Let us consider the availability of the three systems — alternating, direct, and direct with storage — for this purpose. The practice with the alternating system at present is to have a transformer for each house to which lights are supplied. When a large number of houses are to be supplied in a city district, this plan cannot be economically carried out, especially if the wires are forced under ground. The insulation of such a complicated network of high-potential wires would be difficult and expensive, — almost impracticable, in fact. Again: as each house would have a transformer whose capacity would be the maximum number of lights that would be used, and as the average number of lights is only a small fraction of the maximum, the transformers — which are not economical when their load is small — would have a low average efficiency. If the alternating system is to be introduced into cities to seriously displace gas, it must be on some such plan as Mr. Kapp proposes. Large converters are placed at different points in the district to be lighted, and the current is distributed at low potential from these. It will be found, if this is done, that the saving in wire is not so large as might be expected, for the greatest expense will be in the low-potential distributing-mains.

The only storage-battery system in extended practical use is that employed by Mr. Crompton. A number of sets of cells are distributed in sub-stations through the district to be lighted, the different sets are connected in series, and the lamp-circuits are taken from the terminals of each set of cells. The batteries act then partly as a converter, allowing high-tension currents for distribution, with a comparatively small difference of potential at points of consumption. Another advantage lies in the fact that the cells can be charged when the demand is light, and discharged at the time of maximum demand, thus allowing a smaller generating-plant. Mr. Crompton claims a high efficiency for the arrangement, and he is no doubt right. There is a loss, of course, in the part of the energy stored, but very little in that converted; and, as the former is not a large part of the total output, an efficiency of eighty-five per cent is not improbable. Mr. Crompton also claims that the repairs of the battery will not amount to more than ten per cent of their cost. The disadvantage of this system lies in the fact, that, with batteries in the circuit, insulation is difficult; and while the difference of potential between the leads taken from the two ends of a set of cells is only, say, one hundred volts, yet the difference of potential between these and the ground depends on the position of the set, and might be high. In fact, we have the disadvantage of distributing at a comparatively high absolute potential, with all the difficulty of insulation that it entails.

The simple direct system has the advantages of a high efficiency and simplicity, and it is economical within a limited area of distribution. It has the disadvantages that the station must be located near the centre of the district to be illuminated, and the area of operation is restricted.

When it comes to supplying an entire city with light, and the question of the relative cost of the various systems is considered, it will probably be found that the most economical will be not any one of the systems, but all of them, — two or three stations in the city proper for the direct and storage systems, the latter for localities distant from the central stations. For the suburbs the alternating system could be used, the stations supplying the alternating currents also supplying arc lights.

It should be noticed that in the discussion in England before the Society of Telegraph Engineers and Electricians, Mr. Kapp, who championed the alternating-current side of the question, admitted that a system of distribution by storage-batteries was the ideal system, but he said that he knew of no reliable storage-batteries. Mr. Crompton's system is not a complete storage system: as has been pointed out, he uses the secondary batteries more for converters than for their storage properties. In a complete storage system the batteries should be so arranged that the full capacity of the station is utilized, so that the engines and dynamos are giving their maximum output the whole twenty-four hours. To do this with safety, there should be two sets of cells, one being charged while the other is discharging. There can be no question that storage-batteries have been greatly improved in the last few years, there is no question about the possibility of future improvement: so we may look for developments in this direction.

If the discussions have shown any thing, they have shown that the direct system is the best for crowded centres, the alternating for scattered towns and suburbs, while Mr. Crompton's storage system could be used to at least double the area of economical distribution from a direct-current station.

ELECTRIFICATION OF METAL PLATES BY IRRADIATION WITH ELECTRIC LIGHT. — The influence of light on electric phenomena, which has attracted so much attention in the last year, is being made the subject of numerous researches. Mr. Hallwachs describes some interesting experiments that he has lately carried out. A metal plate was suspended inside of an iron cylinder whose axis was horizontal. The plate was five centimetres in diameter. The cylinder was fifty centimetres long by thirty-seven centimetres in diameter. The surface of the plate was coated with rust except in one spot, where it was brightly polished. It was first connected with the earth. The wire by which it was suspended passed through, but insulated from, an earth-connected brass tube, to an electrometer. In one end of the iron cylinder was a circular aperture eight centimetres in diameter, covered with wire gauze to prevent any inductive influence of the electric lamp used on the plate. The cylinder was electro-negative to the case, so that any transport of electricity by radiation — a phenomenon described by M. Righi — would have charged the plate negatively. If, now, a plate of mica was placed in the aperture in the cylinder, and the plate illuminated by an electric light, there was no indication on the electrometer. If, however, the plate of mica was replaced by a much thicker plate of selenite, the electrometer gave a gradually increasing deflection, indicating positive electricity. This at once ceased when the selenite was replaced by mica. The rise of potential cannot, therefore, be due to an inductive action, nor can it be referred to the action of heat. The metals which were used for the experiments just described were zinc, brass, and aluminium. In all three, positive electricity occurred on irradiation with brightly polished surfaces. Old surfaces no longer showed the phenomenon. The radiation itself lowers the potential to which the plates can be electrified; so that with any succeeding experiment made with the same surface the potential obtained is lower, while the rise to it takes place more rapidly. The maximum potential with zinc amounted to over a volt, with brass to about one volt, and with aluminium to five-tenths of a volt.

ELECTRIC-LIGHTING IN MINES. — For some years past efforts have been made to introduce electric lights in mines, and rewards have been offered in England for the invention of some safe, reliable, and economical system of lighting. The difficulties to be contended with are these: For permanent lights there is trouble in insulating the leads in such a way as to prevent possibility of breaks or grounds, the demand on the insulation being particularly trying, while there is danger that the breaking of the lamps will explode any inflammable gases around them. For miners' lights, the greatest trouble is to get a portable battery that can be easily carried, and which is cheap and simple. In this country no advance has been made in the application of electricity to mine-lighting; but in England much attention has been directed to it, and electric miners' lamps are being extensively introduced. In the National Colliery, Rhondda Valley, no less than eight hundred such lamps are used, while they are being introduced into other mines controlled by the same company. These are on the Swan system. At Cannock Chase the Pitkin system is employed; at Aldwarke, the Sun system. With the excellent primary batteries that have been lately brought out, and with the improvements that have been introduced in miners' lamps, it is probable that they will soon be largely used in mining-work.

BOOK-REVIEWS.

Proceedings of the Society for Psychical Research. Part XII. June, 1888. London, Soc. Psych. Research.

THIS number of the Proceedings deals almost exclusively with a class of facts towards which it is becoming more and more difficult for the man of science to assume a fitting attitude. The men who vouch for the correctness of the facts are in part drawn from their confrères, eminent in other branches of science. They are apparently on their guard against some, at least, of the many and various forms of deception. They, with some exceptions, set forth their results with much candor, and without conscious bias. And yet one reads their writings with the conviction, that grows as one reads, that all this is premature, that these men do not give evidence of that same comprehensiveness and scientific reserve which they would exhibit in case of a problem touching upon their own specialty. One feels the absence of a sound psychologic insight, such as comes only from years of special training, and the experience of a life dominated by a powerful interest for this kind of phenomena. One longs for the counterpart of such a man as Robert-Houdin, training every sense to its maximum of sensitiveness, and every muscle to the utmost expertness, in order to be a master in the art of deception. In the goings-on of his daily life he is constantly on the alert for some chance combination of events that suggest a new mode of misleading the spectators of his conjuring. Again, the length of the articles; the large proportion of theorizing; the lack of constant reference to the results of others, especially of those not in harmony with their own views, — all this, not to mention occasional serious faults in logic and sad deficiencies in the stringency of the observations, will far postpone the day when these Proceedings will be found on the shelves of a strictly scientific library.

The English Society for Psychical Research, it need scarcely be said, has definitely accepted the hypothesis of telepathy, — of the action of mind upon mind apart from the recognized channels of sense. They accept this not merely as the only satisfactory principle by which their facts can be accounted for, but they are ready to use the theory as a means of explaining other groups of facts. All of the four main contributions to the present number deal with facts of telepathy, and largely with the relation of this power to hypnotism. M. Charles Richet takes up one hundred and fifty pages with an account of a very elaborate and extended series of observations of such transferrence. This paper is to be ranked as among the most serious evidence that has yet been presented, and will be noticed in a future number of *Science*. Messrs. Schmoll and Mabire describe very similar experiments, but conducted with far less caution and insight. Failures are overlooked as unimportant. Just at the point where one desires most accurate information, the account is vague. The percipient is allowed too many trials, is too clearly informed of his success. The series in which the conditions were most convincing "produced only failures." The repeated statement of the percipient after seeing the object he was to think of, that at first this had come to his mind but was rejected, is recorded with great *naïveté*. Such illusory instructions as that the agents must entertain no "secret hope of failure" are seriously recorded. All this renders these observations of little weight.