is the training of the specialist officer in the Japanese Navy. He is encouraged to specialise according to the bent of his mind, whether in gunnery, torpedo or navigation, but apart from the special course in those subjects which he has to go through, each officer has to take up several other subjects not immediately bearing upon the one in which he is to be strongest. Here again are points to be studied and thought over, for it is certain that until very recently our specialist officers have been kept too much in a groove. The gunner has "stuck to his linstock," the "timonnier to his helm," and though either might easily be called to do the other's duty, they have seldom if ever changed duties and thus obtained experience.

As rewards to specialist officers, the Japanese give the more important positions and earlier promotion, but no extra pay. We give extra pay but no earlier promotion; nevertheless, their expert knowledge bears fruit when selections are made for certain higher posts of the service.

With the personnel at our disposal, and a naval administration which does not hesitate to throw down the barriers of prejudice standing in the way of sound progress, may we not look to doing "one better" than any competitor in the naval world? The answer is, Yes, if the voice of science is clearly heard in its proper place.

THE NATIONAL PHYSICAL LABORATORY.

THE report of the National Physical Laboratory for the year 1903, which was submitted to the Board last Friday, is the first report covering a full year's working, and shows that very satisfactory progress is being made. It is clear, however, that on the financial side the laboratory is in need of further support, even if it is only to continue to work as at present, whereas it is eminently desirable that the work should be widely extended so that the laboratory can undertake to carry out a number of tests for which there is a demand, and which it is now obliged to refuse. These will in many cases necessitate a considerable increase in the equipment, which is at present very inadequate in many branches, and naturally also an increase in the annual expenditure, which will be only partially recouped by the fees derived from the tests carried out. It is also pointed out in the report that the staff is not large enough, and that the income should be sufficient to allow of higher salaries being paid to the assistants, as those which are at present paid are not liberal enough to secure the permanence of the services of men of the necessary ability.

The net result of last year's working was a loss of a little more than 100*l*., the receipts being, in round figures, 10,200*l*., and the expenditure 10,306*l*. The president and council of the Royal Society have been in communication with the Treasury, and it has been arranged that the grant of 4000*l*. shall be continued for another year (until April, 1905), and also that a scheme for the future working shall be drawn up by the executive committee for the consideration of the Treasury. It is earnestly to be hoped that satisfactory arrangements will be made, and that the very valuable work which the laboratory can perform in the future will not be crippled for want of funds. It is interesting to compare the Government grants to similar institutions abroad which are stated in the report. The Reichsanstalt alone enjoys a grant of 16,000*l*., the total grant to the various departments at Charlottenburg doing the same work as the National Physical Laboratory being 40,000*l*. In America the grant to the Standards Bureau is 19,000*l*., and in France the Laboratoire d'Essais had a grant of 5500*l*. for its first year's working.

If we turn, however, from these financial considerations to the technical parts of the report, we find nothing to cause dissatisfaction, but, on the contrary, a record of very valuable work accomplished. The laboratory has a double function to perform; it has to carry out tests, measurements and standardisations for the public, and it has also to undertake research work, often of a very difficult character, in connection with these measurements. Many of the tests which the laboratory is asked to make are, as a matter of fact, researches in themselves; some of these are quoted in the report, and we may mention, as an example, a series of comparative tests on the materials used for lagging steam pipes. But apart from these there is a vast amount of experimental work to be done in connection with the fixing and reproduction of primary standards of all sorts, and it is very gratifying to see that attention is being given to these questions in a manner which gives promise of excellent results in the near future. We cannot refer to all the work of this kind which has been undertaken at the laboratory but may mention a few typical examples.

Experiments have been carried out on the mercury standard of electrical resistance, eleven resistance tubes having been constructed by Mr. Smith. The results of the measurements made with these tubes show that they agree among themselves to about 3 parts in 100,000, and that the final result agrees with that of the Reichsanstalt to about 1 part in 100,000. Experiments on the standard (Clark) cell have shown that impurities left in the mercurous sulphate have a considerable effect on the value of the electromotive force; it is hoped that a standard method of purification leading to consistent results will eventually be obtained; at present it is stated that the general result of the work carried out and the tests on cells submitted for standardisation show that the Clark cell cannot be regarded as a trustworthy standard. The laboratory has also under construction a standard ampere balance, and when this is completed a Lorenz machine, to be presented by the Drapers' Company, can be taken in hand. The laboratory will thus in time be in a position to give final authoritative determinations of the three fundamental electrical units.

As typifying research work of a somewhat different character, we may refer to the work which the laboratory is doing in connection with photometry. This is a subject in which the only standard we possess—the pentane lamp—is at best only a secondary standard, and one of a very unsatisfactory character. Work is being carried out in connection with the variation of this standard with the barometric pressure, and with the amount of carbonic acid and water vapour present in the air. The result of these researches may lead to a more accurate definition of the conditions for using the pentane lamp, but the laboratory also proposes to undertake experiments on some more definite standard, such as the radiation from a square centimetre of glowing platinum or from a perfectly black body at a definite temperature, which may lead to the establishment of a standard which can be regarded more as a primary standard. It is to be noted that the laboratory is using large bulb electric lamps as secondary standards, and it is probable that these will prove more satisfactory than the pentane lamp, especially as a standard which requires a chemical analysis of the atmosphere every time it is used will not be very practicable. Another research of very great practical importance, which is being carried out by Dr. Harker, is the investigation of the various methods of measuring high temperatures; an examination has already been made of the relative merits and accuracy of the different methods available for measurements up to 1100° C., the results of which have been communicated to the Royal Society, and Dr. Harker is now engaged in carrying the investigation further—up to temperatures between 1000° C. and 2000° C. This research includes an examination of the thermoelectric force of various platinum and platinum-alloy junctions, and of the effects of small percentages of impurity. The results of this work should be of high value to a great number of industries.

We have referred more especially above to the work which is being done in the physics department, but we might equally have quoted from the work of the other departments. For example, in the engineering department important work is in hand in connection with wind pressure, with the specific heat of superheated steam, and with the determination of the physical properties of a series of nickel-steel alloys prepared for the laboratory by Mr. Hadfield. Similar examples might be taken from all the other departments, but space does not permit us to enter into further detail, and we must refer those particularly interested to the report, which is itself very condensed. Sufficient has been said, we trust, to give some idea of the importance of the work which the laboratory is carrying out and of the progress which has been made. It seems that the value of the institution is likely to be fully recognised by the technical public if one may judge by the steady increase in the number of tests which have been carried out. In 1902, during nine months' working, 269 tests were made; last year this number increased to 1330, which is equivalent to an increase of nearly 300 per cent.

MAURICE SOLOMON.

FERDINAND FOUQUÉ.

BY the death of this illustrious geologist and mineralogist the ranks of science have lost one of their most notable chiefs. Half a century has passed away since he began that remarkable series of investigations which have contributed in so large a measure to the progress of vulcanology and petrography. In 1854, associated with St. Claire Deville, he published his earliest experiments on the losses effected by heat on minerals, but he was soon led into the domain of volcanic geology by studying the combustible gases given off from the flanks of Vesuvius. The eruption of Etna on January 31, 1865, furnished him with opportunities of investigating the phenomena of a volcano in full activity, and the series of communications to the Paris Academy of Sciences recording his observations and deductions established his reputation as an accurate and accomplished chemist and mineralogist. The following year came the famous outburst of Santorin, and Fouqué, who had now taken enthusiastically to the subject, hastened to profit by the rare opportunities which this eruption afforded for the detailed study of volcanic phenomena. For several years he continued to publish the results of his visit and of his analyses of the rocks and gases which he had collected, finally embodying the whole elaborate investigation in his great monograph "Santorin et ses Eruptions," which appeared in 1879, and was at once hailed as one of the most important treatises that had yet been written in the domain of vulcanology.

While these studies were in progress he applied the modern microscopic methods to the investigation of volcanic rocks. After some years of successful labour in this field he associated himself with M. Michel-Lévy, whose powers in the determination of the optical characters of minerals and the minute structure of rocks pointed him out as an admirable colleague in such a domain of research. Fouqué had given himself with the utmost ardour to the investigation of the optical characters of the felspars, a research in which he employed all the resources of modern chemistry and microscopy, which engaged his time and thought for some twelve years, and on which he justly prided himself as his most original contribution to science.

In the course of these inquiries his attention and that of his fellow-worker were directed to the importance of endeavouring to imitate the processes of nature by reproducing minerals and rocks artificially. In 1878 he published his "Synthesis of the Felspars," and in subsequent years the experiments were continued by the two observers through a series of trials in which they successively produced, by fusion and cooling, artificial compounds which, alike in chemical composition and minute structure, precisely resembled basic igneous rocks. From pyroxenic labradorite they were led to obtain in succession artificial leuco-tephrites, like the lavas of Vesuvius, basalts, diabases, dolerites and ophitic meteorites. The results of these researches were collected in the memorable "Synthèse des Minéraux et des Roches," the appearance of which in 1882 marked an epoch in experimental geology. Up to the end, however, it was found impossible to reproduce artificially the acid rocks of granitic type.

MM. Fouqué and Michel-Lévy, while engaged in these inquiries, found also time for a detailed study of the minute structure and composition of the crystalline rocks of France, and embodied the results of this laborious investigation in the great quarto monograph "Minéralogie Micrographique: Roches éruptives Françaises," which, with one volume of text and another of admirable coloured plates, was published by the Geological Survey of France in 1879.

The eminent petrographer was not merely one who relied on all the resources of a well equipped modern laboratory. He studied his subject in the field also. One great element of value in his volcanic investigations arose from personal acquaintance with the phenomena of active volcanoes. His knowledge of the eruptive rocks of his native country was likewise widened by prolonged examination of them on the ground. To him we owe some of the most interesting sheets of the map of the volcanic region of central France, where he traced the relations and order of sequence of the volcanic eruptions which give that part of the Continent such absorbing and perennial interest.

In his early years he had given some attention to the phenomena of earthquakes. Hence when the French mission was dispatched to study and report on the phenomena of the Andalusian earthquake of December 25, 1884, Fouqué was placed at its head as director, associated with some of the ablest geologists in France. The massive quarto memoir containing the report of this mission is specially notable for the record of the experiments made by MM. Fouqué and Michel-Lévy to determine the rapidity of the propagation of waves of shock in different kinds of rocks. Fouqué likewise showed his continued interest in this subject by contributing in 1888 a little popular treatise, "Les Tremblements de Terre," to the *Bibliothèque Scientifique Contemporaine*.

For many years past the professor had given courses of lectures at the Collège de France, where also he carried on his chemical and petrographic researches. He lectured with his usual clearness and earnestness on Saturday, March 5. On the following evening he seemed in his usual health, and discussed petrographical subjects with his son-in-law, Prof. Lacroix, but next morning (March 7) he passed away in his sleep at the age of seventy-five.