West of this central fountain were two others of very different character, being more spasmodic in activity, but never long quiet. Occasionally they would unite their forces for half an hour at a time, forming a stationary line of 130 feet of spraying billow much like a surf-comber with flying spray. This stationary surf-wave was 15 feet high, incessantly flinging its spray 10 feet higher along its whole length. In the night, the effect of these fountains was extremely brilliant and was attended by loud metallic crashing.

The other three fountains were smaller, near the borders of the lake, and often quiet for hours together.

During the thirty months' interval between my two visits, the gradual elevation of the fire-lake continued quite uniformly, as attested by occasional photographs. By its frequent overflows it had built itself up to a height of fully 50 feet above the previous main floor of Kilauea, so that it formed an extremely low truncated cone, surmounted by the level lake, to the edge of which visitors daily approached.

About March, 1894, a recession began, which ended in a final collapse of activity. The lake soon sank some hundreds of feet, carrying with it the sides of a circular pit, about 1400 feet in diameter, and central to the original 2400-foot pit. When I saw it in the following September, the fire-lake was not less than 500 feet below the rim. During the evening, masses of rock frequently crashed in, driving heavy surges of fire far up the talus. There was a good deal of steam-cloud slowly rising, charged with sulphur. During my previous visit, all vapour had seemed to be absent, and I made the circuit of the pit without encountering sulphur. Subsequent photographs had also indicated the absence of vapour from the lake.

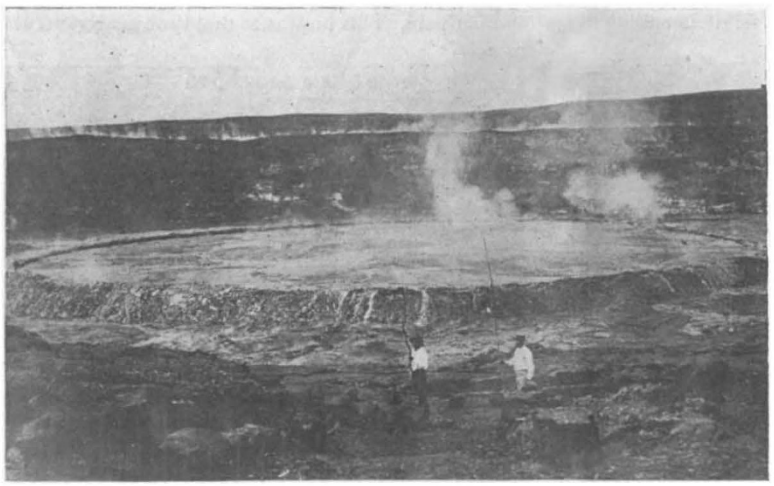

FIG. 2.—Fire-lake as seen in 1892–3. Lake gradually rose so as to overtop the rim of the pit, more than 50 feet in 1894, but all the time keeping its position and limits.

I now have to add an important observation. To my great surprise, at this last visit, I perceived that the three fountains above described were in full activity and in the same relative position as before, although during the thirty months the level of the lake had risen 350 feet and had then fallen 500 feet. By what system of supply-ducts such fountains had been so long maintained was a mystery concealed in the fire-depths. But the fact of a marvellous steadiness and uniformity of action was obvious. For a long period a uniform and gentle outpour of effervescence had been maintained. It had persisted for two years and a half, throughout all the immense changes.

I submit as the unavoidable conclusion that the source of supply for this five years' outpour of gently effervescing lava was in an interior magma which itself contained the impelling force in its own originally occluded gases. For its activity this source was wholly independent of any encounter with water to generate steam. Expanding steam evidently had no part in that steady, quiet, persistent activity in the fire-lake of Kilauea.

I would add that the exceptionally quiet and uniform activity of Kilauea seems to render it one of the most important of all volcanoes for study. I regret to say that since the collapse nearly eight years ago no lava has appeared in the crater, except a small quantity last June, which has again gone out of sight.

Having seen no European notice of the fact, I would report that twelve days after the Martinique eruption very vivid afterglows appeared here, about as bright as those seen here after the first two weeks of the Krakatoa glows in September, 1883. They have not yet wholly disappeared. The solar corona, or "Bishop's Ring," is still conspicuous. It is worth stating that the Krakatoa glows reached Honolulu in ten days, coming twice the distance of the Martinique glows in twelve days.

S. E. BISHOP.

Honolulu, July 31.

## *THE INFLUENCE OF EDUCATION UPON TRADE AND INDUSTRY.*

A SHORT time ago the Technical Education Board of the London County Council appointed a sub-committee to report upon the "application of science to industry." The witnesses called before the committee were leaders of science and employers in various branches of industry. Dealing first with the loss of industries to the country, during the last twenty or thirty years, the committee points out that all the witnesses were practically agreed in considering the loss sustained to be due to deficiencies of our educational system. It is not so much the training of the workmen which is at fault; they even consider that the opportunities open to the London workman for obtaining technical education are superior to those enjoyed by workmen abroad. It is the want of highly trained men of science who are able to undertake research work. Prof. Dewar says he knows of no firm in England where chemists are employed in research work, while in Germany a large firm will employ a number of men for research only, who will have no connection with the business or managerial part of the works.

The causes which have operated to keep manufacturers from taking highly trained men into their works are twofold. In the first place, generally speaking, the men who have been employed as scientific experts have had a wholly inadequate training, but have often the idea, as Mr. Beilby says, that they have "nothing to learn and everything to teach." In the second place, the manufacturer is often afraid that they may learn something. He may be willing to take all they can give him, but he will not let them learn the details of the process which he desires to have improved—details which are not to be found in text-books. There is also the lack of scientific training of the manufacturers themselves, and their consequent inability to recognise the importance of scientific assistance.

With reference to our secondary education, Prof. G.

Lunge observes that in our grammar schools the faculty of observation is too little developed, and that mathematics, drawing and modern languages should be more thoroughly taught. "At present there is no time for this, because far too much time and interest are devoted to athletics. The idea that secondary education should mainly aim at breeding manly characters is very fine, but the hardly veiled contempt of positive knowledge which this implies causes much mischief, and this is, of course, much worse if you substitute 'gentlemanly' for 'manly.'" The committee is convinced that scientific industries have suffered, not only through defects in higher scientific education, but to an even greater extent through defects in general secondary education. Mr. Levinstein, in his presidential address to the Society of Chemical Industry at Liverpool, also refers to our want of a sound system of secondary education; he considers that our primary education is fairly good, but what we require is "*general non-specialised secondary education.*" Those engaged in the educational profession must surely have had it forced upon them that the crying need of the country is specialisation; but it is useless, and worse than useless, to attempt to specialise without first having the sound foundation of a thorough general education.

Dr. Merz thinks that science teachers in secondary and public schools are not of a sufficiently high standard as compared with the teachers abroad. They have too little time for improving their knowledge by further study, the result being that they soon become disciplinarians only instead of men of science. Our teachers often seem unable to instil the love of science into their students, who lack the enthusiasm which exists abroad, and may almost be compared to the tradition which is found in our public school life here. How often one hears a graduate say, "Ah! that's finished; I ground up science for my degree, but I shall drop it now." To such men the degree is a qualification and that is all.

In referring to the London polytechnics, the committee recognises the difficulties under which the heads of departments labour if they desire to carry on research. They are understaffed and underpaid, and almost the whole of their time is taken up in teaching or in superintending the teaching of all branches of their subject. It might here be pointed out that in many cases the governors of the institutes, with the exception of those appointed by the Technical Education Board, have absolutely no idea what research means, and strongly object to chemists and others taking up expert work whereby they would obtain an insight into the technical side of their subject, which otherwise it is almost impossible for them to do.

A generation ago the bulk of the manufacture of fine glass for scientific and optical purposes was in English hands. Now it is almost entirely in the hands of Germans. "German chemists have succeeded in introducing such modifications in the manufacture of optical glass that opticians have been enabled to place on the market lenses approaching more closely to mathematical perfection than any previously manufactured in this country." Mr. Conrad Beck says, "there is no place in the whole of England where a man can learn optics in a way that is of any use to him for practical application to optical instrument making. . . . It is a positive fact that if I desire to employ a mathematician to work out my lenses, I cannot find any ready-made man in England." The German Government has not only endowed institutes where optics, among other subjects, is taught in a practical way, but has granted large sums of money "by which costly experiments on a manufacturing scale have been rendered possible."

Mr. Levinstein's presidential address to the Society of Chemical Industry has already been mentioned, and perhaps a short notice of some of the points in it may be of interest.

In directing attention to the unsatisfactory condition of our trade, he points out that in 1890 our total exports amounted to 328 million pounds. The average amount during the decade 1891–1900 was only 300 millions. That is to say, during these ten years we exported 280 million pounds' worth of goods less than we should have done if the figures for 1890 had been maintained. With Germany it is otherwise; in 1890 the total exports amounted to 3409 million marks, while the average for 1891–1900 was 3688 million marks. Germany has gone forward, we have gone back; this can hardly be called satisfactory. Mr. Levinstein suggests the following as some of the reasons why Germany has advanced so markedly:—

(1) Superior economy, thoroughness, *attention to detail.*
(2) The possession of a far larger number of thoroughly and systematically trained men than any other country (not men only trained technically, but with a thorough *general* training).
(3) A close alliance of legislation and of science with the interests of trade and industry—a result no doubt indirectly due to the high average of general education and training.
(4) A national system of railways and canals, with a scale of internal and external freights averaging less than one-third of our own.
(5) Cheaper skilled labour, *with longer hours than our own.*[1]
(6) A large supply of unskilled labourers, trained to habits of punctuality and discipline through a system of universal military service.
(7) Protective tariffs.
(8) A system of patent laws which takes the interests of the public as well as those of the inventor into consideration.

Some of these conditions obviously could not be introduced into this country, but Mr. Levinstein suggests the following four measures which he considers require immediate attention:—

(*a*) The appointment of a competent and expert Minister of Commerce.
(*b*) The nationalisation and extension of our canals and waterways.
(*c*) A measure for greatly extending and improving our secondary education.
(*d*) A sensible reform of our patent laws.

It does seem an anomaly that a commercial empire such as ours should be without a Minister of Commerce. The Board of Trade is so tied up with red tape and so steeped in routine that deputations upon trade and commerce often receive but scant attention, and have to be content with hazy assurances of good will which are often forgotten almost as soon as uttered.

Mr. Levinstein pays considerable attention to the question of freights. In France and Germany, the combined network of railways and canals enables merchandise to be carried at extremely low rates. Undoubtedly our railway companies might learn a good deal from America as to the handling and haulage of goods, by which means very considerable savings in the cost of transport could be made. But owing to the enormous cost of construction and over-capitalisation of our railways, even if all possible improvements were introduced and the boards of directors were business men and not appointed because of their social position, we could not compete on level terms with other nations. But how about our 4000 miles of canals? For years they have hardly been used at all, and many of them have become antiquated and are almost, if not quite, ruined. In contradistinction to our want of forethought, France, Belgium and Germany have been continually increasing and improving their canal system, and America, that land of restless energy, is building canals. Before the opening of the Erie Canal the cost of moving one ton of freight from Buffalo to Albany was 100 dollars; on the opening of the canal this immediately

[1] The tendency here seems to be a general shortening of hours and extra holidays to watch *others* playing games.

fell to 10 dollars. At present the cost of moving merchandise by canal from Buffalo to New York, a distance of 500 miles, does not, on the average, exceed one dollar, or four shillings per ton.

European States are devoting millions of money annually to the construction of canals and canalised rivers, with the result that it costs less to-day to bring sugar from Hungary, thousands of miles across Europe, to London than to carry the same sugar on our own railways from London to Manchester. Goods which can be carried from Hamburg to Berlin, a distance of 174 miles, at four shillings per ton cost eight shillings and fourpence per ton from Manchester to Liverpool, a distance of 30 miles. Cattle can be sent at less cost from Chicago to Liverpool (about 4000 miles) than from Northumberland to Liverpool. It costs more to send one ton of goods from London to the west of Ireland than from London to Japan. Denmark can send her dairy and farm produce to London at less cost for transport than can the English farmer living only 30 miles away in the home counties.

Mr. Levinstein calls for a reform of the patent laws. He attributes, as do many of the witnesses examined by the committee of the Technical Education Board, much of the success of the German manufacturer to the excellent and protective patent laws, which have been in operation since 1876. Yet though our patent laws leave very much to be desired, they do not directly, as Prof. Meldola points out, prevent discovery or originality. Indirectly they may do so, because if a man feels that his invention is not properly protected, he may give up working in disgust. In order that a patent may be valid in Germany, it is necessary that the article patented should be manufactured in Germany. We have no similar provision. It pays an inventor to manufacture in Germany and export to England better than to build extra works here, where British labour would be employed.

Admitting, however, that our patent laws are bad, our manufacturers narrow-minded and unscientific and our business methods lacking in enterprise, and that therefore we are, if not absolutely falling behind, barely holding our own in the markets of the world, we always come back to the fact, if we will but admit it, that all these causes may directly or indirectly be traced to our educational system or want of system.

The report of the Technical Education Board is so valuable that I should like to suggest that the County Council publish a digest of it in pamphlet form and circulate it among manufacturers in London. This may seem a rather large order, but how otherwise are these men, upon whom so much depends, to be reached?

F. MOLLWO PERKIN.

## *BIRD-PHOTOGRAPHY IN THE GARDEN.*[1]

ALTHOUGH he disclaims the title of naturalist and states that he knows nothing of photography, the author has contrived to produce a very entertaining little work, illustrated by reproductions from photographs which we have seldom seen equalled and rarely surpassed. They are, in fact—especially the full-page plates—ideal representations of the birds they portray, and ought to tempt the amateur photographer to try to do likewise—if he can. The object of the volume, like so many others at the present day, is to show the outdoor naturalist and bird-lover how full an insight he can obtain of the life-history and habits of his feathered favourites by portraying them in their natural haunts and surroundings. And with this end in view, he describes in some detail the type of camera and plates best suited for the purpose, and the mode of using them. His main difficulty appears to be to find a "shutter" which shall be sufficiently rapid in action, and at the same time not frighten the bird as it falls.

As the title implies, the author, in place of wandering far afield, has been content with the birds commonly met with in any English country garden, and he shows how much may be learnt that is more or less new even with regard to familiar species. Perhaps he would have been better advised had he refrained from saying that our knowledge of bird-anatomy is such that work is no longer needed in that branch of ornithology. Indeed, it is a great pity that field-naturalists and museum-workers are constantly in the habit of belittling one another's efforts; each has his appointed place, and the work of the one cannot be completed without that of the other.

The author restricts himself to ten species, five of which are tits, and he has something interesting to say about each. If we were asked to select the two best illustrations in a work in which all the pictures are charming, we should choose the page-plates of the pied flycatcher and redbreast. We reproduce one of the text-figures.

FIG. 1.—Robin Pausing at Food. (From "Birds in the Garden.")

R. L.

[1] "Birds in the Garden." By G. Sharp. Pp. xi + 190; illustrated. (London: J. M. Dent and Co., 1902.)

## *A NEW THEORY OF THE TIDES OF TERRESTRIAL OCEANS.*

MR. ROLLIN HARRIS has done so much good work in preparing his "Manual of Tides" for the United States Coast Survey that it is an ungrateful task to find oneself constrained to criticise adversely his recently published part iv. A. of that treatise.[1]

I shall pass over many points of interest which occur in the earlier portions of the book, because the discussion of them is apparently designed to lead up to a new theory of oceanic tides. That theory, to which I shall confine my attention, depends on a proposition that it is possible to dissect our oceans into a number of basins in which the oscillations are virtually independent of one another and are almost unaffected by the diurnal rotation of the earth.

We may, then, pass at once to chapter vi., where Mr. Harris considers forced oscillations in tanks, as impeded by friction. The waves are treated as long waves in which the water in any vertical slice always remains vertical, and the friction is assumed to be proportional to the velocity of the slice. These assumptions are open to criticism, but I will follow Mr. Harris in supposing that

[1] Reports of the U.S. Coast Survey. Parts i., ii., Appendices 8, 9, Report for 1897. Part iii., Appendix 7, Report for 1894. Part iv. A., Appendix 7, Report for 1900.