against." Evidence is always cropping up that the author is in the habit of going farther into a subject by original mathematical analysis than by reading up other people's work. I will give some examples. Speaking of a reference by Rankine to cubic asymmetry, he says :—"I only came across this in Rankine two or three days ago. But I remember going through the same thing myself not long ago, and I said to Stokes—I always consulted my great authority, Stokes, whenever I got a chance—'Surely there may be such a thing found to exemplify this kind of asymmetry; would it not be likely to be found in crystals of the cubic class?' Stokes—he knew almost everything—instantly said: 'Oh, Sir David Brewster thought he had found it in cubic crystals, but there was an explanation that it seemed to be owing to the effect of the cleavage planes or the separation of the crystal into several crystalline laminæ'" (p. 158). Then again he says :—"I am ashamed to say that I never heard of anomalous dispersion until after I found it lurking in the formulas. I said to myself, 'These formulas would imply that, and I never heard of it;' and when I looked into the matter I found, to my shame, that a thing which had been known by others for eight or ten years I had not known until I found it in the dynamics" (p. 120). Once more we find :—"I was thinking about this, three days ago, and said to myself, 'There must be bright lines of reflection from bodies in which we have those molecules that can produce intense absorption. Speaking about it to Lord Rayleigh at breakfast, he informed me of this paper of Stokes's, and I looked and saw that what I had thought of was there. It was known perfectly well, but the molecule first discovered it to me. I am exceedingly interested about these things, since I am only beginning to find out what everybody else knew, such as anomalous dispersion, and those quasi colours, and so on" (p. 282).

The purely physical bent of the author's reasoning is well shown in speaking of Rankine's work at p. 270: "I do not think I would like to suggest that Rankine's molecular hypothesis is of very great importance. The title is of more importance than anything else in the work. Rankine was that kind of genius that his names were of enormous suggestiveness, but we cannot say that always of the substance. We cannot find a foundation for a great deal of his mathematical writings, and there is no explanation of his kind of matter. I never satisfy myself until I can make a mechanical model of a thing. If I can make a mechanical model, I can understand it. As long as I cannot make a mechanical model all the way through, I cannot understand; and that is why I cannot get[1] the electromagnetic theory. I firmly believe in an electromagnetic theory of light, and that, when we understand electricity and magnetism and light, we shall see them all together as part of a whole. But I want to understand light as well as I can without introducing things that we understand even less of. That is why I take plain dynamics. I can get a model in plain dynamics, I cannot in electromagnetics. But so soon as we have rotators to take the part of magnets and something imponderable to take the part of magnetism, and realise by experiment Maxwell's beautiful ideas of electric displacements, and so on, then we shall see electricity, magnetism, and light closely united and grounded in the same system."

The model of an electromagnetic ether described by Prof. Fitzgerald on March 28 to the Physical Society, founded on Clerk Maxwell's celebrated papers in the *Philosophical Magazine* in 1860 and 1861, goes a long way to clear away the objection raised by Sir William Thomson.

In reading these lectures, it must be remembered that they are uncorrected *verbatim* reports, and one is surprised at seeing that the matter is so continuous and readable. A considerable freshness is given by the conversational interludes and remarks, which would not perhaps have appeared in a written work. As mentioned before, Sir William spoke of the pressural wave as an animal; this was very happy, as he had just before called it the *bête noir* of the mathematicians. He says at p. 34 :—"I do not like the words 'paradoxical phenomenon.' 'Curious phenomenon' or 'interesting phenomenon' would be better. There is no paradox in science. We may call it a *dynamox*, but not a *paradox*." At p. 115 he says :—The struggle of 1815 (that is not the same idea as *la grande guerre de* 1815) was, who was to rule the waves, Cauchy or Poisson?"

To many it will seem, after reading these lectures containing a review of what has been done and suggestions of what might be done, that certain facts are hopelessly irreconcilable with the wave-theory of light. Sir William Thomson has certainly not shirked a single difficulty, and perhaps has even made them look more glaring than is necessary. But, if this be an error, it is on the right side.

The reporter has introduced into the volume some doggerel rhymes read by a certain student of the lectures at a farewell dinner at Baltimore given by President Gilman :—

The Lament of the Twenty-one Coefficients at parting from each other and from their Esteem d Molecule

An æolotropic molecule was looking at the view,
Surrounded by his coefficients twenty-one or two,
And wondering whether he could make a sky of azure blue,
With plagiotatic *a b c* and thlipsinomic *Q*.

They looked like sand upon the shore with waves upon the sea,
But the waves were all too wilful and determined to be free;
And in spite of *n's* rigidity they never could agree
In becoming quite subservient to thlipsinomic *P*.

Then web-like coefficients and a loaded molecule,
With a noble wiggler at their head, worked hard as Haughton's mule;
But the waves all laughed, and said, "A wiggler, thinking he could rule
A wave, was nothing better than a sidelong, normal fool."

So the coefficients sighed, and gave a last tangential skew,
And *a* shook hands with *b* and *c*, and *S* and *T* and *U*,
And with a tear they parted; but they said they would be true
To their much-beloved wiggler and to thlipsinomic *Q*.

Signed, (g, f), A Cross Coefficient now Annulled

The social and scientific intercourse of these three weeks at Baltimore was an experience that will be forgotten by none of the twenty-one coefficients, and they all sympathised with Sir William Thomson in his concluding remarks at p. 289 :—

"I am exceedingly sorry that our twenty-one coefficients are to be scattered, but, though scattered far and wide, I hope we will still be coefficients working together for the great cause we are all so much interested in. I would be most happy to look forward to another conference, and the one damper to that happiness is that this one is now to end, and we shall be compelled to look forward for a time. I hope only that we shall all meet again in some such way. I would say to those whose homes are on this side of the Atlantic, 'Come on the other side and I will welcome you heartily, and we may have more conferences.' Whether we have such a conference on this side or on the other side of the Atlantic again it will be a thing to look forward to—as this is to look back upon—as one of the most precious incidents I can possibly have. I suppose we must say farewell!" George Forbes

[1] These reports are generally quite *verbatim*, but I am sure Sir William Thomson is not responsible for this characteristic Americanism.—G. F.

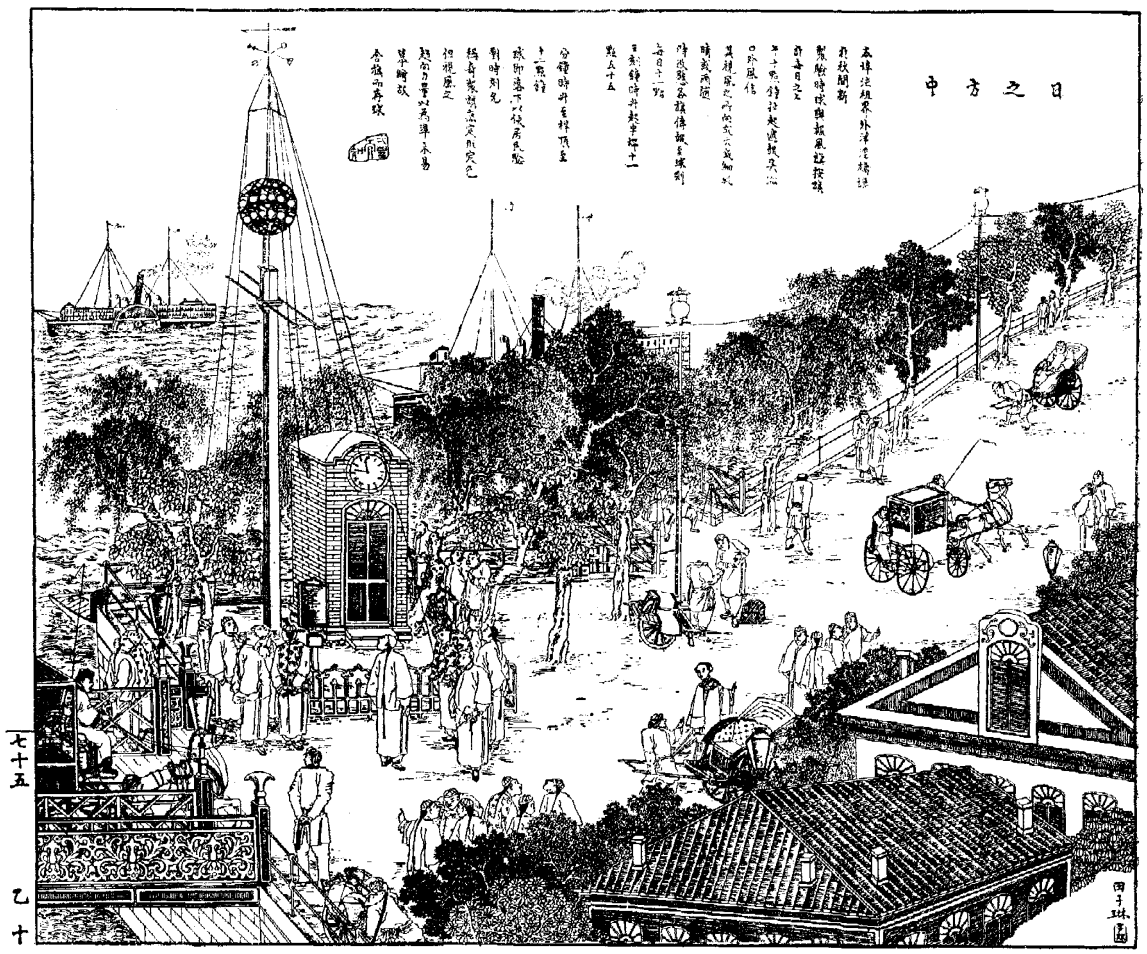
THE SEMAPHORE AND ELECTRIC LIGHT AT SHANGHAI

THE European and American community occupying the so-called foreign concessions in Shanghai has lately adopted the electric light. The illustration given

below is the reproduction of a Chinese drawing representing the light and a semaphore with a time-ball in the French concession. It is taken from *La Nature*, and originally appeared in a Chinese illustrated journal called the *Hu-pao*, which described the illustration in the following manner :—

"On the French concession, at the end of the settlements of the other foreign nations, a semaphore which marks the hour and the wind was erected last autumn. Every day at 10 o'clock a flag is hoisted which denotes the wind that is blowing on the sea at the mouth of the river. Every day at 11.45 a ball is raised to half mast, and five minutes before noon it is raised to the top. Precisely at noon it falls. In this way all the people of Shanghai can know the exact hour. The flags vary in form, in number, and in colour, according to the direction and force of the wind. Truly, it is a very good thing."

The illustration represents the semaphore to the left,



with the Chinese looking up at the ball which is about to be raised. The semaphore was erected on September 1, 1884, at a cost of 28,000 francs, by the French Municipal Council. It gives the hour at noon, and the force and direction of the winds at the mouth of the Yang-tsze-kiang. It is connected with the Zikawei Observatory, which receives the observations respecting the wind from Gutzlaff Island, at the mouth of the river, and which the director of the Observatory, Père Dechevrens, passes on by telephone to the assistant in Shanghai. The time-ball is in direct connection with Zikawei. The wires, poles, and lamps of the electric light are also noticeable in the illustration. The light, which was set up last year, appears for some reason not to be successful, and when the last mails left Shanghai the Municipal Council were in correspondence with the gas company with the object of coming to an arrangement for a return to lighting the streets with gas.

VARIABLE STARS

IN his stirring "Call to Friends of Astronomy" (*Schumacher's Jahrbuch*, 1844) to aid the advance of the science by taking up some definite department of work, Prof. Argelander, among other points for investigation, drew attention to the observation of variable stars as presenting a fascinating field of inquiry in which much valuable work might be done. Forty years have passed since this appeal was made. The list of eighteen stars visible in these latitudes then certainly known to be variable has grown to at least ten times the number, while a new "instrument of precision" has been placed in the hands of the observer in the form of the spectroscope, which has largely increased his powers. But, after all, it must be acknowledged that we are still greatly in ignorance of the causes which immediately underlie the striking phenomena which are presented to our view.

In taking a rapid glance at some of the phenomena with which we have to deal, it may be convenient to