peratures and the formation and decomposition of double salts. Although the present volume is a second edition of the work, yet the text is not free from misstatements. On p. 87 we are told that "when liquids mix in all proportions . . . then it is possible to make a complete separation of the constituents by a fractional distillation, provided the vapour pressures of the two differ," a statement which is afterwards contradicted by examples which are given of the different types of liquid mixtures. On p. 210 we are told that the ferrous ion is greenish-black in colour, and on p. 260 that all binary organic acids satisfy the dilution law of Ostwald. Misprints are also not uncommon and authors' names are not always correctly spelt, "Tammen" for "Tammann" and "Pebel" for "Pebal" being instances.

If, however, the defects here alluded to are remedied in the next edition, the book will, without doubt, serve as a very useful aid to students of physical chemistry.

H. M. D.

Practical Botany for Beginners. By F. O. Bower, Sc.D., F.R.S., and Dr. T. Gwynne-Vaughan, M.A. Pp. xi + 307. (London: Macmillan and Co., Ltd., 1902.) Price 3s. 6d.

THIS excellent little book, written by Prof. Bower in 1894, appears in a second edition after being subjected to careful revision. Mr. Gwynne-Vaughan now shares with Prof. Bower the author's responsibility. The more prominent changes are the adoption of the nomenclature introduced with the stelar conception and a more elaborate description of grosser morphological features. The number of seeds described is increased to eight Dicotyledons and three Monocotyledons, and more than twenty flowers are taken as types of these two groups. The main types remain the same, except that the elm gives place to the lime. Other additions are the stems of *Ricinus*, *Veronica Beccabunga* (aquatic Dicotyledon), *Elodea Canadensis* (aquatic Monocotyledon), and leaves of *Ligustrum*, *Hedera*, *Deschampsia* and *Phormium*. The paragraphs on reserve and transitory materials have been considerably added to and improved, so that suitable material and the necessary tests are given for demonstrating the presence of starch, proteids and various sugars in the vegetative parts and in seeds. Exception may be taken to certain types chosen—for instance, *Marchantia* and *Fucus*—but obviously the general occurrence of these has weighed with the authors in their choice. Passing to methods of manipulation, glycerine and chlor-zinc iodine are almost exclusively recommended as mounting media; in several cases, notably *Pinus*, double staining and mounting in Canada balsam would give better results, while mounting in water avoids undue swelling of the walls of phloem cells such as follows the use of glycerine and Schulze's solution.

The book is already so well known that it is unnecessary to emphasise the careful arrangement of subject and the clear descriptions which characterise it.

Quelques réflexions sur la mécanique suivies d'une première leçon de Dynamique. Par Émile Picard, Mem. Inst. France. Pp. 56. (Paris: Gauthier Villars, 1902.)

The first part is based on a report drawn up by M. Picard in connection with the Paris Exhibition of 1900 dealing with modern views on the principles of mechanics and in particular on the "energetic" method, and the dynamical system of Hertz. The second part consists of the first lecture given by M. Picard, since 1894, in his course on general mechanics, introducing the elementary principles of dynamics. It differs somewhat from the conventional treatment, and in this country Newton's third law will probably be regarded as constituting a less artificial definition of *mass* than is used by M. Picard.

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LETTERS TO THE EDITOR.

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Volcanic Eruption in Java, Brilliant Sunset Glows in 1901, and probable Glows from the Eruption in Martinique.

THE brilliant sky glows and sunsets following the eruption of Krakatoa, near Java, on August 26 and 27, 1883, threw a flood of light on the movements of the upper atmosphere in a way which was probably not otherwise possible. Up to that time it had been supposed generally by meteorologists that the air forming the trade winds ascended at the equator and turning toward the poles became a south-westerly current in the northern hemisphere and a north-westerly current in the southern hemisphere flowing over the trades. After the explosion eruption of Krakatoa, the large mass of observations gathered by the committee of the Royal Society and the admirable discussion of the optical phenomena by Russell and Archibald ("The Eruption of Krakatoa and Subsequent Phenomena," London, 1888) brought out the following facts:—

(1) The haze, sky glows and brilliant sunsets progressed from east to west three times around the world within the tropics at a rate of about seventy-five miles an hour.

(2) They spread northward and southward from 20° N. and 20° S. very slowly, taking from September 2 to about October 7 for the conspicuous phenomena to spread from 20° N. to 35° N. in America, a velocity of about one-half a degree a day, or one mile an hour.

(3) Above 35° latitude the progressive motion was rapid and apparently from the south-west in the northern hemisphere and from the north-west in the southern hemisphere.

There are two other important conclusions which I think may be drawn from the data, and these are:—

(1) The atmosphere between 20° N. and 20° S. moved with a nearly uniform velocity from the east; otherwise it would have been impossible to trace the movement of the dust cloud around the world three times, because a very slight difference in velocity or direction at different latitudes would very soon have destroyed the individuality of the cloud, whereas Russell's lines of first appearance are nearly parallel with each other between 20° N. and 20° S.

(2) There are frequent temporary disturbances in this region by which the air is carried rapidly outward in narrow belts into extratropical regions. One of these disturbances was shown on August 27, when the dust was carried rapidly to Japan, another on August 28, when dust was carried to South Africa, and another on September 1, when dust was carried to Santiago, Chili.

The movement of the atmosphere above the tropics established by this investigation differed so from that supposed to exist by meteorologists that it was sought to explain it as a temporary movement and not representative of average conditions. But Abercromby was so much impressed by the phenomena that he began to gather observations of the movements of cirrus within the tropics. These are published in the volumes of *NATURE* between 1887 and 1890. Hildebrandsson has pursued the subject farther, and his results show that in the equatorial regions between 20° N. and 20° S. the prevailing movement of the cirrus is from the east. North and south of these latitudes the directions change to a movement from the west. It is probable that between these two opposing belts of wind there is a nearly calm zone across which the air moves very slowly from the equator.

These facts are dwelt on in order to show the importance of such observations preliminary to calling attention to recent sky glows and volcanic eruptions.

In the autumn of 1901, Mr. Rotch, Mr. Sweetland and myself noticed independently that the sunsets were more brilliant than usual at Blue Hill (lat. 42° 13' N., long. 71° 7' W.), and the following notes were entered in the records of the Observatory:—"October 7.—Since about September 20 the sunsets on clear days, including to-day, have shown unusually bright colours, a bright red predominating and lasting near the horizon for three-quarters of an hour or longer; November 2, a very brilliant sunset, red prevailing, and the colours continued for about forty-five

minutes after sunset; November 3, a brilliant orange sunset after a very clear day."

These observations were recalled by the receipt within a few days of a pamphlet from Mr. T. F. Claxton on "The Recent Sunset and Sky Glows." This paper was presented to the Mauritius Meteorological Society on August 27, 1901.

The first few paragraphs are as follows:—

"The gorgeous sunsets and sky glows of the past three months recall those vivid displays of 1883 and 1884 which were associated with the disastrous volcanic eruptions at Krakatoa, in the Straits of Sunda, and it is not surprising to learn that toward the end of May of this year similar, though less serious, eruptions occurred in about the same locality, according to the following cablegram which appeared in the *Daily Graphic*:—

"Batavia, May 23, 1901.—The volcano of Keloet is in eruption. It is reported that there has been great loss of life among the natives. District of Kediri enveloped in total darkness."

The sunset glows at Blue Hill followed this eruption, and the sky glows at Mauritius after about the same interval as similar but more brilliant glows in these latitudes followed the eruption of Krakatoa. It would be extremely interesting to know if there are observations at intervening places. We should be glad to receive notes of such at the Blue Hill Observatory, Hyde Park, Mass., U.S.

I wish also to call attention to the recent violent volcanic eruption in the island of Martinique, and suggest that observers be on the watch for the earliest optical phenomena. We should be glad to receive notices of such observations. There were some marked barograph undulations at Blue Hill on the morning of May 7 which are perhaps connected with this volcanic eruption.

HENRY HELM CLAYTON.

Blue Hill Observatory, Hyde Park, Mass., May 10.

A Method of Showing the Invisibility of Transparent Objects under Uniform Illumination.

As is well known, a perfectly transparent object is visible only in virtue of a variable illumination. This condition might be approximately realised, as Lord Rayleigh points out in his article on "Optics" in the "Encyclopedia Britannica," on the top of a high monument in a dense fog. It is doubtful, however, if the experiment would be very successful even under these conditions, as the observer's body screens the light in certain directions, making the illumination far from uniform. The following method I have found to give very good results:—

The inside of a hollow sphere of metal, which can be separated into two cups, is thickly coated with Balmain's luminous paint. A small hole, not much larger than the pupil of the eye, enables the observer to view the interior and any objects within the sphere. I used for the sphere one of the metal floats which are used as automatic regulators in water tanks, and which can be obtained from any plumber. The float was made in two parts, which were easily separated by melting the solder. It is rather difficult to get a good uniform layer of the paint. Several coats are required, and even then it is apt to appear streaky in the dark. I am inclined to think that a better plan would be to mix the dry powder with boiled down Canada balsam, which will harden on cooling, and coat the outside of two glass hemispherical evaporating dishes with the hot mixture. The lips of the dishes would make the eye-hole. This mixture I have found produces much more uniform surfaces, and I am employing it at the present time in some experiments in infra-red photography.

If the inner surface is exposed to sunlight, and a transparent object such as a glass or crystal ball, a thick lens or a cut glass decanter stopper is put in the interior, it will be found to be practically invisible when viewed through a small hole, for light of equal intensity is incident in every direction. I have found that a large stopper with many facets does not quite disappear, some of the edge facets appearing darker than the diffused blue glow which fills the interior of the ball. This I believe to be due to the fact that the light reaching the eye from these facets by refraction happens to have undergone several internal reflections and suffered a loss by absorption owing to a long path through the glass. The luminosity of the interior of the sphere is not quite uniform, however, and this may be sufficient to explain the appearance of these facets. The observation is best made in a darkened room, the eye being brought close up to the small aperture.

Since writing the above I have tried the balsam mixture on

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the outside of hemispherical glass dishes. It is, however, better to scratch a small hole in the paint than to attempt to use the lips of the dish as an aperture, as in the latter case the line of union, which is always slightly darker than the rest of the surface, cuts directly across the field of view, which is a disadvantageous arrangement.

R. W. WOOD.

Johns Hopkins University, Baltimore.

Misuse of Coal.

THE tone of Prof. Perry's letter in reply to Mr. Rosenhain is so acquiescent that it may seem to diminish the force of his original contention as to the national misuse of our stock of coal. There are two considerations which ought to be stated in reply to the plea that men may learn to grow their fuel as they go on, by a proper cultivation of the best vegetation.

The first is this. The soil will not long continue to yield food if it be asked to provide fuel also. About three years ago Sir W. Crookes devoted his address, as president of the British Association, to the consideration of the present position of the world's food-supply question, and arrived at the conclusion that the outlook was not far from a gloomy one.

In that conclusion he was but echoing Malthus, though with much better data and a more complete record as to what were in Malthus' day unexplored countries.

If examination of the food-yielding powers of the soil leads to such a result, it is evident that to add an additional demand for fuel will seriously injure both. Even though Malthus and Sir W. Crookes be only partially right, enough is left to prevent us getting any long-lived satisfaction by growing fuel. There remains the possibility of "intensive" cultivation, and this may be one form of the new engine Prof. Perry asked scientific men to look for. Already Lord Rayleigh has made a bold attempt to make this economically possible by preparing nitric acid from the air. Perhaps with the resources Prof. Perry asked for, Lord Rayleigh might succeed.

The second point is this. Prof. Perry's concern was mainly for British resources. The economic life of a large proportion of our people is bound up with an economic advantage in fuel and other minerals. Every scientific discovery which raises the efficiency of transformation from coal fuel to mechanical power helps to defer the day in which England's mineral endowment will no longer be exceptional. The moment that oil or other natural fuel can compete with coal in the open markets, our prosperity must begin to decline. Similarly, if fuel can be grown to compete with coal, we lose position, simply because we cannot expect to grow so easily and well as many other countries.

The motive impelling towards a constant search for improved efficiency in the use of coal is therefore doubly strong on our people and Government. Any improvement would be helpful to the whole world; for us it would defer a calamity, possibly for a very long time.

W. HIBBERT.

101 Goldhurst Terrace, N.W., May 20.

The Conservation of Weight and the Laws of Thermodynamics.

IN NATURE of May 15, Lord Rayleigh uses the laws of thermodynamics to prove the conservation of weight.

In regard to the doctrine of the conservation of energy (the first law of thermodynamics) the following statement is made in Maxwell's "Theory of Heat," p. 145, tenth edition: "The evidence which we have of the doctrine is nearly if not quite as complete as that of the conservation of matter."

Taking this passage to imply that the two doctrines, conservation of weight and of energy, are to be held true as far as experiment has proved them true, and no farther, the question arises—To what extent have the laws of conservation been proved?

The experiments of Landolt (1893) and of Heydweiller (1901) show that the conservation of weight holds, in the cases investigated by them, to one part in one hundred thousand. The accuracy of the law to one part in a million is left under suspicion.

Energy being more difficult to measure than weight, it is unlikely that the conservation of energy has been proved to one part in one hundred thousand. At the present time, would not Maxwell say, "The evidence which we have of the conservation of energy is not as complete as that of the conservation of weight"?