attach valency values to the metals is carried out in all cases with the exception of iron, to which no value is affixed. The reason for this omission is not obvious, as the author does not hesitate to call lead a dyad, antimony a triad, &c. Amongst minor points the use of potassium antimony tartrate for potassium antimonyl tartrate, of arsenic acid for arsenic pentoxide, may be noticed.

The book may go some way to fulfil the author's expectation that it will give the student "some acquaintance with the art of test-tubing," but that it will materially increase his knowledge of the principles of practical chemistry, or sharpen his appreciation of the *raison d'être* of a chemical process, is another matter.

Manual of Pharmaceutical Testing. By Barnard S. Proctor, F.I.C. Pp. vii., 176. (London: *The Chemist and Druggist*, 1890.)

THIS book is a collection of tests suitable for ascertaining the purity of the chemicals of the British Pharmacopœia, &c. The tests described are the simplest possible, and can be carried out with the apparatus and chemicals in use at the dispensing counter. They apply more especially to the impurities of manufacture than to adulterations. In many cases they are simply those recommended by the British Pharmacopœia for determining if the purity of a material falls short of the required standard. As a rule they are qualitative, and sufficiently accurate for the purpose in view, although quantitative methods, more especially in determinations of solubility, or fixed residues of volatile liquids, are employed. The book contains a chapter on manipulation, which includes the method of weighing precipitates, and an index, and will be found a handy volume to the pharmacist.

The Encyclopædia of Photography. By Walter E. Woodbury. (London: Iliffe and Son, 1890.)

THIS work, which will be concluded in about twelve parts, is written on the same lines as other photographic encyclopædias, but treats especially of the sciences of optics and chemistry. The art of photography being so largely practised nowadays, it is curious what a small percentage of those who have taken it up know anything about optics or chemistry, which form the basis of the whole subject.

Throughout the book the author has borne this well in mind, and has spared no pains to place before the reader, in a simple and clear manner, the principles underlying the formation of images, the construction of lenses, chromatic and spherical aberration, the theory of atoms and molecules, and many other very important points relating to optics and chemistry.

The illustrations, which will be about 200 in number, consisting of explanatory sketches and diagrams, will be found, if up to the standard maintained in this first part, to serve their purpose well.

For amateurs this encyclopædia should be very useful, as it is written especially for beginners, and some of the most complicated terms likely to lead to confusion are avoided as much as possible.

Dynamics for Beginners. By the Rev. J. B. Lock, M.A. Third Edition, stereotyped. (London: Macmillan and Co., 1890.)

THE author has fully succeeded in supplying the want that has been long felt, of a book which should explain the elementary principles of dynamics, illustrating them by easy examples in a manner suitable for use in schools with boys of ordinary mathematical attainments.

Section I. deals with rectilinear dynamics, in which the fundamental principles are explained. The words "velo" and "celo," abbreviations for unit velocity and unit acceleration respectively, are here used, and the author

says in the preface, "Of their value for the purposes of teaching and explanation I have received the very strongest testimony from those best qualified to judge."

Sections II. and III. treat of "Direction" and "Illustrations," the former dealing with the parallelograms of distances, velocities, and accelerations, chords of quickest descent, &c., the latter with projectiles, oblique impact, relative motion, hodograph, &c.

Work, energy, power, are discussed in Section IV., and there is a chapter on the indestructibility of matter.

An excellent set of examples is collected at the end, and a series of examination papers is added, taken from the various examinations held from time to time at Oxford and Cambridge.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.]

"The Climates of Past Ages."

I FEEL somewhat disappointed not to see a flood of correspondence in your pages arising out of Dr. Neumayr's very interesting lecture on the climates of past ages. The subject is difficult and complex, and the factors of the problem are no doubt various and of different kinds. I wish to make a few remarks on some of these.

It seems impossible to doubt that the sun is losing heat; and, consequently, that the quantity of heat annually received by the earth from the sun is less than it once was. Now, one of the most remarkable of the facts before us is the evidence, from fossil vegetation, of comparatively warm climates in the polar regions. There is no similar evidence respecting the equatorial regions; but it is probably impossible that such evidence should be preserved, so that its absence proves nothing as to the equatorial climate of the same period; but it is worth noticing that, if we suppose the force of solar radiation increased, the increase of terrestrial temperatures will be greater in high than in low latitudes, because, with the increased quantity of heat received into the atmosphere, an increased quantity will become latent by evaporation in the lower latitudes, and will be carried to the higher latitudes by vapour-bearing winds.

If our planet had neither atmosphere nor ocean, the temperature of the higher latitudes could be raised only as a direct result of increased solar radiation. If it had an atmosphere but no ocean, the increase of the temperature of the higher latitudes would be assisted by heat-bearing winds; and this would be at the expense of the temperature of the lower latitudes, which would be lowered by the heat so carried away. In the actual case of our earth, with both atmosphere and ocean, this action will be greatly increased by the power of vapour-bearing winds to carry heat in the latent form, which again becomes sensible heat on the condensation of the vapour. This appears to show that a considerable increase of temperature might be produced in the higher latitudes by a comparatively small increase in the force of solar radiation.

Dr. Neumayr says that the cause of the glacial climate is quite unknown; and at the same time he asserts that both hemispheres—the northern and the southern—were glaciated at the same time. I dispute both of these opinions. I think Mr. Croll has shown the direction in which the explanation of the glacial climate is to be sought; and if this is so, the two hemispheres were not glaciated at the same time, but alternately.

If, during a glacial period, the northern and the southern hemispheres were each alternately glaciated for geologically short periods, this would account for the fact mentioned by Dr. Neumayr, that the glacial period appears not to have been continuous, but interrupted by periods of milder climate. Croll's theory accounts for this. His theory is, that glacial periods occur at those astronomical epochs when the eccentricity of the earth's orbit is at its greatest; and a glacial climate is produced in the two hemispheres alternately, according as the

summer of each hemisphere is in perihelion or in aphelion. This, in consequence of the precession of the equinoxes, will occur at intervals of about 25,000 years. That is to say, if in either hemisphere the summer is now in perihelion, at the end of 12,500 years its summer will be in aphelion, and in 12,500 years more it will be in perihelion again. Mr. Croll maintains that glaciation occurs in the hemisphere where there is perihelion summer and aphelion winter, because of the intense cold of such a winter. I think, on the contrary, that the facts of climate which come under our observation show that winter cold has little or no effect in producing glaciation; and that a cold summer, which leaves the winter snow unmelted, is the most favourable condition for glaciation. Such is the climate of the Antarctic continent now. It is obvious that a summer in aphelion, when the eccentricity of the earth's orbit was many times greater than now, must have been a very cold summer.

This theory of the glacial climate appears perfectly satisfactory. The astronomical cause is known to exist, the geological effects are known to exist, and the effect is that which the cause must necessarily produce.

Even if it were true that a glacial climate prevailed in both hemispheres at the same time, no geological evidence could prove such a fact. No geological evidence could tell whether glacial mounds in Norway and in Patagonia, for instance, were strictly contemporary, or separated in date by an interval of 12,000 years.

Dr. Neumayr appears to retain the old notion that changes of climate may be to some extent due to changes in the position of the earth's poles. I am no mathematician, and cannot speak on such a subject with any authority, but Sir William Thomson believes he has proved that the earth is for all dynamical purposes perfectly solid and rigid; and I should think that the axis of rotation of a perfectly rigid oblate spheroid is unchangeable.

Belfast, July 10.

JOSEPH JOHN MURPHY.

The American Meteor.

I RECEIVED the following observations from my son, G. S. Henslow, who witnessed the fall of the meteor referred to lately in NATURE. I forward it, as it may perhaps interest some of the readers of this journal.

"The meteor fell about 5 p.m., and divided in mid-air, part of it falling in Minnesota near a town called Kasota; this portion was not found. The other and larger piece fell near Butt City, Iowa. The two places are about a hundred miles distant. It exploded on reaching the ground into myriads of fragments, a number of which have been picked up and sold at fabulous prices. The State University of Minnesota bought the largest piece. It fell on the open prairie, but broke into such small fragments that the surrounding soil was scarcely disturbed at all. We all saw it fall here at Windom. It illuminated the southern sky, and left a cloud resembling the smoke from the funnel of an engine. On bursting, there was a sound like a sharp peal of thunder."

G. HENSLOW.

SPONTANEOUS IGNITION AND EXPLOSIONS IN COAL BUNKERS.

AT the Royal United Service Institution, on Friday, July 4, a paper on this subject was read by Prof. Vivian B. Lewes, Royal Naval College. Rear-Admiral N. Bowden-Smith was in the chair.

The lecturer, after premising that in the fast ocean steamers it is now becoming an event of frequent occurrence for the contents of the bunkers to spontaneously ignite, whilst in the Service such a thing as fire in the bunkers is practically unknown, and an occasional, although fortunately very rare, explosion of gas is the worst trouble which the coal stores of our naval monsters have given rise to, directed attention to the causes which give rise to the so-called "spontaneous ignition of coals," and traced the particular circumstances which tend to increase the tendency to it.

The pyrites or coal brasses present in the coal when exposed to dry air undergo little or no change, but when moisture as well as air is present they absorb oxygen and

combine with it, forming sulphates of iron, and the ordinary explanation of the spontaneous ignition of coal is that this process of oxidation causes a rise of temperature in the coal which determines its ignition; this, however, has of late years been much doubted, and it can now be proved that the pyrites when present in ordinary quantities are perfectly incapable of doing more than adding slightly to the general rise of temperature, although when present in very large masses they may increase the tendency of the coal to spontaneous combustion by swelling during oxidation, and causing the coal to crumble, and also by setting free sulphur, which, having a lower melting-point of ignition than coal (482° F., or 250° C.) would lower the temperature at which the mass would catch fire.

The real causes which give rise to heating and ignition in any large accumulation of coal are twofold. First, the absorption of oxygen from the air by the carbon; and secondly, the chemical action set up by the absorbed oxygen with the hydrocarbons of the coal.

The most important point to be noticed is the extraordinary effect which initial temperature has on the rapidity of chemical actions of this kind. At a low temperature, and indeed up to about 100° F. = 38° C., the absorption of oxygen, and consequent chemical action, will go on slowly with practically little or no chance of undue heating taking place, but directly the temperature exceeds 100° F., then, with some classes of coal, ignition is only a question of time and mass.

Although the ignition point of various coals lies above 700° F., yet if many of these coals are powdered, and are placed in perforated zinc cases in masses of 2 lbs. or upwards, and these are kept at a steady temperature of about 250° F. in an oven, ignition will generally follow in a few hours; whilst between this and 150° F. it will take days instead of hours for the same result to follow, and at ordinary English temperatures several thousand tons of coal would have to be stored in a very broken condition before any risk of heating or ignition would ensue. In considering this question with regard to coal bunkers, it must be remembered that, although the considerations which had to be taken note of in the case of coal-laden ships still exist, yet they are considerably modified by the smallness of the amount of coal carried, and by the methods of loading and storage employed.

Liability to spontaneous ignition increases with:—

1. *The increase in the bulk of the cargoes.*—Evidence given before the Royal Commission of 1875 showed that in cargoes for shipments to places beyond Europe the cases reported amount to $\frac{1}{4}$ per cent. in cargoes under 500 tons; in cargoes from 500 to 1000, 1 per cent.; 1000 to 1500, to 3.5 per cent.; 1500 to 2000, to 4.5 per cent.; and over 2000 tons, to no less than 9 per cent. Mass influences this action in two ways:—

(a) The larger the cargo, the more non-conducting material will there be between the spot at which heating is taking place and the cooling influence of the outer air.

(b) The larger the cargo the greater will be the breaking-down action of the impact of coal coming down the shoot upon the portions first loaded into the ship, and the larger thereby the fresh surface exposed to the action of the air.

2. *The ports to which shipments are made* (26,631 shipments to European ports in 1873, resulting in only ten casualties, whilst 4485 shipments to Asia, Africa, and America gave no less than sixty).—This startling result is due to the length of time the cargo is in the vessel, the absorption and oxidation being a comparatively long action, but a far more active cause is the increase of temperature in the tropics, which converts slow action into a rapid one.

3. *The kind of coal of which the cargo consists* (some coals being especially liable to spontaneous heating and ignition).—There is great diversity of opinion on this