with numerous analyses of soil which give to this part a great importance for agriculture. The third part deals with erratic blocks as to their composition and origin; the fourth part describes subsoils, and contains a description of Lake Leman.

JURASSIC ROCKS OF THE ALTAI MOUNTAINS.—According to the researches of M. Schmalhausen, noticed in the *Memoirs* (*Troudy*) of the St. Petersburg Society of Naturalists, vol. x., the fossils of the Kouznetzk Carboniferous basin in the Altai Mountains, which fossils were described until now as palæozoic by Göppert in Tchikhatcheff's "Travels," by Eichwald, and by Heinitz in Cotta's "Altai," are identical with the Jurassic (Bathonian) plants which Heer has recently described in the Jurassic Flora of Eastern Siberia and Amour. M. Schmalhausen describes them as *Phyllothera, Asplenium whitbiense tenuis, Pterophyllum inflexum, Podozanistes lanceolatus,* Lindl., *Brachyphyllum,* and *Czekanowskia rigida,* Heer.

MIOCENE FLORA.—In his work, "Die Miocene Flora von Sakhalin," just published by the St. Petersburg Academy of Sciences, Prof. Schmidt describes 74 species of plants he has discovered, of which 43 were formerly known in other countries, and 31 are new; 27 are identical with Arctic Tertiary plants, 25 with Swiss, 18 with those of Alaska, and 21 with those of North America. The eighteen Alaska species are the most common of the Sakhalin Miocene flora, which circumstance, as well as the intermediate characters of the Tertiary flora of Kamchatka, is a new argument in favour of Asia, having formed, with America, one continent at this geological period. It is important to observe that the Tertiary flora of Sakhalin has more likeness to that of Greenland, of Spitzbergen, and of Switzerland, than to that of Central Siberia; thus, out of the eighteen species of Tertiary plants discovered by M. Lopatin on the banks of the Choulym River (not far from Krasnoyarsk), none were found among the Miocene fossils of Sakhalin, whilst the Tertiary flora of the southern shores of Lake Baïkal is very like that of Sakhalin and of Alaska. To explain these differences Prof. Schmidt supposes that the fossil plants which are all described by Heer as Miocene ought to be considered as belonging to an older substage, all the more that the Sakhalin plant-beds are very intimately connected with the marine chalk which they concordantly cover.

CHEMICAL NOTES

THE influence of sewage on potable waters is again being discussed. Herr R. Emmerich—in *Bied. Centralblatt*—makes an original contribution to the subject. He has for a long time daily drunk from a half to one litre of water from one of the Munich brooks which receives sewage of every kind; he has satisfied himself that there were cases of typhoid in some of the houses which drained into the brook. No bad effects having followed the consumption of this beverage, Herr Emmerich invites other experimenters to pursue investigations similar to his own! The same observer, however, finds that sewage water produces death in rabbits when injected subcutaneously in quantities of from 6 to 60 c.c., rabbits of a similar size being killed by the injection of 200 c.c. of distilled water. The injection of the residue from the evaporation of 500 c.c. of sewage water produced strong convulsions and death in rabbits. He proposes that suspected water may be examined by injecting 40 to 80 c.c. under the skin of a full-grown rabbit; if no rise of temperature greater than 1° occurs, or if death does not quickly follow the injection, the water would probably be uninjurious to human beings drinking it.

CITRIC acid has been formed synthetically by Grimaux and Adam. The process, which is described in the *Comptes rendus,* consists in forming dichloracetonic acid $CH_2Cl—COH\langle{CO_2H \atop CH_2Cl}$ from symmetrical dichloracetone, itself produced from glycerin through the intermediate stage of dichlorhydrin. By saponifying, by means of hydrochloric acid, the sodium salt of dichloracetonic acid, citric acid is produced; this synthesis confirms the generally accepted structural formula of citric acid.

DOUBT as to the elementary nature of sulphur is expressed by Th. Gross because of recent experiments wherein he claims to have produced a black, nonoxidisable, chemically indifferent substance by heating perfectly pure sulphur with linseed oil, dissolving the product in sulphuric acid, and precipitating by sulphuretted hydrogen.

THE influence of very small quantities of foreign substances in modifying processes of chemical change is a subject of much interest to the chemist, although as yet no full explanation has been given of this class of phenomena. In the course of his researches at high temperatures Victor Meyer has given one or two instances of such reactions. Thus he finds that ferric chloride, aluminium chloride, and zinc chloride are decomposed with evolution of chlorine at much lower temperatures when the vapour-density apparatus is previously filled with nitrogen gas than when no foreign gas is present. Meyer cannot trace any connection between the temperature, or amount of decomposition, and the chemical nature of the foreign gas.

THE long-protracted discussion between Berthelot and Wurtz regarding the dissociation of the vapour of chloral hydrate appears at length to be closed; Berthelot admits in the *Comptes rendus* that the vapour is partly dissociated at 100°, and that if the pressure is small the dissociation is probably complete.

AN interesting experiment, and one likely to lead to further results, is described by Berthelot in the *Comptes rendus.* He finds that such unstable compounds as ozone, hydrogen peroxide, &c., are not affected by sonorous vibrations of the rapidity of 100 and 7,200 per second.

M. MEUNIER claims, in *Comptes rendus,* to have produced spinel crystals, and thinks he has also produced periclase and corundum by the action of steam on aluminium chloride, at a red heat, in presence of magnesium.

AMONG other results accruing from V. Meyer's recent determinations of vapour densities is the addition of six or eight substances to the small list of gaseous metallic compounds. From the densities, and analyses, of these compounds the following numbers may be deduced as representing the *smallest possible valency* of the element placed opposite each number:—Arsenic, 2; cadmium, 2; copper, 2; iron, 4; indium, 3; tin, 2; zinc, 2. The formula of stannous chloride is shown by Meyer to be Sn_2Cl_4 at about 700°, but $SnCl_2$ at 900°. Hence the valency of tin varies at different temperatures.

IN the last number of the *Berliner Berichte* an attempt is made by Wiebe to trace a connection between the atomic weights of elements and the molecular weights of carbon compounds, and the coefficients of expansion of the same substances. He shows that for many elements the ratio between the reciprocal of the number obtained by multiplying the atomic weight of an element into the mean coefficient of cubical expression from 0° to 100°, and the heat required to raise unit weight of the same element from absolute zero to the melting-point, is a nearly constant number. For elements crystalising in the regular system the mean value of the constant is 2·6; other elements show considerable divergences. For certain classes of carbon compounds the following equation is shown to hold : $\dfrac{A . a}{d}. T = n.$ const., where A = molecular weight, a = mean cubical expansion from 0° to 100°, d = density of liquid compound, T = absolute boiling-point, and n = number of atoms in the gaseous molecule of the compound. The constant for the fatty acids and ethereal salts is from 3·1 to 3·8.

IN the *Proceedings* of the Asiatic Society of Japan R. W. Atkinson gives the results of his analyses of several Japanese porcelain clays; these results show that the opinion of H. Wurtz, viz., that Japanese porcelain is prepared from decomposed felspathic rocks alone, without admixture of kaolin, is not generally correct. Many of the clays analysed by Atkinson contained from 54 to 59 per cent. of silica, with 26 to 32 per cent. of alumina; others again contained from 73 to 79 per cent. of silica. In the clays exhibited in the Philadelphia Exhibition Wurtz found only one containing less than 74·5 per cent. of silica.

IN a series of papers by Nilson, and by Nilson and Pettersson, in the last number of the *Berliner Berichte,* important additions are made to our knowledge of the rarer earth metals. The existence of ytterbium seems proved. The atomic weight of this metal is 173 (mean of seven closely-agreeing determinations), assuming the formula of the oxide to be Yb_2O_3. The chief reasons for this formula are the isomorphism and general analogy of the sulphates of ytterbium, erbium, and didymium; the close analogy between the selenite of ytterbium and the selenites of metals which form oxides of the formula M_2O_3, and the molecular heat and molecular volume of Yb_2O_3 compared with the same constants for the group M_2O_3.

REASONS are given for adopting the formula of scandium oxide as Sc_2O_3, and the atomic weight of scandium is determined to be 44·0 (mean of four closely-agreeing results). Scandium is undoubtedly identical with Mendelejeff's ekabor.

THE specific heat of beryllium has been determined by Nilson and Pettersson. Between 0° and 100° the specific heat is 0·4246; between 0° and 300°, 0·5060. These chemists have likewise made a new determination of the combining weight of beryllium, and find it to be 4·55, which is a very little less than the number found by previous observers. They think that the atomic weight of beryllium is undoubtedly 13·65, and not 9·1, as generally supposed; oxide of beryllium is therefore Be_2O_3, and this metal is not to be placed, in Mendelejeff's system, as the first member of the magnesium group. Neither can beryllium form the first member of the aluminium group, as suggested by Lothar Meyer. Nilson and Pettersson detail many facts which lead them to regard beryllium as the first member of the group of cerite and gadolinite metals, which comprises the metals, Be, Sc, Y, La, Ce, Di, Tr, Y_α, Y_β, Soret's x, Er, Tu, Yb. The paper contains many most important chemical and physical data concerning the salts of the metals of this group.

FROM the specific heats of the oxides of beryllium, scandium, gallium, indium, and aluminium, the specific heat of oxygen in combination is deduced by Nilson and Pettersson as being 2·3 to 3·1; the mean specific heat of oxygen in combination is 4·0; the oxides named are therefore somewhat anomalous.

THE "molecular volume," *i.e.*, $\dfrac{\text{molecular weight of gas}}{\text{sp. gr. of solid}}$, of the various molecules of water of hydration has been recently shown by Thorpe and Watts to vary in the magnesium group of sulphates; Nilson and Pettersson obtain nearly the same number (8·5) as representing the mean volume of each water-molecule in the sulphates of yttrium, erbium, and ytterbium; but a somewhat larger number (11·5) for the mean volume in the sulphates of cerium, lanthanum, and didymium.

PHYSICAL NOTES

IN liquids small particles often show dancing motions under the microscope, and similar motions have been attributed to dust-particles in air, and accounted for by the shock of molecules with the particles. In a recent paper treating fully of the movements of very minute bodies (*Münch. Ber.*, 1879, p. 389) Herr Nägeli calculates from data of the mechanical theory of gases as to the weight and number and collisions of molecules, the velocity of the smallest fungus-particles in the air that can be perceived with the best microscopes, supposing a nitrogen or oxygen molecule to drive against them. It is, at the most, as much as the velocity of the hour-hand of a watch, since these fungi are 300 million times heavier than a nitrogen or oxygen molecule. The ordinary motes would move 50 million times slower than the hour-hand of a watch. Numbers of the same magnitude are obtained for movements of small particles in liquids. In both cases a summation of the shocks of different molecules is not admissible, as the movements are equally distributed in all directions. Herr Nägeli therefore disputes the dancing motion of solar dust-particles, and attributes the Brownian molecular motion to forces active between the surface-molecules of the liquid and the small particles; but he does not say how he conceives of this action.

THE absorption of heat-rays by powders has been lately investigated by Herr van Deventer (*Inaug. Diss. Leid.*, 1879, p. 78, or *Wied. Beibl.*, 6) without use of any binding material. Under a copper cube kept at 100° was brought a thermo-element consisting of a brass plate, on the lower side of which was soldered a piece of bismuth and antimony (parallelopiped shape). On the plate was strewn the powder to be examined. A second similar element, with thermo-element lampblacked, served for control. Briefly, the results were these: (1) Powdered substances in the same physical state have different absorptive power; (2) this depends on the thickness of the absorbing layer: each powder has its maximum absorption layer; (3) quite comparable values for the absorption cannot be had, as the thickness of the powder layer cannot be exactly determined; (4) the divergences proved in Tyndall's results with different binding materials are attributed to his not having taken into account the maximum emission layer; (5) whether the binding material affects absorption, and if so, how, can be demonstrated by the author's method (the element being painted over with the liquid holding the powder in suspension): but experiments are here wanting; (6) the author's series of powders arranged according to absorption is quite different from Tyndall's emission series.

DR. PULUJ observes that if an electric radiometer is worked for some minutes and then the circuit is broken, a reversed motion is immediately set up, which continues for four or five minutes with an enormous rapidity. This he explains by assuming that there are really two actions tending to produce rotation: the electric reaction between the vanes and the molecules, and the heating of the metallic side of the vanes; that these two actions oppose one another, but that at small pressures, such as the high vacua, the electrical forces are in excess. When however they are brought to an end the heat-forces assert themselves, producing the opposite rotation.

FROM recent experiments (described in *Wied. Ann.*, No. 7) Herr Heitz concludes that the kinetic energy of the electric current in 1 cubic millimetre of a copper conductor, traversed by a current of unit electromagnetic density, is less than 0·008 milligramme-millimetre. As the kinetic energy is equal to half the mass multiplied by the square of the velocity, the mass of the positive electricity in 1 cub-mm. is $< \dfrac{0·008 \, mg.}{v^2}$. *E.g.*, if $v = 1$ mm., 10 mm., &c., the mass of the positive electricity $< 0·008$ mg., $< 0·00008$ mg., &c. The limits here assigned, however, are exceeded where the densities of the electricity in the materials used are as their conductivities. (The experiments were made both with straight wires and with spirals, the former giving the more reliable results.)

THE results of theory regarding stationary vibrations of water are, in a recent paper (*Wied. Ann.*, No. 7) by Herr Kirchhoff and Herr Hansemann, compared with those of experiments in which a prismatic glass vessel, whose vertical cross-section consisted of two straight lines meeting at a right angle and equally inclined to the vertical, formed part of a pendulum, and was vibrated by electromagnetic means about that angle as axis. In the *Journal de Physique* (June) M. Lechat studies the surface vibrations of a liquid in a rectangular vessel, a small vertical rod having been adjusted to any point of the surface, and vibrated in the direction of its length by an electro-magnetic arrangement. The resultant forms were thrown on to a screen by means of a reflected beam of light.

IN a recent paper to the Belgian Academy (*Bull.*, No. 5) Abbé Spée contends that the spectral line D_3, with wave-length about 588, observed in the chromosphere and protuberances, and assigned to a hypothetical body, helium, which some suppose to have a still more simple molecular constitution than hydrogen, probably belongs in reality to this gas. As to its non-reversibility, he considers that at a very small distance from the chromosphere the solar hydrogen may be so far cooled as to be comparable to that which we manipulate, and so, unable to extinguish waves which it can no longer produce, just as a stretched cord loses the property of vibrating in sympathy if its tension have been altered.

PURSUING his researches on the welding of solid bodies by pressure, M. Spring has subjected to various strong pressures (up to 10,000 atm.) more than eighty solid pulverised bodies; this was done in vacuo, and in some cases at various temperatures. The results are highly interesting. All the crystalline bodies proved capable of welding, and in the case of bodies accidentally amorphous the compressed block showed crystalline fracture; crystallisation had been brought about by pressure. Softness favours the approximation of the particles and their orientation in the direction of the crystalline axes. The amorphous bodies, properly so called, fall into two groups, one of substances like wax (*ciroid* bodies), which weld easily, the other of substances like amorphous carbon (*aciroid* bodies), which do not weld. The general result is that the crystalline state favours the union of solid bodies, but the amorphous state does not always hinder it. M. Spring says the facts described do not essentially differ from those observed when two drops of a liquid meet and unite. Hardness is a relative, and one may even say subjective, term. Water may appear with a certain hardness to some insects, and if our bodies had a certain weight we should find the pavement too soft to bear us. Again, prismatic sulphur is changed by compression to octahedric sulphur; amorphous phosphorus seems to be changed to metallic; other amorphous bodies change their state, and mixtures of bodies react chemically if the specific volume of the product of the reaction is smaller than the sum of specific volumes of the reacting bodies. In all