M. LONGUININE has recently determined (in *Compt. rend.*) the heats of combustion of various alcohols of the allyl series, and compared the numbers with those expressing the heats of combustion of metameric aldehydes. He finds very marked differences between the two series of numbers, showing once more a distinct connection between the energy lost by a carbon compound in passing from one state to another standard state, and the structure of the molecule of that compound.

M. BERTHELOT, in continuation of his researches on compounds of metallic halogen salts with haloid acids, describes in *Compt. rend.* the action of gaseous hydrochloric and hydrobromic acids on alkali chlorides and bromides; he shows that the gaseous acids are absorbed by the dry salts with disengagement of heat, and that the products of the actions are possessed of properties which distinguish them from mere mixtures.

M. BERTHELOT also considers the reciprocal actions between alkali haloid salts and haloid acids; he shows that as a rule alkali chlorides are decomposed by hydrobromic acid, but that in some cases and under special conditions of temperature, bromides are decomposed by hydrochloric acid. The general results are shown to be in keeping with the laws of thermochemistry. That action in which most heat is evolved occurs, but the products of the action may be unstable under experimental conditions, and hence the primary change may be modified, or even reversed.

M. MÜNTZ states that his investigations have shown that traces of alcohol exist in all natural waters, whether rain, river, sea, or snow water. He describes his method of applying the iodoform test for alcohol, whereby one part can be detected in 1,000,000 parts of water.

PHYSICAL NOTES

M. LAURENT of Paris has constructed "magic mirrors" giving similar effects to those brought from Japan, but of glass silvered at the back instead of metal. By engraving patterns at the back and silvering the front surface, the mirror has a perfectly plane surface only when the air-pressures at the front and back are equal. If the air behind be compressed or rarefied the thinner parts will have relatively a greater convexity or concavity than the rest, and in the disk of light which the mirror reflects on to a wall from a luminous point the pattern engraved on the back will accordingly appear dark or light.

FROM experiments on the radiation and conduction of heat in rarefied gases (*Wied. Ann.*, No. 13) Herr Graetz finds the results in much better agreement with Stefan's law of radiation than with that of Dulong and Petit, and "it may be affirmed that in the temperature-interval from 0° to 250° C. the radiation is very nearly proportional to the fourth power of the temperature." The factor of proportionality σ (in Stefan's formula $Q = \sigma T^4$) is then that amount of heat which is radiated from one square centimetre of a substance of $-272°$ C. in a second towards a space of the absolute temperature 0° ($-273°$). By the method of least squares Herr Graetz finds

$$\sigma \text{ for glass} = 1{\cdot}0846 - 12 \frac{\text{gramme centigrade}}{\text{centim. seconds}}$$

Certain divergences at low temperatures suggest that while the intensity of radiation grows with rising temperature, it perhaps grows differently for different heat colours.

IN a recent communication to the Munich Academy, Herren Nies and Winkelmann describe an inquiry into the volume-changes of various metals in solidifying. Of eight metals examined, six (viz. tin, zinc, bismuth, antimony, iron, and copper) were proved to undergo expansion in passing from the liquid to the solid state. For three of the metals approximate values for the amount of this expansion were obtained (tin showed an expansion of 0·7 per cent., zinc 0·2, and bismuth 3). Two metals (lead and cadmium) gave doubtful results; but the authors find some reason to believe that they also expand in solidifying. So far then the rule would appear to be general for metals.

M. TRÈVE describes in the *Comptes rendus* some curious observations from which it would appear that when light is admitted from a natural or artificial source through a slit, more light passes if the slit be horizontal than if it be vertical. M. Trève has produced photographs taken behind slits in various positions to prove that the effect is not an illusion of the eye. The phenomenon appears to us inexplicable, but certainly requires further proof to substantiate its reality.

M. MERCADIER still continues to study radiophonic phenomena. He finds it possible to increase the effects by uniting in one tube the vibrations of several receiving disks. He also finds it possible to construct tubes whose length corresponds to the wave-length of the vibrations radiophonically excited, and which respond to the note emitted. M. Mercadier hopes by these means to re-determine with increased accuracy the velocity of sound in air and other gases.

WITH regard to the beats and beat-tones of harmonic intervals Dr. Koenig argues (*Wied. Ann.* No. 3) against Prof. Helmholtz's view, that these are due to harmonic tones of the lower primary sounding with the higher (Dr. Koenig, in his former experiments, having used strongly-excited tuning-forks). He shows how the phenomena may be studied with the aid of a "wave-syren," in which a blast of air is sent through a slit against the serrated border of a rotating disk, or of a ring-section of a thin cylinder. He has the border of the disk cut to represent accurately the curve produced by combination of the curves of two simple tones, giving an air motion, when blown against, quite like that from the two tones sounded together. The beats and beat-tones are then heard. With a mere wavy outline for the border and the slit at right angles one hears a quite simple tone, which however is at once changed to a "clang" with strong overtones, when the slit is slanted a little. Now, with two simple tones got thus the beat-tone heard when the slits are at right angles should (on Helmholtz's supposition) be less distinct than when, the slits being slanted, the overtones are brought out; whereas the reverse is the case.

DR. KOENIG, in the same number, describes a simple lecture-apparatus for producing beat-tones. It consists of two glass rods of different length, clamped in vertical position by the middle to a jointed frame, which, through an elastic contrivance, keeps their lower ends pressed against the cloth-covered periphery of a wheel which dips in water in a trough. The friction calls forth the longitudinal tones and the beat-tone.

AN improved form of the Töpler air-pump has been devised by Herr Bessel-Hagen (*Wied. Ann.* No. 3), with which considerably higher vacua can be reached than those Mr. Crookes obtains with the more complicated and fragile Sprengel-Gimingham apparatus. The average limit of rarefaction was found to be $\frac{1}{83}$ millionths of an atmosphere ($\frac{1}{75}$ in one case), while the other pump only gives $\frac{1}{17}$ millionth. (It is noted that Prof. Ogden Rood has obtained $\frac{1}{95}$, and in one case even $\frac{1}{110}$ with a modified Sprengel.) With his highest vacua the author found electricity to pass (using plate-electrodes and a strong Holtz machine, with Leyden jars). He considers mercury-vapour an insulator for electricity; but shows that radiometric movements depend greatly on its pressure *in vacuo*. No diffusion of hydrogen through the glass could be detected.

AN artificially-formed body showing polar effects in the way of attraction and direction is produced by Herr Holtz (*Wied. Ann.*, No. 3) thus: To one end of a short glass rod is cemented a plane piece of glass, and to this a short narrow glass tube (in a line with the rod). In the tube is placed a sewing-needle longer than it, and carrying at its head a thin pasteboard disk (22 mm. across), which has attached on one half of its periphery, reaching over both above and below, a pasteboard strip (10 mm. broad); opposite this, on one of the surfaces, is fastened a small projecting point of tin-foil. Brought between hollow disks fixed to the rods of a Holtz machine, the tin-foil point always turned to the positive pole. Next, the glass rod with its disk was attached to the end of a light horizontal glass tube, hung bifilarly, and so brought between the hollow disks. The disk first turned into position, and was then attracted towards the negative pole. The phenomena are thought to illustrate unipolar conductivity.

THE simple tourmaline-pincette, by reason of its small field, can be used with only a small number of crystals. To enlarge the field M. Bertin has applied to it a part of the lenses of the polarising microscope. This, it is known, consists, first, of a polariser and focus; second, of a microscope and analyser. The polariser and analyser, at the extremities, are pretty large pieces, and if replaced by two tourmalines placed between the focus and the microscope (of simplified form) the apparatus is rendered much smaller and handier. This is the principle of M. Bertin's new tourmaline-pincette (of which details will be found in the

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Journal de Physique for March). It shows very well the fringes of a crystal only 2 mm. in diameter and ¼ mm. in thickness, and all uniaxial crystals give fringes in it. With the old pincette only two biaxial crystals can be observed (nitre and lead crystal), the limit for the exterior angle of the axis being about 17°; but in the new instrument, a small calamine plate, with axes 78° 20′ apart, showed the fringes well.

ACCORDING to M. Angot (*Jour. de Phys.*, March) the psychrometer, of whatever form, may give pretty good indications in the hands of careful observers, in these regions (France), so long as the atmospheric pressure is not far from 760 mm., the wet bulb thermometer is above 1° or 2°, and the difference of the two thermometers remains below 12°; but otherwise the ordinary formulæ become illusory.

THE influence of atmospheric electricity on the vegetation of the vine has been studied near Palermo by M. Macagno (*Jour. de Agr. Prat.*) thus: Sixteen stocks were rendered more subject to the effects of the electric tension by means of a copper wire inserted vertically with platinum point in the upper end of the fruit branch, while another wire connected the bottom of the branch with the ground. This continued from April to September. An acceleration of vegetation was proved by the wood of these stocks containing less mineral matters and potash than that of the other stocks, while the contrary occurred in the leaves, and in these the potash was mostly in the bitartrate form. A much greater quantity of must was got from the grapes of those vines, and it had considerably more glucose and less acid.

A DETERMINATION of the electric phenomena which occur on contact of metals and gases has been attempted by Herr Schulze-Berge in Berlin (*Wied. Ann.* No. 2). He worked with a condenser having two circular plates of a given metal, the upper plate being connected with an electrometer and submitted to contact with various gases or to vacuum; the lower connected to earth. The quantity of electricity from a known source requiring to be communicated to the upper plate to make its potential equal to the lower, was measured. *Inter alia*, ozone was found to make gold, platinum, and brass negative to a plate of the same metal in air. Hydrogen always made platinum strongly positive, while its influence on gold was hardly perceptible, and on brass qualitatively various. Chlorine made platinum negative; ammoniacal gas (from aqueous solution) made brass positive. The amount of difference of potential with as similar treatment as possible of a given pair of plates was very different in the several observations of a series. Nor could a certain relation be discovered between it and the time of action of the gas. It was greatest with two platinum plates, one in hydrogen (viz. 0·214 D). It gradually decreased to a point generally somewhat short of that at the beginning. As to the cause of this decrease, the author thinks it probable that a gradual neutralisation of the electrical double layer takes place.

THE DEVELOPMENT OF HUMAN INTELLIGENCE

THE Department of Education of the American Social Science Association has issued the following Circular and Register, which we commend to the notice of our readers, some of whom may be able to give Mrs. Talbot answers to the questions given below:—

WE have been made familiar with the habits of plants and animals from the careful investigations which have from time to time been published—the intelligence of animals, even, coming in for a due share of attention. One author alone contributes a book of one thousand pages upon "Mind in the Lower Animals." Recently some educators in this country have been quietly thinking that to study the natural development of a single child is worth more than a Noah's ark full of animals. Little has been done in this study, at least little has been recorded. It is certain that a great many mothers might contribute observations of their own child's life and development that might be at some future time invaluable to the psychologist. In this belief the Education Department of the American Social Science Association has issued the accompanying Register, and asks the parents of very young children to interest themselves in the subject—

1. By recognising the importance of the study of the youngest infants.

2. By observing the simplest manifestations of their life and movements.

3 By answering fully and carefully the questions asked in the Register.

4. By a careful record of the signs of development during the coming year, each observation to be verified, if possible, by other members of the family.

5. By interesting their friends in the subject and forwarding the results to the secretary.

6. Above all, by *perseverance* and exactness in recording these observations.

From the records of many thousand observers in the next few years it is believed that important facts will be gathered of great value to the educator and to the psychologist.

First Series—REGISTER OF PHYSICAL AND MENTAL

Development of (Give the Baby's full name.) .....
Name and occupation of the father?.....
Place and time of father's birth?.....
,, ,, mother's ,, ?.....
,, ,, baby's ,, ?.....
Baby's weight at birth ..... at 3 months?.....
,, ,, 6 months? .....at 1 year? .....
Is baby strong and healthy, or otherwise?.....
At what age did the baby exhibit consciousness, and in what manner?.....

AT WHAT AGE DID THE BABY

smile?.....
recognise its mother? .....
notice its hand?.....
follow a light with its eyes?.....
hold up its head? .....
sit alone on the floor? .....
creep?.....
stand by a chair? .....
stand alone? .....
walk alone? .....
hold a plaything when put in its hand?.....
reach out and take a plaything?.....
appear to be right or left handed?.....
notice pain, as the prick of a pin?.....
show a like or dislike in taste? .....
appear sensible to sound? .....
notice the light of a window or turn towards it?.....
fear the heat from stove or grate? .....
speak, and what did it say?.....

HOW MANY WORDS COULD IT SAY

at 1 year?..... at 18 months?..... at 2 years?.....

Will the mother have the kindness to carefully answer as many as possible of these questions and return this circular, before July 15, 1881, to Mrs. Emily Talbot, Secretary of the Education Department of the American Social Science Association, 66, Marlborough Street, Boston, Mass.

Boston, March 1, 1881

In connection with the inquiry indicated above, the following letter from Dr. Preyer of Prussia, addressed to Mrs. Talbot, will be found of interest:—

Jena, November 22, 1880

DEAR MADAM,—It has given me much pleasure to read your letter and the extract of a paper of mine on "psychogenesis," or "the growth of volition, intellect, &c., in infants," and I readily comply with your wish to have this paper sent off without delay. You will find it reprinted in the book accompanying this letter, p. 199–237. I am about to publish an extensive work on the same subject, which is to contain all my observations and a careful analysis of the phenomena which the development of the faculty of speech presents. This book is to be printed next year. I am sorry to say that a reliable investigator of the whole subject is not known to me. Your newspaper seems to be right in calling the field "as yet almost unbroken." Prof. Kussmaul's "Seelenleben des neugeborenen Menschen" (Leipzig and Heidleberg, 1859), and Mr. C. Darwin's biographical sketch of an infant, contain some good observations, but both are very short. Many excellent remarks on infants and very young children I find in Mr. C. Darwin's book, "On the Expression of the Emotions." The German books on the subject, although numerous, are nearly worthless; many are sentimental, giving no facts, or, what is worse, false statements. B. Sigismund's "Kind und Welt" (1851) is an exception.

The case you mention of a child of eleven months expressing

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