two curves shows what becomes of the water which falls on the naked earth, without vegetation, distinguishing between what returns to the atmosphere by evaporation, and what penetrates the subsoil which is permeable or drained. Another atmograph gives similar indications for a soil covered with various plants; but the latter being sheltered from the wind, ought to be moistened according as is necessary. Fig. 4 represents only the register of the atmograph. *a* is the lower part of the stem which is suspended to the extremity of the arm of the balance, in which is placed the mass of earth. A second lever arm, *b c*, follows and amplifies the movements of that stem which it inscribes on the vertical cylinder covered with paper blackened with smoke. This same stem bears a glass test-tube, *d*, containing mercury, in which is a fixed glass tube *e*. The diameter of this stem is so calculated that the point *c* traverses 100 millimetres for each millimetre of water gained or lost by the mass of earth. In calm weather we may thus appreciate the $\frac{2}{100}$th of a millimetre; but when the atmosphere is disturbed, the vertical components of the wind cause the needle to oscillate, thus interfering with the precision of the readings.

The anemograph (Fig. 5) gives us, at once, the direction of the wind and its mean rate per hour. Eight electro-magnets communicating electrically with the sectors arranged on the vane according to the eight principal points of the compass, can, by acting singly or two and two, record the winds for sixteen directions, which may be regarded to be sufficient for the wants of meteorology. A ninth electro-magnet is acted on each time that the Robinson drum shows a length of one kilometre traversed by the wind. The toothed wheel *b* then moves one division, and its movement is transmitted by the satellite wheel *d* to a third toothed wheel, *c*, on the axis of which is rolled a thread, *cp*. The point which marks the velocity then advances 1 mm. towards the left. This effect is produced during one hour for each kilometre traversed by the wind; but at the end of each hour the needle of the clock establishes an electric contact; the satellite wheel, *d*, is lowered; the wheel, *c*, becomes free; and the weight, *p*, restores the metallic point to its starting-place.

Fig. 6 presents a specimen of the curves traced by the registers from June 28 to July 3, 1878, reduced to one-third of their natural size. Beginning at the top, we find first the two curves, T N and T B, which together furnish the actinometric data; T N is the curve of the black thermometer, T B that of the silvered. The two following curves, T S and T C, give the temperature of the surface of the ground without shade; T S corresponds to the ground thermometer; T C gives the correction to be made in the ordinates of the first. The two curves, T O and T M, are those of the dry and wet thermometers; besides the temperature of the air in the shade, they give its hygrometric degree and the elastic force of its vapour. H is the curve of barometric pressure.

Underneath are eight straight lines corresponding to the eight principal directions of the wind; the vertical lines which rest on them indicate the directions in which the wind has blown. Further down are shown the velocity, V, of the wind in kilometres per hour.

The last curve, P E, is made by the atmometer; the increase in a vertical direction of this curve marks rain; the decrease marks evaporation. Notwithstanding the frequent and at one time very copious rains, the earth, on July 3, had very nearly resumed its weight of June 28. Finally, the last line is the datum-line on which the hours of the day are marked.

GERMAN PHYSIOLOGICAL CHEMISTRY[1]

As our general knowledge of nature increases, the possibility of individual knowledge decreases; the variety of discovery, the immense number of investigators, and the innumerable details which they accumulate in their respective branches of science, preclude the possibility of a modern "admirable Crichton." Werner's sigh, "True I know much, but yet I would know all," has been long acknowledged as an aspiration incapable of fulfilment, even supposing him to limit his desire of knowledge within the bounds of what is already known. To know "something of everything, and everything of something," is all that can be hoped for; day by day each science advances with such rapid strides, that one brain is incapable of grasping more than the general principles of one science; and any man who aims at enlarging the domain of science by fresh discovery, must content himself with confining his attention to a small corner, and by patient industry and indomitable perseverance seek to elicit some new facts.

Such, expressed in general terms, is the drift of the preface to Hoppe-Seyler's "Zeitschrift für physiologische Chemie." It seldom happens—unfortunately too seldom in this country—that medical men have more than a smattering of chemistry. A very low standard of chemistry is required for a medical degree, comprising a superficial knowledge of inorganic chemistry, chiefly of the non-metals; the merest smattering of organic chemistry, and ability sufficient to detect the acid and base in simple salts—such are the qualifications in chemistry necessary for graduation in medicine. When the student, following out the prescribed course, comes to attend lectures on physiology, and hears—almost always for the first time—the names of the various principles contained in the animal fluids, in the brain, in the liver, and in the muscular tissue, they fail to convey any definite idea to his mind, and he is utterly unable to comprehend, or even to form an idea of the reactions which take place in the animal organism. In Germany this state of things has been recognised in many universities, and special professors of physiological or animal chemistry have been appointed; these professors are not merely teachers, but are engaged in the active extension of their branch of science; and it is to facilitate the interchange of ideas between them, and to afford a medium in which the results of their investigations may be brought together, that Hoppe-Seyler has undertaken the editorship of this journal.

One noticeable feature of the investigations of German physiological chemists at present, is the attention devoted to ascertaining the changes which food undergoes in passing through the system. At least six memoirs on the subject are to be found in the nine published numbers of the journal, comprising the work of a year and a half. The methods and results of these experiments are worthy of a short description.

The food which we eat consists for the most part of carbon, hydrogen, and nitrogen; all food, however, does not contain nitrogen; starch, sugar, and fat are devoid of that element. The carbon and hydrogen, after being absorbed by the tissues, and performing work, are cast off as waste material, partly by the lungs, in the form of carbonic acid and water-vapour, and also, to a much smaller extent, in the urine. An almost inappreciable amount of nitrogen escapes by the lungs; by far the largest portion passes into the urine in combination with hydrogen and carbon, in the form of urea—a white crystalline body. Now this substance, urea, possesses a chemical, as well as a physiological interest. It was formerly supposed that all chemical compounds could be divided into two grand classes: inorganic bodies, such as could be prepared from purely mineral matter; and organic bodies, those existing only in a living organism, or obtained from these compounds by a process of decomposition. It was, therefore, imagined that an insurmountable barrier separated the two classes. Urea was ranked as an organic substance, for it had never been obtained except from the organism, till Prof. Wöhler, of

[1] From Hoppe-Seyler's "Zeitschrift über physiologische Chemie."

Göttingen, succeeded in preparing it from material of purely mineral origin. This process was to heat ammonium cyanate, $NH_4.CNO$, when, without decomposition, a new body was formed, possessing all the properties of, and undistinguishable from, urea. It has since been discovered that urea is very closely connected with the carbonates of ammonium, that, in fact, it is simply carbonate of ammonium minus water. Now it appears probable that urea is formed in the organism either from ammonium cyanate or from ammonium carbonate, and the question which Prof. Salowski, of Berlin, has tried to answer is: By which process is it formed? (vol. i. p. 1). As there is a general resemblance between all nitrogenous food, inasmuch as it contains albumen itself, or principles closely allied to albumen—among others, myosine, vitelline, serum-globuline (which form the subject of an article by Th. Weyl [vol. i. p. 72]); and moreover, as cyanic acid, carbonic acid, and ammonia, are products of decomposition of albumen, the question is an open one.

Every one knows the old plan of detecting the filcher of coin from a till, by placing a secret mark on a number of the coins, and so making their identity unmistakable. The plan adopted by Prof. Salowski is somewhat similar, though the simile is not quite applicable. There is a method of putting a private mark on cyanic acid and on ammonia, by using compounds containing more carbon in the former case, and by employing a substituted ammonia in the latter, that is, a substance possessing in the main the properties of ammonia, but capable of recognition afterwards. But as neither ammonia nor its salts are normal constituents of food, it was necessary to prove that by giving ammonia, a compound of nitrogen and hydrogen, along with food, the amount of urea in the urine is increased. Direct experiments on rabbits proved the point. After feeding them on a diet of potatoes containing a known amount of nitrogen, the amount of urea eliminated was augmented by addition of salts of ammonia to that diet. Now by introducing ammonia to form carbonate of ammonium, two atoms of nitrogen are introduced; and if that ammonia were "marked" the resulting urea would be "marked" also, and would contain two atoms of "marked" nitrogen. But, on the other hand, if the reaction takes place between cyanic acid (a body containing one atom of nitrogen itself) and ammonia, only one atom of nitrogen would be derived from the introduced ammonia, and if that ammonia could be afterwards identified, the urea into which it is resolved should contain only one atom of marked nitrogen.

In chemical language, let ethylamine be substituted for ammonia; in the first instance the equation should be—

$$C_2H_5NH_2 + HCNO = CO \left\{ \begin{matrix} NH_2 \\ NH . C_2H_5 \end{matrix} \right. ;$$

and in the second—

$$CO(C_2H_5 . NH_2)_2 - 2H_2O = CO(NHC_2H_5)_2.$$

The former hypothesis was found to be true; only one nitrogen atom in the urea bore the mark, and the reaction is proved to take place by cyanic acid and ammonia combining, and then altering into urea, a body of the same composition but different properties, otherwise called an isomeride.

In spite, however, of this apparently convincing experiment, Prof. Salowski regards it as improbable that urea is actually formed by the reaction between ammonia and cyanic acid, unless, indeed, ammonia be supplied directly to the organism; he takes the view that under normal circumstances the urea is derived solely from cyanic acid assimilating water and evolving ammonia thus:—

$$2CNOH + H_2O = CO(NH_2)_2 + CO_2.$$

This would account for the increase of urea under a diet containing ammonia.

Dr. E. Baumann (vol. i. p. 60) contributes a paper announcing the discovery of phenol, or carbolic acid, in urine, and remarks that it is curious to observe a substance regarded as a preventive of fermentation generated, although in extremely small quantity, by fermentation. He also noticed the appearance of a nearly allied body, indicane, which, on allowing the urine to stand, changed into indigo, the well-known dye.

The colouring matter of the blood forms the subject of a series of contributions from the pen of the editor, Prof. Hoppe-Seyler (vol. i. pp. 121, ii. 149). Every one has noticed the fact that blood from an artery has a brighter red colour than that from a vein; the cause of this is that arterial blood is pumped by the heart from the lungs, where it has received a supply of oxygen from the air, into the arteries, which distribute it through the body. During its progress this oxygen is gradually used in oxidising waste matter and in converting the spent carbonaceous substances, which have fulfilled their purpose, into carbonic acid. The blood takes up this carbonic acid, and in doing so its colour becomes darker. The bright red principle of the blood is named oxyhæmoglobine, and after it has turned dark it has changed to hæmoglobine. Both of these substances can be separated from blood by appropriate processes. When placed in a tube and viewed through a spectroscope, oxyhæmoglobine exhibits two dark bands, whereas hæmoglobine shows only one band, occupying a position nearly between that of the two bands of oxyhæmoglobine, but slightly overlapping the one at the red end of the spectrum. These two substances can thus be easily distinguished from each other, and as the smallest trace of oxygen converts hæmoglobine into oxyhæmoglobine, the spectrum of which is easily recognised, even in presence of the other, a dilute solution of the former is a very delicate test for the presence of oxygen in liquids; so delicate, indeed, that one cubic millimeter of oxygen, or about as much as would occupy the space of a pin-head, can be detected.

It is of course evident that, as decay, and consequently removal of used-up material proceeds throughout the whole body, it is impossible to obtain blood, either wholly charged with oxygen or wholly free from it. Yet to be able to detect oxygen in such minute quantity, it is necessary to procure hæmoglobine absolutely free from oxygen. Hoppe-Seyler effects this by exposing the colouring-matter of blood to a putrefying medium; the small living organisms consume the oxygen that it contains, and reduce it to hæmoglobine. He remarks, *en passant*, that the colouring-matter of the blood withstands putrefaction perfectly, as well as the action of a special ferment found in the pancreas, which in this respect resembles bacteria, the living organisms in ordinary putrefying media.

This very delicate test for oxygen has been applied to various animal secretions. Saliva from the parotid and submaxillary glands, as might be expected from its proximity to external air, contains oxygen, but neither gall nor urine contain any, owing to the presence of easily oxidised substances named bilirubine and hydrobilirubine, by which any free oxygen is consumed.

It is not uncommon to hear of deaths caused by sleeping in an apartment in which there is a charcoal-stove. This is owing to the poisonous qualities of carbonic oxide gas produced by the combustion of the charcoal, and the effect is not improbably due to the formation of a compound between the hæmoglobine of the blood and the gas. Blood, when charged with carbonic oxide, acquires an almost vermilion-red colour. It also gives a characteristic spectrum, and its examination shows with certainty the cause of death. Hoppe-Seyler has noticed that, like oxyhæmoglobine, the compound of carbonic oxide with hæmoglobine is not destroyed by putrefaction, and hence blood taken from the veins long after death reveals the carbonic oxide spectrum, if death has resulted from charcoal-poisoning.

M. Dionys Szabó has made the character of the acid in gastric juice a subject of research (vol. i. p. 140), and has ascertained that it consists of both hydrochloric acid and lactic acid, analogous to that produced by the souring of milk. As hydrochloric acid is the more powerful corrosive and solvent agent, it is natural to expect it to be present in larger quantity than lactic acid in the stomach of the dog, which requires it to bring fragments of bone, &c., into solution. In certain dyspeptic cases hydrochloric acid is wanting, hence, probably, the dyspepsia, owing to lactic acid alone not being sufficient to bring the food into solution. It is probable that the lactic acid is produced from the albuminous constituents of food by oxidation, and that it acts on the salt which we take with our food, forming lactate of sodium, and liberating hydrochloric acid. Chemical decompositions of this nature, the converse of what happens in laboratory experiments, appear to be greatly favoured by dialysis through colloidal membranes, such as the walls of the ducts of the mucous membrane of the stomach.

Prof. Richard Maly (vol. i. p. 174) has made an attempt to explain the phenomenon of inverse chemical reactions, occurring under the influence of diffusion, with regard to the formation of hydrochloric acid. Prof. Graham, in his well-known researches on diffusion, showed that hydrochloric acid is the most diffusible of all liquids; that if a jar be filled with it, and carefully immersed in water, taking care not to mix the acid with the water, more hydrochloric acid escapes in a given time than is the case, under similar circumstances, with any other liquid. Now it is an ascertained fact that a weak acid can replace a strong one to a small extent, provided the weak acid is present in large quantity compared with the strong one. This replacement proceeds to a given point, when balance sets in, and the reaction goes no further, owing to the strong acid being liberated in such amount as to check any further decomposition, provided no disturbance takes place. But in the case of lactic and hydrochloric acids in the stomach, disturbance does take place, owing to the more rapid diffusibility of hydrochloric acid through the walls of the ducts. The hydrochloric acid is constantly being removed as it is formed, and the sodium chloride, or common salt, is continually in process of decomposition by the lactic acid. Hence the presence of hydrochloric acid in gastric juice. This decomposition is also effected by what is generally called "neutral sodium phosphate," which, although it has a faint alkaline reaction on litmus paper, yet, in a chemical point of view, is an acid substance, for it still contains hydrogen replaceable by a metal.

Dr. O. Lassar (vol. i. p. 165) contributes a paper on irrespirable gases. Every one who has visited a vitriol work knows the insufferable feeling of choking produced by the fumes of the evaporation-chamber, and even those who have not had that opportunity must occasionally have experienced the disagreeable sensation of breathing the fumes of burning sulphur from a sulphur match. This choking sensation seems not to be felt by animals; it is due to spasm in the glottis and involuntary contraction of the vocal chords. The object of Dr. Lassar's experiments was to ascertain whether such acid fumes are absorbed by the lungs, conveyed into the blood, and passed out by the urine. For this purpose he exposed rabbits and dogs to the dense fumes of sulphuric acid for more than an hour at a time, and examined the urine carefully for that acid. It was invariably absent, showing that the acid is not absorbed by the lungs. It was curious to remark that on exposure of an animal to nitric acid vapour of such strength that the hair, and even the membrane of the lungs, turned yellow, the animal did not suffer in health, and that the only effect of acid fumes in air is to diminish the proportion of oxygen. This explains what has often been wondered at—that workmen in the chlorine chambers and sulphuric acid evaporating-chambers are not injuriously affected by the acid fumes.

WILLIAM RAMSAY

GEOGRAPHICAL NOTES

THE special committee appointed by the International Meteorological Congress at Rome for the promotion of expeditions to the Arctic seas charged with making synchronous meteorological and magnetic observations, will meet at Hamburg on October 1 next, in order to arrange details and to discuss the means of arriving at the object aimed at. Preliminary steps in this direction have, as our readers are doubtless aware, been taken by Count Wilczek and Lieut. Weyprecht.

ON August 7 next a century will have elapsed since Karl Ritter, unquestionably the greatest geographer of his time, was born at Quedlinburg.

IN the last issue of the *Colonies and India* the attention of members of the Alpine Club is directed to the mountain peaks of the West Indies. In the Blue Mountains of Jamaica, for instance, views can be obtained which cannot be surpassed in the world. Many of these mountains have been, as yet, untrodden by the foot of man, and they offer a wide field to the student of natural history as well as the practical explorer. In the Island of Dominica, again, there are opportunities for exploring mountains which are hardly, if at all, known. An expedition under two Englishmen has lately scaled for the first time one of the peaks, known as Morne Trois Pitons, situated to the north of Roseau. The heights of these peaks are 4,528, 4,552, and 2,672 feet respectively. The foot of the centre *piton* was found to be at an elevation of about 1,800 feet. For a considerable distance the party were able to follow a wild-pig track, but they had to leave this and cut their way through dense vegetation and scrub. On reaching the summit they found it to be nearly flat, and covered with impenetrable vegetation. This curious plateau was estimated to be about ten acres in extent.

THE new number of the Belgian Geographical Society's *Bulletin* publishes reports from M. Cambier and Dr. Dutrieux on the march of the first Belgian African expedition from Mpwapwa to Tabora, in Unyanyembe. These are accompanied by a sketch-map of the country between the East Coast and Lake Tanganyika, on which the route of the expedition is laid down.

A GOOD harbour is stated to have been discovered near Point Parker, in the Gulf of Carpentaria, which will probably be of service in the development of that part of Australia.

THE Coreans are as little given to leaving their own country as the Japanese used to be, but we learn from a Shanghai contemporary that there appears to be a little colony of them forming in the neighbourhood of Chinkiang, for, in addition to the usual *ginseng* traders, there are now there several well-dressed Coreans having the appearance of the better class of officials. They wear slate-coloured garments as a sign of mourning for the Queen.

THE new number of *Le Globe* contains M. Veniukof's account of geographical work in Asiatic Russia during 1878, and a paper on the Sahara.

THE last *Bulletin* of the Société de Géographie Commerciale of Bordeaux has a long note on French establishments in India, which will be found useful in supplying information on a subject respecting which the world at large knows but little.

THE just published number of *Les Annales de l'Extrême Orient* contains the continuation of Dr. Harmand's notes on Khmer monuments, and of the Marquis de Croizier's essays on Indo-China, based on Dr. Bastian's investigations.