tion, though I should say, from the number of flowers fertilised, that other agencies preponderate. E. L. LAYARD

British Consulate, Noumea, New Caledonia, July 31

Intellect in Brutes

I CONFESS I do not see much "intellect" in a snake biting its own tail (cf. NATURE, vol. xxii. p. 40); on the contrary, I consider the creature evinced remarkable stupidity. Perhaps however you will think what I now relate will show that snakes do possess reasoning powers.

Many years ago, while in Ceylon, I lived in a house in "Slave Island," raised on a high platform. The steps up to the door had become loosened, and behind them a colony of frogs had established themselves. One morning I watched a snake (a cobra) creep up, insert his head into a crack, and seize a frog, which he there and then swallowed. But the crack that admitted the thin flat head and neck of the ophidian would not permit of the same being withdrawn when the neck was swollen with the addition of the frog inside it. The snake tugged and struggled, but in vain, and after a series of futile attempts disgorged its prey and withdrew its head. But the sight was too tantalising. Again the head was inserted in the crack and the coveted morsel swallowed, and again the vain struggles to withdraw were renewed. *I saw this repeated several times*, till, gaining wisdom by experience, the snake seized the frog by one leg, withdrew it from its coigne of vantage, and swallowed it outside. E. L. LAYARD

I SEND you the following dog story, the truth of which is vouched for by the young lady who owned the animal. Her pet dog, a black-and-tan-terrier, was well known to the neighbours for his intelligence. He had established a remarkable friendship for a certain kitten, although given to fierce attacks on all others. This kitten was infested with fleas, which, when the dog discovered, he took her by the nape of the neck, in truly parental fashion, and *soused her up and down in a bucket of water*. He would then take her out into the sunshine and carefully pick out the drowned fleas.

A friend of mine, a naturalist, and a very conscientious man, whose word can be implicitly trusted, gives the following, to which he was an eye-witness. His grandfather, then a very old but hale and hearty man, had a splendid Newfoundland. There was a narrow and precipitous road leading from the fields to the house. It was regarded as a very dangerous place. One day when the old gentleman was doing some work about the farm his horse became alarmed and started off with the wagon along this causeway. The chances were that he would dash himself and the empty wagon to pieces. At once the dog seemed to take in the situation, although until that time he had been impassive. He started after the horse at full speed, overtook him, caught the bridle, and by his strength arrested the frightened creature until help could reach him. My friend gives many other stories of this fine dog, and thinks he had a decided sense of humour. I will repeat that both of these tales come to me well authenticated, and I could, by seeking permission, give names and places. W. WHITMAN BAILEY

Broun University, Providence, R. I. (U.S.A.), October 10

Atmospheric Phenomenon

LAST evening (October 21) at 5.45 p.m. I observed four huge radiating arms of faint white light, like the spokes of a gigantic wheel, rising from a centre apparently on the west-south-west horizon, and extending almost to the zenith. I say apparently on the west-south-west horizon, because an intervening house prevented me from seeing the nucleus of the diverging rays. The aspect of the phenomenon was more suggestive of an aurora than anything else I know of, but the beams of light seemed to be quite stationary, and although I fancied their brilliancy increased at one time for a few moments, I cannot be sure. Other fainter rays appeared to me to divide the west-south-west sky with those I have mentioned; but on that point I am also not sure. The sun set at 4.53 p.m., and twilight ended about 6.43 p.m., at which time the appearance I have attempted to describe was no longer visible. The sky was heavily clouded.

I should very much like to know the cause of this (to me) singular exhibition of light. B.

Kentish Town, N.W., October 22

Temperature of the Breath

WITH reference to the high reading, 107°-108°, noticed by Dr. Dudgeon when a thermometer tightly wrapped up in the folds of a silk handkerchief was kept in the mouth for five minutes, might I ask Dr. Dudgeon if he has verified this reading by immersing the thermometer, with a handkerchief tightly rolled round its bulb, in a vessel of water, at say 108°, the temperature of the water being simultaneously taken by a standard thermometer with its bulb uncovered? It seems to me that there is some danger of actually squeezing up the reading of a delicate thermometer when twenty or thirty folds of a silk handkerchief tightly encircle its bulb. F. J. M. P.

October 23

Crossing Rapid Streams

HAVING read some letters lately in your paper on the subject of crossing rapid streams by means of carrying heavy stones, it strikes me that the following may be of interest to your readers. It is an extract from a survey report by Lieut. (now Major) Woodthorpe, R.E., written in 1876, describing the method, which he saw practised by men of the Nàgà tribes, for crossing a deep stream too rapid for their feeble powers of swimming, and about twenty yards wide:—

"Taking large stones in their hands, they waded in up to their necks, and throwing up their legs and lowering their hands, the stones carried them to the bottom, along which they crept on all-fours till they reached the shallows on the other side."

The rough bottom afforded them sufficient hold to withstand the modified current and resist flotation. C.

Mussoorie, September 28

Construction of Telescopes and Microscopes

PERHAPS some of your readers may be able to inform me whether there exists in English or French a work on geometrical optics, in which the author applies himself thoroughly to explain the optical (not the mechanical) construction of telescopes and microscopes. Works like those by Parkinson and Polter stop short exactly where the application of theory to the construction of the best instruments begins. P. C.

September 30

BENJAMIN PEIRCE, F.R.S.

WE regret to have to record the death at Cambridge, Mass., on October 6, of Prof. Peirce of Harvard University, following upon an illness of three months from Bright's disease. Prof. Peirce was the son of a former librarian of the university, Benjamin Peirce, who died in 1831. For the past thirty-five years he has occupied a professorship at Harvard; and as a lecturer, author, thinker, and investigator, has not only ranked amongst the first of a numerous corps of professors, but also among the first of American men of science. Devoting himself originally to mathematics, Prof. Peirce has successively pursued exhaustive studies in all the branches more closely allied to mathematics, and has obtained eminence equally in physics, astronomy, mechanics, and navigation. His numerous investigations in these various departments, while read before various scientific societies, have been published, unfortunately, for the most part in the briefest possible form, and the results of many of his researches are to be found only in the manuals he published on various subjects. As an author Prof. Peirce was highly esteemed upon both sides of the Atlantic, his work on analytical mechanics, which appeared in 1857, being regarded then even in Germany as the best of its kind. His chief works are a "Treatise on Algebra," a "Treatise on Plane and Solid Geometry," "Pure Mathematics," a "Treatise on Sound," "Ocean Lanes for Steamships," "Tables of the Moon," "System of Analytic Mechanics," "Potential Physics," "Linear Associative Algebra," "Analytic Morphology," and "Criterion for the Rejection of Doubtful Observations." As a lecturer Prof. Peirce was highly esteemed in both scientific and popular circles. It is related that in 1843, by a series of popular

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lectures on astronomy, he so excited the public interest that the necessary funds were supplied for erecting an observatory at Harvard. A remarkable series of lectures on "Ideality in Science," delivered by him in 1879 before the Lowell Institute in Boston, attracted the general attention of American thinkers, on account of the thoughtful consideration of the vexed question of science and religion.

Much of Prof. Peirce's activity was absorbed by his duties as the head of the American Coast Survey, a position in which he succeeded Prof. Bache. He brought to this work the same degree of zeal and ability which were so brilliantly evidenced by his predecessor, and constantly maintained the well-earned reputation of the Coast Survey among the hydrographic efforts of our day. Prof. Peirce was one of the founders of the American National Academy of Sciences. In 1853 he presided over the American Association for the Advancement of Science. The degree of LL.D. was conferred upon him twice, by the University of North Carolina (1847), and by Harvard University (1867). He was elected an Associate of the Royal Astronomical Society (1849), and a Fellow of the Royal Society of London (1852), and of the Royal Societies of Edinburgh and Göttingen.

Prof. Peirce leaves behind him his wife, a daughter, and three sons. Of the latter one is Professor of Mathematics at Harvard, and another is Professor at Johns Hopkins University.

RECENT CHEMICAL RESEARCH

THE masses of facts accumulated in the text-books on chemistry are already portentous: each month, almost each week, adds to the store.

The difficulty of getting a stable standing-ground from which to survey, in order, if possible, to find the meaning of these facts, increases likewise.

Fortunately from time to time there are found investigators who, turning from the easy toil of adding new compounds to those which are as yet but imperfectly known, concern themselves with the fundamental questions of chemical science.

Why are the properties of bodies so largely modified under certain conditions? This is the all-important question for the chemist. Before this question can be answered for a series of substances the properties of those substances must be accurately known, and the variations in their properties under varying conditions—themselves definitely ascertained—must be determined. Among the properties of substances those which we usually call physical are, as a rule, more susceptible of accurate measurement than those which we call chemical.

But these physical properties must be connected in some way with the chemical structure of the little parts, or molecules, of which we conceive the substances to be built up.

To determine what this connection is in the case of a definite physical property, and for a series of chemical substances, is at present one of the most promising problems which presents itself to the chemical inquirer.

But these physico-chemical problems require for their solution, a practical knowledge both of chemical and physical methods; methods of laboratory work and methods of reasoning on the results obtained. Students of nature trained in both methods are not extremely abundant.

The suggestion made in the preface to Armstrong and Grove's new volume on Organic Chemistry, that each chemical school should regularly prepare special series of pure compounds, and should let it be known that physical observers can procure these compounds in order to determine their physical properties, is well worthy of being acted on by all in whose hands may rest the arrangement of the work of any chemical school.

The older method of regarding chemical physics as consisting of a little chemistry loosely tacked on to a great deal of ordinary physics, is disappearing; and chemists and physicists now recognise that the problems which each attacks are, in very many instances, but different aspects of the same question.

The more thoroughly the chemical worker is trained in the correct use of dynamical principles and dynamical reasoning, the more likely is he to succeed in his search for chemical truth.

Very recently two papers have appeared, the contents of which illustrate the importance of the results obtainable by physico-chemical methods.

Brühl has published in Liebig's *Annalen*—and in a condensed form in the Berlin *Berichte*—the results of his investigations on the connection between physical properties and chemical constitution of carbon compounds; and Thomsen, in the *Journal für practische Chemie* (and also in the *Berichte*) has given the first two instalments of his thermal work bearing on the isomerism of carbon compounds.

I propose to give a short account of the work of these two chemists: let us begin with Thomsen's.

The "heat of formation" of a compound substance is the difference between the sum of the heats of combustion of the constituent elements of the compound, and the heat of combustion of the compound itself. But this heat is not the true "heat of formation" of the molecule of the compound; it is only the algebraic sum of various heat disturbances. The thermal change which accompanies the formation of a compound molecule from various elementary molecules consists of various parts: (1) heat absorbed in dissociating the molecules of the different elements; (2) in some cases, heat absorbed in liquefying or gasefying the constituent elements; (3) heat evolved in the formation, from the dissociated elementary atoms, of the new compound molecules; and (4) in some cases heat evolved in the liquefaction or solidification of the gaseous compound molecules. If the physical state of the various substances concerned be constant throughout the experiment, (2) and (4) may be neglected; and the heat of formation will be equal to the difference between the heat absorbed in splitting the elementary molecules, and that evolved in the falling together of the atoms so produced, in the new configuration. The value of the first part of this operation will always be constant for the same element or elements; but the value of the second part will depend upon the configuration assumed by the elementary atoms in the new compound molecules.

Now the generally accepted chemical theory of isomerism is that it (isomerism) is dependent on varying configuration of the same atoms. Some chemists have urged that isomerism is more probably due to the possession, by the different compounds, of different amounts of energy. But these two theories are really parts of the same theory. Thomsen's method, indeed, may be said to be based on this fundamental identity.

Given the dissociated elementary atoms, they may arrange themselves in various ways, each arrangement will be attended with a definite but different evolution of heat, hence, inasmuch as the heat absorbed in the preliminary elemental dissociation is fixed, the heats of formation of the various isomeric molecules will be different.

But when it is said that isomerism depends on atomic configuration, two things are included in this statement. Let us consider isomerism in a hydrocarbon: the carbon atom combines with four, and not more than four, hydrogen atoms to form a compound molecule. The carbon atom is said to be tetravalent; this is usually graphically expressed by the symbol $=C=$. The maximum number of hydrogen atoms which two carbon atoms can combine with to form a definite molecule will be six,

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