towards the sheep field. What taught him that he could thus reach his game unobserved? A. J. A.

HERE is an instance of "instinct" which shows, I think, that there is no difference whatever between the reason of animals and that of men.

A mare here had her first foal when she was ten or twelve years old. She was blind of one eye. The result was that she frequently trod upon the foal, or knocked it over when it happened to be on the blind side of her, in consequence of which the foal died when it was three or four weeks old. The next year she had another foal; and we fully expected that the result would be the same. But no; from the day it was born she never moved in the stall without looking round to see where the foal was, and she never trod upon it or injured it in any way. You see that reason did not teach her that she was killing her first foal; her care for the second was the result of memory, imagination, and thought, after the foal was dead and before the next one was born. The only difference that I can see between the reasoning powers of men and of animals, is that the latter is applied only to the very limited sphere of providing for their bodily wants, whereas that of men embraces a vast amount of other objects besides this.

The above limitation does not, I think, apply strictly to domestic animals, dogs especially, which seem to acquire some perceptions beyond mere animal ones.

Hull, February 28 C. W. STRICKLAND

Parhelia

ALLOW me to record the occurrence of parhelia here this morning. The phenomenon lasted about twenty minutes, and was fairly brilliant. No halo was apparent, merely a mock sun on either side of the true one, and the line passing through the three, dipped towards the south at an inclination of 2° to 3° to the horizon. E. W. PRINGLE

Uxbridge, March 4

Unscientific Art

As a specimen of Unscientific Art, let me bring to the notice of your readers a two-page engraving in the last number of the *Illustrated London News*, entitled "Capture of Sirayo's Stronghold."

If there is any truth in the laws of perspective the Zulus flying before the cavalry are indeed "sons of Anak."

Scientific Club, March 2 E. W. PRINGLE

Bees' Stings

IN NATURE, vol. xix. p. 385, a correspondent asks whether the identity of bee-poison with formic acid has yet been determined. Some sixteen years ago I made a few experiments with the poison from wasp-stings, and found, to my astonishment, that it was invariably alkaline instead of acid. A living wasp, duly held in the cavity of a perforated cork, was easily induced to sting a piece of turmeric paper; a brown-red spot immediately appeared. A. H. CHURCH

Cirencester, March 1

A NEW PROCESS IN METALLURGY[1]

LONG before human art acquired the knowledge of metal-making, prehistoric man had learned to make fire of the dry stems and branches of trees; in the charred fragments of half-burnt wood we recognise a form of carbon, the first simple elementary body produced by man from the complex natural bodies with which he was surrounded. In the knowledge of the use of fire, then, was the first dawn of art, particularly of that art which deals with the reduction of simple bodies from compound minerals. To convert metallic compounds into metallic elements is the domain of the metallurgist, and the means by which this is effected constitute the basis of metallurgic art. Carbon was thus a necessity to metallurgy—with the knowledge of fire the world emerged from the stone age. From those early times down to the present day, no fusion has been effected without using carbon, which in the form of wood, coal, or charcoal, has been the substance invariably used by the metallurgist for the production of heat, and to enable him to decompose and to smelt metal-bearing materials.

The new process, however, we are about to describe, has for its object the smelting of metalliferous substances without the employment of carbonaceous fuel. The sulphides of iron, lead, and zinc are known to be combustible substances of almost universal occurrence, and when burnt under favourable conditions give rise to a great evolution of heat. We have calculated the relative temperatures thus produced, from which it appears that the temperature at which iron pyrites (bisulphide of iron) burns in air under the conditions most favourable to the development of a high temperature is over 2,000° C., protosulphide of iron burning at about 2,225° C. Zinc sulphide, or blende, gives a temperature of 1,992° C., and galena 1,863° C.; while calculations made in a similar manner with coal, assuming it to be completely burnt, show the temperature attainable to be 2,787° C. These mineral sulphides, which are therefore natural and almost inexhaustible sources of heat and energy, can under certain circumstances be burnt more economically than their heat-giving equivalent of coal.

The best means, however, of utilising this heat-producing property of metallic sulphides is not so apparent as would appear at first sight. Only iron pyrites is sufficiently combustible at a low temperature to burn in the open air, the mass being raised to the temperature at which the oxidation takes place solely by the union of the sulphur and iron with aerial oxygen. In Spain this is carried on in vast heaps of hundreds of thousands of tons, and the operation extends over many months. The oxide of iron that remains is typical of those mineral substances which, once burned in the primeval operations of nature, gave up their stores of heat and force, and became, as it were, inert bodies.

Going back now to the combustion of carbon, it is well known that it burns at widely varying temperatures, as, for example, in our bodies, in a common coal fire, or in a powerful furnace. A great deal of attention and thought has been spent upon the subject of the economy of carbonaceous fuel, and great advances have been made in this direction, yet the expenditure of coal or coke necessary, say, to melt a given quantity of metal, still far exceeds the theoretical limit. The main causes of this discrepancy may be accounted for as follows:—(1) That only a fractional part of the oxygen of the air passed into the furnace acts upon the material to be burnt. (2) That the oxygen is not brought in contact with the combustible matter with sufficient rapidity to attain the necessary temperature for the operation. (3) That gases pass off hot and unburnt; these are now, however, frequently utilised.

There is one metallurgical operation in which the first two sources of loss are perfectly avoided—namely, by blowing air through molten crude iron, as in the Bessemer operation, where, by the burning of small quantities of carbon and silicon contained in the crude iron a very high temperature is attained, which is not the case in the process of puddling, where the oxidation is spread over a considerable period of time, although the same constituents are frequently burnt in similar proportions. But even in the Bessemer process the carbon is only half burned, and a large amount of heat escapes with the carbonic oxide and nitrogen. When, however, we blow thin streams of air through molten sulphide of iron lying upon a tuyère hearth, a high temperature is produced by the perfect combustion which ensues in the midst of the sulphides, and no unburnt gases excepting sulphur vapour escape from the surface of the molten mass. Hot nitrogen and sulphurous acid being the only gaseous products

[1] A paper with full details of the process was read by John Hollway at the Society of Arts on February 12, 1879; Prof. H. E. Roscoe, F.R.S., in the chair.