

he was very eager to get the meat out of it, and that when later in the day he succeeded, he showed no manner of misgiving as to his legal right to its possession.

Other of my correspondents misunderstand the purpose of the experiment. They see in it a desire to belittle their canine pets. This was very far from my thoughts. We have innumerable anecdotes telling us what dogs can do. I wish, partly I admit with a view to enabling us to sort these stories, to obtain, as data, definite observations showing what dogs will not do. Into most dog stories there creeps the little touch of human nature which makes them and ourselves akin.

Mine is the point of view of an anatomist. A dog has a brain very different from that of man. Brain and mind are the two sides of the same coin; or rather, brain is the coin, mind its value. The dog's brain cannot make a man's thoughts. How near can we come to picturing to ourselves the nature of a dog's thoughts? Without committing ourselves to Flechsig's theory of the division of the cortex of the brain into "projection areas" and "association areas," we may on anatomical grounds assert that the cortex of a dog's brain contains fewer association elements than does that of a man. It is an apparatus for transforming sensory impressions into actions, in a more limited and exclusive degree. Probably we can best picture to ourselves the work that it does by supposing that the wordless thoughts of animals are direct combinations of sensory impressions; whereas man has invented symbols for his sensory impressions. He works the symbols into thought. Nor do his symbols stand for material objects alone. They also stand for inferences from observations. But this is a subject which perhaps I ought not to touch without having at my disposal more space than I can ask you to give me in your Journal.

We must admit with Sir William Ramsay that dogs make use, in their mental operations, of sensory impressions and not of inferences, although I dissent from his qualification of their impressions of smell as "vague." It is my object to ascertain, by means, if possible, of observations which can be made under properly controlled conditions upon numerous dogs of various breeds, the limits of their power of substituting inferences for sensory impressions as materials of thought.

Perhaps I may be allowed to use a new nomenclature in defining the position in which, as it appears to me, we stand with regard to the axioms of animal psychology at the present time. An animal remembers. When it performs an action a picture of the action is stored in memory. If the result of the action be satisfactory, a picture of this result is stored in memory. When in future the animal desires to obtain the result it repeats the action. This we may call the product of "reasoning in the first degree." Action depends upon inference. We may accept it as an axiom that an animal can draw an inference of this kind. It is not yet established, by experimental methods, that an animal can combine two inferences, or, as I venture to term it, "reason in the second degree." My box-experiment was intended to throw light upon this question. I shall be very grateful for any further suggestions of possible experiments of the same kind.

ALEX. HILL.

Downing Lodge, May 2.

Spherical Aberration of the Eye.

WITH reference to the experiment described by Mr. E. Edser (p. 559) as appearing to have "escaped observation," perhaps I may be allowed to state that this phenomenon was (to the best of my recollection) described by me before the School Natural History Society when I was a boy at Rugby, about 1873-1874. I could not explain it, and no one at the meeting had any suggestion to make.

I think I connected it in my mind with irradiation phenomena, though I was baffled by the fact that the whole line is bent.

If the black horizontal lines drawn between different advertisements on the outside of NATURE be held five or six inches from the eye, and the rounded end of a pen be brought down close to the eye, the whole line will be seen to curve upward to meet the pen, becoming also blacker and more distinct.

W. L.

THE phenomenon mentioned by W. L. must have frequently been noticed; while resembling that described by me as a proof of the spherical aberration of the eye, it is yet due to an essentially different cause. The black line, when placed at a distance of five or six inches from the eye, is within the shortest distance of distinct vision from the latter. A point source of light, situated on the axis of the eye, at a position closer to the eye than the "near point," produces a relatively large spot of light on the retina. If the pupil be now progressively covered from above, the rays passing through the middle and upper part of the pupil will be cut off, so that those passing through the lower part of the pupil alone remain; these cut the retina in a comparatively restricted area below the point of intersection by the axis of the eye, so that the image apparently rises, at the same time becoming more sharply defined. Under the conditions mentioned, the same phenomenon would be observed if the eye were entirely free from spherical aberration. For this reason I stated that the black band should be placed "just beyond the shortest distance of distinct vision from the eye; . . . care must be taken to keep the eye carefully focused on the edge of the black band, or an exaggerated displacement, due to relaxation of the accommodation of the eye, may result." It was merely as a proof of the spherical aberration of the eye that I described this experiment as having apparently escaped observation.

April 12.

EDWIN EDSER.

IN connection with the experiment on the spherical aberration of the eye, described in your issue of April 16, I may relate a striking observation I made some years ago. Regard with one eye any light or bright object on the wall, turn the head away until the object is just covered by the line of the nose; then move the eye to its natural position, and the object will reappear, supposing the nose is not too prominent. Moving the eye several times to and fro, the phenomenon will be easily observed.

Leipzig, April 29.

W. BETZ.

THE SOLAR AND METEOROLOGICAL CYCLE OF THIRTY-FIVE YEARS.

THE fact that the rainfall of many regions of the earth's surface has, for the last decade or more, been gradually diminishing has led many inquiries to be made concerning the possible periodicity of this meteorological element, and during the last few months more general attention has been drawn to this interesting question. The great importance of this inquiry, not only to agriculturists but to others, renders it desirable that all facts which may tend to elucidate the subject should be thoroughly discussed.

The object of the present article is to bring together, without entering into too great detail, a few statistics relating to the rainfall of different stations in various parts of the earth to see whether there be grounds for assuming a continuation of the present small supply, or whether a greater abundance may be looked for with special reference to the condition of the British Isles.

A few introductory remarks may here not be out of place. Eduard Brückner first discovered that wet periods, great droughts, &c., occurred at intervals of about thirty-five years, and he published his important conclusions in a volume which was, and still is, a valuable contribution to meteorological science. To take one element only, namely, rainfall, Brückner showed that during the last century the mean epochs of the wet years were 1815, 1846-50, and 1876-80, while those for the dry years were 1831-35 and 1861-65.

Since the publication of this volume, many workers have studied rainfall and other records extending over long periods of time. Thus, to take one instance among many that might be cited, Herr Hofrath Julius Hann, the distinguished late director of the Vienna Meteorological Institute, made a minute investigation of the