the necessity for further inquiry, and suggested an inter-departmental committee on which the Treasury, the Board of Education, the Solar Physics Observatory, and the Meteorological Office should be represented.

The committee actually appointed consisted of three persons who are or have been fellows of Trinity College, with the addition of a distinguished honorary graduate of the University of Cambridge. In the terms of reference a condition is assumed that the sum spent in the future upkeep at either place should be approximately the same as that now expended in the present observatory.

Out of the three scientific members of this committee, two, the Astronomer Royal and Dr. Schuster, agreed that the Cambridge site should be preferred, while one, Dr. Glazebrook, the director of the National Physical Laboratory, dissented.

In making a very careful examination of the report of the departmental committee, together with the evidence and appendices, it is really a matter of great difficulty to understand, in the face of the evidence offered, how Messrs. Dyson and Schuster arrived at their conclusion.

The question of site may first be dealt with. The superiority of the Fosterdown site is frankly acknowledged, and evidence is given that some of the present disadvantageous conditions at Cambridge may be much worse in the future. There is no guarantee that the land surrounding the proposed Cambridge site will not be built on, that tram-cars and other heavy traffic will not run along the main road which bounds it. In short, there is no guarantee that this part of the outskirts of Cambridge will not in the near future be an important suburb of Cambridge.

One of the greatest objections to Cambridge is touched on in cavalier fashion. Cambridge, like London, is lighted by electricity; and one of the points in favour of Fosterdown was that town glare at night would be abolished, and that long-exposure photography on the spectra of stars and nebulæ, which is carried on under bad conditions at present at South Kensington, would be rendered more fruitful of results.

As we learn from the solar physics report, this work requires at present the attendance of three assistants on every fine night.

Q. 169.—Is there any interference owing to the town light at the observatory in Cambridge?

Answer.—I do not think anything that would affect solar observations—

is all we can find on this point; and it does not suggest that we are likely to have a continuance of the study of the detailed chemistry of stellar spectra which for many years past has formed part of the routine work of the Solar Physics Observatory, and is not done elsewhere. Town glare naturally does not affect solar observations, because the sun can be observed only by day, while the town is lit only by night. But it does very seriously affect the astrophysical work of the Solar Physics Observatory, which can be carried on only at night. If it is really intended to put an end to a unique investigation of stellar chemistry and physics, the question ought surely to be debated on its merits, and not simply hustled out of sight. There is reason to fear that this is the intention, not only because of the non-recognition of anything beyond solar observation, but also because it is to be gathered from the representative who gave evidence for Cambridge that in the Cambridge view it is not simply a question of transferring the observatory, but of dismissing its staff and putting an end to it as it exists.

Of the ten members of the staff, from Sir Norman Lockyer downwards, not more than two are to be employed (Q. 222), and even none of the existing staff may be of the right "calibre" (Q. 139).

The departmental committee apparently does not accept this (Report, Section 15).

It is understood that the Government desires to relieve itself of the direct control of the Solar Physics Observatory, but that at the same time it acknowledges the value of the work done by that observatory by its willingness to continue the grant at present made for its maintenance. The inducement offered by Cambridge University to transfer control to its hands is that the University undertakes to provide a suitable building for the work, which involves no very serious expenditure. If public money to the amount of 3000*l.* a year is to be handed over to the University on account of certain specified work, then security should be taken that the public shall get value for its money, and that the specified work shall be efficiently carried on. Otherwise the transaction will merely amount to giving the University 3000*l.* a year to spend as it pleases in return for the erection of a building worth 200*l.* or 250*l.* a year.

Now in order that the work shall be carried on efficiently—that is to say, the astrophysical work, which, in spite of its title, is the speciality of the Solar Physics Observatory—it is not enough that a suitable building should be erected, even though it be manned by persons of the "right calibre." It is also necessary that the suitable building should be upon a suitable site, and the only suitable site for an observatory obviously is a site permitting its work of observation and record to be performed in the best conditions attainable. It will not be seriously argued by any responsible person that Cambridge offers the best attainable site for carrying on the astrophysical work of the Solar Physics Observatory. That work involves long exposures of sensitive plates to the light of particular stars. It is necessary that the star should be followed with the utmost accuracy in its diurnal motion, and it is obvious that vibration of the instruments due to heavy traffic in the vicinity cannot conduce to sharpness of definition. If the star has to be photographed through the illuminated haze that hangs over every well-lighted town, another serious difficulty is thrown in the way of the observer, and when spectrographic complications are added the difficulties become indefinitely more formidable.

Thus, while it may be right that the Government should rid itself of direct control of the Solar Physics Observatory, and while it may be right that Cambridge University should assume control, it cannot be right that the University should erect the observatory in Cambridge. For Cambridge is shown by the departmental committee itself to be a bad observing station for this particular work, and to be very likely to become progressively worse. A site can easily be found free from the objections that attach to Cambridge; and if astrophysical work is to be carried on at all with public money, the public have a right to demand that such a site shall be chosen. In placing the observatory at a distance from the University, Cambridge would only be following the practice of other universities, such as those of California and Chicago, which prosecute analogous researches upon the principle that observatories must be placed where the things to be observed can be best observed.

THE ENCYCLOPÆDIA OF SPORT.[1]

AS the third volume commences with hunting and concludes with racing, while it also comprises articles on lawn tennis and polo, it will be obvious that a large portion of its contents does not come within the purview of a journal like NATURE. Nevertheless, there are numerous articles connected with natural history which call for brief mention. As a whole, these articles have been brought well up to date, although in some instances there is a certain amount of repetition, and occasionally discrepancies, when two writers treat of the same subject from different points of view. The illustrations are numerous, and for the most part good (as will be evident from the one here reproduced), but the accompanying legends are in some instances not so full as is desirable. On page 85, for instance, a doe and kid are simply lettered Himalayan Ibex, while there is no indication to show whether the "Caucasian Ibex," figured on the next page, is an example of the western or eastern tur. Misprints seem to be few, although the specific name of the mule-deer is given as *nemionus* in place of *hemionus*, while its alternative

[1] "The Encyclopædia of Sport and Games." Edited by the Earl of Suffolk and Berkshire. Vol. iii., Hunting—Racing. Pp. viii + 448. Vol. iv., Rackets to Zebra. Pp. viii+471. (London: W. Heinemann, 1911.) Price 10*s.* 6*d.* net; abroad 12*s.* 6*d.* net.

generic name, Cariacus, is printed with a small initial letter.

The most valuable of the natural history articles, in our opinion, is the one by Mr. Rothschild on pheasants, in which the number of species of the typical genus Phasianus is reduced from about thirty-five to half a dozen, all the forms allied to *colchicus* being regarded as local races or colour-phases of that species. As these will all interbreed and propagate fertile offspring, the new classification is far preferable to the old. In this connection it may be noted that the author of the article on partridges refers to the red-legged *Caccabis rufa* as a "variety," instead of a species. It is high time that all sportsmen who attempt to write on natural history subjects should make themselves acquainted with the respective significations of the terms species, race, and variety. Before leaving birds, reference may be made to a statement that the smooth surface of the shells of the eggs of North African ostriches is probably brought about by grinding and polishing on the part of the Arabs from whom they are generally procured. It has, however, been pointed out in *The Field* that eggs of North African ostriches laid at Woburn and Tring prove the smooth surface to be natural.

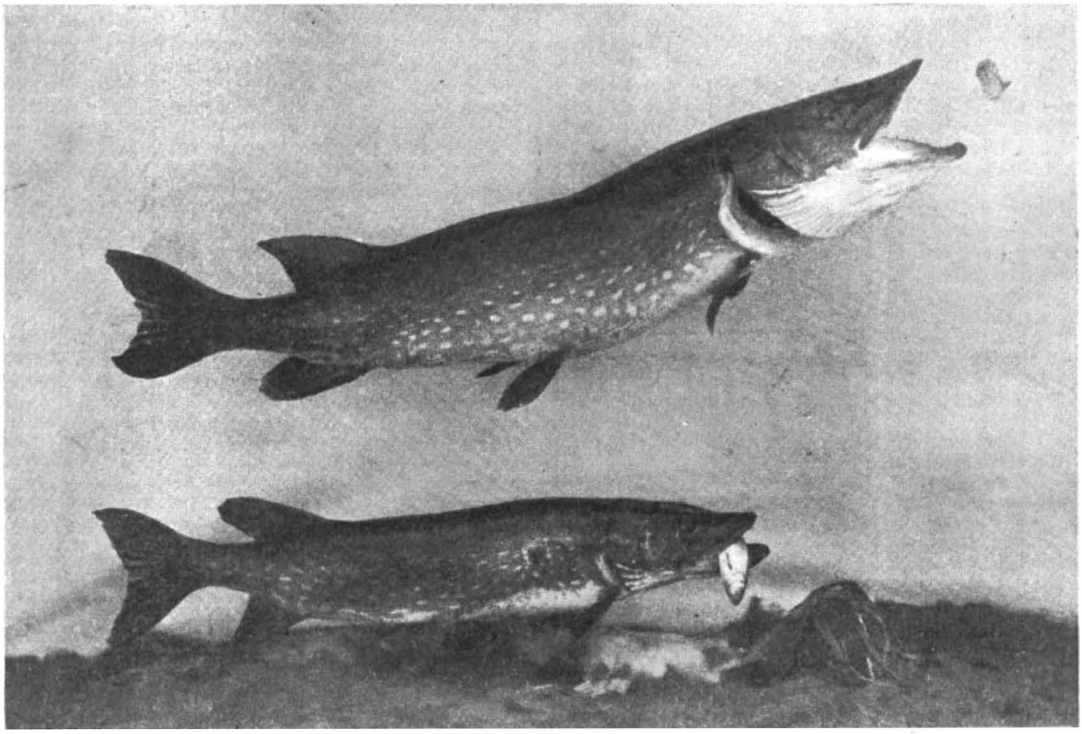
Many of the articles on big game are by Mr. H. A. Bryden, who always writes in a picturesque, if not strictly accurate, style. His worst blunder occurs under the heading Okapi, where it is stated that this animal "may be looked upon as a connecting-link between the giraffe and the antelope, having marked characteristics common to both races." If the okapi is nearly related to any family (not "race") of ruminants other than the giraffe group, it is to the deer, and not the antelopes, the alleged resemblance in bodily form to certain members of the latter group being a feature utterly devoid of systematic value.

Mr. Roosevelt communicates articles in both the third and fourth volumes on American game animals, such as peccari, prairie-chicken, pronghorn, puma, and turkey, all of which are admirable from the sportsman's point of view, although they do not enter deeply into the natural history of the subject.

From Mr R. B. Marston's excellent article on pike and pike-fishing in vol. iii. we reproduce a striking illustration of a pike feeding, other photographs in the fourth volume showing the mode in which salmon take their prey.

Among the zoological articles in vol. iv., it may be noted that the one on red deer appears in much the same form as in the original edition, the Manchurian *Cervus xanthopygus* being still affiliated to the European species instead of to the wapiti, while the Sikhîm *C. affinis* is erroneously stated to come close to the latter. The rhinoceros articles, on the other hand, have been well revised, and do full justice to the discovery of the white species in the heart of equatorial Africa. In the article on the rook, Mr. Harting expresses himself as being fully convinced of the value of these birds to the farmer; and the same authority is responsible for the articles on snipe and woodcock, which appear well up to date. Sir Henry Pottinger's article on rype, or ryper (ptarmigan), illustrated (like several of the other bird-articles in this volume) by one of Mr. Thorburn's exquisite paintings, is just what might be expected from such an experienced sportsman, and the same may be said with regard to Sir Herbert Maxwell's account of the salmon. Finally, it may be mentioned that although the author of the article on trout conceals his identity under the pseudonym of "John Bickerdyke," it is satisfactory to find that his view as to the specific unity of all forms of trout is in accord with that adopted by Mr. C. T. Regan in his new book on British fishes.

Without expressing any definite opinion as to the



Photo] Pike Feeding. From "The Encyclopædia of Sport." [*J. Turner-Turner.*

purely sporting articles, we may confidently state that, in spite of a certain number of errors and shortcomings, like those mentioned above, the "Encyclopædia of Sport" supplies in the main exactly the kind of information on natural history subjects the sportsman is likely to require. R. L.

THE PROPAGATION OF EARTHQUAKE WAVES.[1]

"DOS PALABRAS," or "two little words," has a much more friendly sound than the abrupt word "preface." "Preface," standing by itself, is suggestive of a snappy military command, something like "halt" or "quick march," whilst "Dos Palabras" is the kindly invitation of a writer to the public, asking them to read his work. In the "Dos Palabras" we are told that the ordinary person only thinks about earthquake prediction and that which is utilitarian, whilst the principal object of the seismologist is to extend human knowledge about the interior of our planet.

This memoir, which was presented to the American International Congress of Science held in Buenos Ayres in 1910, although dealing especially with the propagation of earthquake waves, gives in an introduction of forty-two pages a rapid review of many problems with which modern seismology deals. From the velocity with which earthquake waves are propagated through our world, we have already learned something new about the constitution of its interior. The conclusions arrived at by these velocities as bearing upon the rigidity of our world, together with investigations made by Lord Kelvin and others on the same subject, are briefly mentioned. References are made to the investigations of Prof. Ricco which indicate a relationship between the value of gravity and the seismic and volcanic phenomena of a district. But the more general relationship between the abnormal movements of magnetic needles, earthquake disturbances, and the value of g in localities characterised by the presence of volcanic rocks, has been overlooked.

Sunspots, unusual movements in bodies of water, the times at which geysers erupt, barisal guns, microphonic disturbances, abnormal earth currents and other phenomena, are pointed to as subjects which should arrest the attention.

Unexpected side issues in the daily work of a seismologist—as, for example, the effect of tidal load, the transpiration of vegetation, which is always wrinkling the face of our globe, the emotional effects produced by earthquakes upon man, their effects on the behaviour of certain animals, and the exploitation of many other byways—have been overlooked. These, however, have nothing to do with Dr. Negri's chief subject, which occupies the next seventy-three pages of his publication. This entirely deals with the velocity with which earthquake motion is propagated. He starts out with the assumption that in a teleseismic record we frequently see many phases, P_1, P_2, &c., and that there are as many corresponding velocities which are distinguished as V_1, V_2, &c. He derived this idea from the publications of Dr. Ōmori. With this assumption V_1 has a velocity of about 12·5 kilometres per second, V_8 would be about 2 kilometres per second, and V_{20}, if there is such a value, would be less than 0·5 per second, *i.e.* if all these phases of earthquake motion started from an origin at the same time. We fear that many seismologists will not readily accept this hypothesis, and to explain the rising and falling in amplitude and changes in period exhibited in teleseismic writings will require some other assumption. P_1, P_2, P_3, and their corresponding velocities, are explicable by the existence of three types of waves, but the lengthening of the caudal appendage of a megaseism as it travels into and sometimes beyond its quadrantal region is a phenomenon about which many explanations have been offered, but the one to be accepted does not appear so far to have been decided on.

In his conclusion to this section, Dr. Negri says that the relation of $\frac{V_1}{V_2}$, $\frac{V_1}{V_{3\frac{1}{2}}}$ (*sic*), $\frac{V_1}{V_6}$, &c., represents a series in increasing arithmetical progression. All that the majority of seismologists at present recognise is that in round numbers V_1 equals 12 kilometres, V_2 equals about 6 kilometres, and V_3 about 3 kilometres per second, and we fear that they are not yet in a position to accept values which might correspond to P_{20} or P_{40}. In an appendix the author shows that his acquaintance with modern seismology is rather one-sided. He gives a bibliography of 176 books and papers, nearly all of which are in the Italian or Spanish language. Japan is credited with thirteen papers, England with five, whilst two or three are in French. The first exhibition of seismological instruments, we are told, was represented by a section in the International Exhibition of 1900 in Paris. The exceedingly popular exhibition of earthquake instruments held in Tokio twenty years earlier is not even mentioned. The author concludes his memoir by two queries: Why do not all the students of seismology in South America combine? Why does not the national authority do something to bring about this union, which would be for the good and progress of science in general? It is my prophecy, says Dr. Negri, that these desires will very soon become realised. JOHN MILNE.

[1] "Velocidad de Propagición de las Ondas Sismicas." By Dr. G. Negri. Traducción de Alfredo Torcelli. Pp. 143. (La Plata: Observatoria Astronomico, 1911.)

PROF. GEORGE CHRYSTAL.

THE lamented death of Prof. George Chrystal, of Edinburgh University, removes an outstanding personality in academic and educational circles. Aberdeen and Cambridge claim him as a distinguished alumnus. In 1875 he was bracketed with Prof. Burnside as Second Wrangler and First Smith's Prizeman. Even then he showed his leaning towards applied rather than pure mathematics; for Prof. Tait, who was one of the examiners, used to say that Chrystal excelled all the others in the way in which he solved physical problems.

After two years as professor of mathematics in St. Andrews University, Prof. Chrystal in November, 1879, began his life's work as occupier of the like chair in Edinburgh. The nature of his work compelled him to give his best mind to the teaching of mathematics and the training of the mathematical teacher. In those days every student of arts had to graduate in the same seven subjects. There were no options. Even the comparatively mild problem-solving mathematics of the old school, of which Kelland had been a shining light, had made many a man of classical and philosophical attainments tremble as he entered the examination hall and sat down to tackle the algebra or the Euclidean geometry paper. But the first year of Chrystal's professoriate struck terror to their hearts. Keen, rapid, logical, full of suggestions as to higher fields of mathematical delights, Chrystal transformed the whole atmosphere of the class-room. Eagerly the mathematical minds followed his fascinating lead; despondingly and despairingly those not so gifted fell hopelessly behind, faintly perceiving, if at all, the finely knit sequence