flower and bring their pollen-covered under-side first in contact with the stigma, which slightly overtops the anthers. The flowers of *Lilium Martagon* must consequently be considered as adapted to cross-fertilisation by Lepidoptera.

The colour of these flowers, dark reddish brown, with dark purple dots on the inside, is not very striking, and in the daytime they are but slightly scented, whereas during the evening they emit a very attractive sweet odour. Hence we may safely conclude that they are far more attractive to crepuscular and nocturnal than to diurnal Lepidoptera.

Thus far, in Thuringia, in July 1873, I had succeeded in explaining the separate peculiarities of the flowers; but in vain had I watched them repeatedly during the evening in order to surprise the fertilisers in the very act of fertilisation. But the hope I had failed in when making every effort to realise it, happened to be fulfilled a year later, quite unexpectedly. In the Vosges, returning from the Hoheneck, and passing the village Metzerall, July 5, 1874, towards the evening, I was struck with the sight of flowering plants of *Lilium Martagon* growing in a garden hard by, and a specimen of *Macroglossa stellatarum* flying round them and fertilising them.

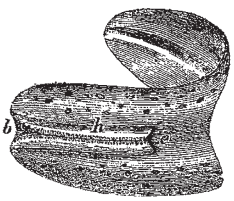

FIG. 64.—A single sepal or petal of this flower, magnified.

Freely fixed in the air by the rapid movement of his wings, this busy Sphinx inserted his long slender proboscis into the honey-channels of the sepals and petals, now of a single one, now of others of the same flower, and having done so immediately flew away to another flower. Yet, the flowers never being turned directly downwards, but somewhat inclined, all the honey-channels of any flower were never sucked by the Sphinx, but in every case only those of the uppermost sepals and petals. When sucking he always touched the stigmas and the anthers with his legs and under-side, and the latter ones were to be seen rocking and swinging. Thus, undoubtedly, the under-side of the Sphinx was dusted with pollen, and the stigma of the flower next visited, when first touched by the pollen-covered under-side, was cross-fertilised. A single Sphinx, with his vehement movements during a quarter of an hour, may easily visit and cross-fertilise plenty of flowers of *Lilium Martagon*. Nevertheless, self-fertilisation in many of these flowers will occur, where visits of Sphingidæ are wanting. For the stigma, by being bent upwards more decidedly than the anthers, comes frequently into contact with one or two of them; and C. Sprengel, who enclosed the yet unopened flowers of *L. Martagon* in a net, thus excluding all insects except some ants (and perhaps Thrips), was surprised to find that every capsule developed and matured its seeds.

Lippstadt HERMANN MÜLLER

NOTE ON THE HYRCANIAN SEA

THE resolution of the problems which are involved in the physical aspects of Western Turkestan, and which have offered so ample a scope for speculation, will probably be one of the earliest and most important consequences of the occupation of the banks of the Amú Darya by Russia. But, whatever may be the light which will thus be afforded to geographers, ethnologists, or historians, it is to be expected that the field of inquiry will widen and recede, in proportion as each step forward is made, along paths which have hitherto been shrouded in obscurity.

Among the observations which will demand, and which will most certainly fully repay, the greatest attention, are those which shall accurately determine the true rate of evaporation from the surface of Lake Aral. A meteorological observatory was established in June 1874 on the lower courses of the Amú, and its working will contribute much to a knowledge of the rate of local evaporation. It may be doubted, however, whether such observations as are recorded at Núkús will be of practical value for determining the desiccation going on in Lake Aral itself. In the absence of precise information we shall for some years be dependent upon data of doubtful trustworthiness, in regard to the aspect the lake may have presented at different epochs in past history.

Among such data there is an isolated observation which seems worthy of more attention than has hitherto been given to it. Between the years 1848 and 1858 Boutakoff found that the depth of water at the entrance of Abougir (the gulf at the south-west corner of Lake Aral, which is now entirely dry) had decreased by eighteen inches, or, in other words, at the rate of 0·05 yards per annum. This rate of decrease may possibly be not very exact; but it is approximately so, and may therefore serve, until better data are available, to draw some conclusions regarding the Aralo-Caspian Sea.

The chart of Lake Aral, compiled from the surveys of 1848-49, shows the waterspread to be about 24,500 square miles. The contour line drawn at a depth of twenty-four feet on this chart includes an area of about 18,300 square miles, *i.e.* the loss of surface is 6,200 square miles. For every yard of fall below its surface of 1848, Lake Aral, down to a depth of eight yards, loses a waterspread of 775 square miles. And since during the past twenty-seven years the surface has fallen $27 \times 0{\cdot}05 = 1{\cdot}35$ yards, the waterspread of 1875 will be $24500 - 775 \times 1{\cdot}35 = 24500 - 1046{\cdot}25 = 23453{\cdot}75 = 23454$ square miles, say. The mean of the two waterspreads of 1848 and 1875 will be $\frac{24500 + 23454}{2} = \frac{47954}{2} = 23977$ square miles, or 74,271,155,200 square yards; and this quantity multiplied by 0·05 gives 3,713,557,760 cubic yards as the volume of water lost by Lake Aral yearly since 1848, or a loss of 120 cubic yards per second.

The supply poured into Lake Aral by the Amú and by the Syr can only be guessed at, since it has probably fluctuated during the past twenty-seven years. At the present time the combined volume afforded by those two rivers may be taken at about 2,000 cubic yards per second; and this estimate is probably not ten per cent. removed from the actual truth. The evaporation, then, from the lake must be assumed to have been, since 1848, $2000 + 120 = 2120$ cubic yards per second, from a waterspread of 23,977 square miles, or 74,271,155,200 square yards, which is equal to an evaporation of 0·0026 yards per diem = 0·0936 inches per diem, or thirty-four inches per annum.

The physical aspects of the shores of Lake Aral suffice to show that in very recent times its level has been at least fifty feet higher than that of to-day. With this increased depth the waterspread would be about 36,500 square miles, or 113,062,400,000 square yards. The daily evaporation from this surface at 0·0026 yards will be 293,962,240 cubic yards, or 3,400 cubic yards per second. There was therefore a time (and that a recent one) when Lake Aral received a supply of 3,400 cubic yards per second; and, indeed, of more than that quantity. The Russian knowledge of the country, handed down by the great map of the sixteenth century, informs us that a river flowed from the Aral to the Caspian. The geographical MS. of (according to M. Vámbéry) Ibn Said el Belkhi, notices in the early part of the tenth century, the opinion that the two seas communicated; and this com-

munication could, and almost certainly did, take place in the following way.

The crest of the spur of the Ust Urt plateau, which formed the southerly limit of the now desiccated gulf Abougir, is about fifty feet above the present level of Lake Aral. Once filled up to that level, if the lake continued to receive more water than was evaporated from its surface, *i.e.* more than 3,400 cubic yards per second, an overflow would take place into the country now traversed by the channel called Uzboy, which has a gentle slope to the south of less than four inches per mile.* It is probable that the lands stretching from Uzboy westwards to the foot of the elevations encircling Karaboogas would have been flooded. Perhaps at this high level Aral may have discharged at its extreme north-western point also, and have flooded the country stretching round the northern foot of Ust Urt. On the north, it may have topped the low transverse ridge which now divides the northern and southern drainage. And if, in addition, the level of the Caspian was at that time some few feet higher than it now is, its waterspread would have advanced to meet the overflow from Aral, and Ust Urt and its narrow southern spurs, which run along the east shore of the Caspian, would have been isolated among marshes and shallow water. The classical geographers would thus have had ample grounds for the description they have handed down to us of the Sea of Hyrcania, as well as good reason for giving but a single name to the waterspread of the sea, since the separation of its basin from that of Aral would have become evident only after the fall of the level of this lake.

Until the separation became evident, this Aralo-Caspian Sea would have presented all those aspects which history tells us it has had. As the level gradually fell in Lake Aral, the inundated ground would become dryer; and in the first century of our era, as reported by the Chinese, the banks of the "Western Sea" would have been surrounded with great marshes. It may be doubted whether the Palus Oxiana of Ptolemy and the Oxian Marsh mentioned by Ammianus Marcellinus should be placed in this locality; but there is more probability that the Sinus Scythicus of Mela is identical with Lake Aral and its former southern marshy appendage, of which Uzboy is the axis.

The waterspread of such an Aralo-Caspian Sea would have added an area of about 70,000 square miles to the limits of the Caspian of to-day; and the evaporation from such a surface would have absorbed a supply from the rivers then feeding Lake Aral of about 7,000 cubic yards per second; in other words, a volume of water three-and-a-half times greater than that discharged by the mouths of the Amú and the Syr together at the present time.

If it be considered that at this epoch the greater, if not indeed the entire volume of the Oxus passed directly westwards into the Caspian, the difficulty is somewhat increased in finding an answer to the important question, where the large volume of water mentioned came from?

However, it is very probable that the Tchuy and the Sary Su discharged at that time into Lake Aral, instead of losing themselves, as they now do, in the sand. The Kenderlik of the great Russian chart, as well as the Demous, the Baskatis, and the Araxetes of the classics, together no doubt with many other minor streams, have disappeared in these countries, though their waters formerly would have fed Aral. Their disappearance seems to have been contemporaneous with the desiccation of the Oxus branch of the Caspian, at an epoch when those irruptions of Mongol hordes from the north-east were taking place, which swept away early Central Asian civilisation, and which subsequently caused the destruction of the Greco-Bactrian Monarchy. Whether this ruin of ancient social culture was accompanied by the destruction and wreck of a system of hydraulic works which were necessary for the cultivation of the soil, is a question whose answer possibly bears very nearly on the causes of the desolation which Nature now wears in the countries of Western Turkestan.

HERBERT WOOD

* See NATURE, vol. xi. p. 231.

THE COMMONS EXPERIMENTS ON ANIMALS BILL

THE Bill for the prevention of cruelty in experiments on animals, made for the purpose of scientific discovery, prepared and brought forward by Mr. Lyon Playfair, Mr. Spencer Walpole, and Mr. Evelyn Ashley, is of a very different character from that introduced by Lord Hartismere in the House of Lords and commented on in our last issue (NATURE, vol. xii. p. 21). In it no legislative interference is proposed in the case of operations performed for scientific purposes under the influence of anæsthetics, provided that the insensibility is continued throughout the experiment; immediately after which the animal is to be killed if it has been in any way seriously injured. In the case of operations performed on animals in which it is impossible to employ anæsthetics, it is proposed that those who wish to conduct them shall be required to obtain a license authorising their undertaking them, to obtain which from the Secretary of State a certificate must be produced signed by one at least of the following persons, viz.: the President of the Royal Society, or the Presidents of the Royal Colleges of Physicians or Surgeons of London, Edinburgh, or Dublin; and also by a Professor of Physiology, Medicine, or Anatomy in Great Britain. In the case of the applicant being himself one of the just-named professors, or an authorised lecturer on the same subjects, such a certificate is not to be required, but in its place his application would have to be signed by the registrar, president, principal, or secretary of the university or college with which he is connected. The license requires renewal each five years, except in the case of professors, with whom it lasts during their tenure of office. It extends to any person assisting the holder of the license, provided that the person assisting acts in the presence and under the direction of the holder of the license.

The penalty proposed for any contravention of the Act is a fine not exceeding fifty pounds, or imprisonment for a term not exceeding three months.

The whole tenour of this Bill is so much in accordance with our own feelings that we can say nothing against it. Physiological operations on the lower animals, when conducted under the full influence of anæsthetics, cannot shock the most sensitive-minded; and supposing the Bill passes, it will be in the power of all to see that nothing of a painful nature is undertaken. No definition of what is meant by pain is given, it is true; and the only improvement we can suggest is that one be added which prevents the employment of curare as an anæsthetic until its pain-killing power is demonstrated.

BALLOONING AND SCIENCE

THE number of aëronautical ascents in France has been greatly increased since the *Zenith* catastrophe attracted public notice to aërial questions. On Sunday, the 9th of May, not less than three different balloons went up in different places.

These ascents took place at Ivry, close to Paris, at 5.30, at Nantes at 5.40, and at Algiers at 3.45. In the three cases the balloonists experienced a change in the direction of the wind, varying greatly with altitude. The general direction of the Nantes balloon was south-east. The Paris balloon had a less velocity with a greater number of circuits, having ultimately run a distance of ten miles in two hours. The greatest velocity of the air was in close vicinity to the earth; this is an indication of a special current probably pro-