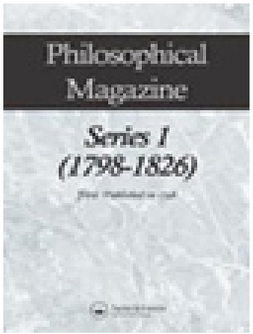

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VI. Experiments on bats deprived of sight

M. de Jurine

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flight as any other animals of the ſame ſpecies which enjoy the uſe of their eye-ſight.

M. Spallanzani tried the ſame experiments with the ſame reſult on the eyes of the horſe-ſhoe bat *(veſpert. ferrum equinum)*, the dwarf-bat, the great bat (*noctula*), and the bat of Buffon. M. Spallanzani is convinced that the other four ſenſes ſtill remaining to theſe animals cannot ſupply the want of ſight; and he is therefore of opinion that a *new organ*, perhaps a *new ſenſe*, which is wanting in the human ſpecies, may in them be put in activity by their being blinded. Profeſſor Vaſalli at Turin, Profeſſor Roſſi at Piſa, M. Spadone at Bologna, and M. Jurine at Geneva, repeated theſe experiments, and obſerved the ſame phenomena as thoſe mentioned by Spallanzani.

VI. *Experiments on Bats deprived of Sight by M.* DE JURINE.

From the Journal de Phyſique *for* 1798.

THE experiments of M. Jurine were made only on the long-eared bat (*veſpertilio aurilus*), and the horſe-ſhoe bat *(veſpert. ferrum equinum)*. The bats were procured from the vaults under the fortifications of Geneva in the months of December and January. The author firſt obviates ſome doubts reſpecting the places where theſe animals reſide in winter, as ſome of them have been found in a torpid ſtate in the trunks of old trees during that ſeaſon.

The author obſerves, that he found at the above ſeaſon, and in the ſame vaults, abundance of moths (*phalænæ*) and crane-flies (*tipulæ*), and thinks he here diſcovers one of thoſe wiſe diſpenſations of nature, by which other animals of more utility find a ſource of aliment when they could procure nothing in the atmoſphere at that rigorous ſeaſon.

The long-eared bat has ſix inciſive teeth in the under jaw, three-lobed, and cut into the form of a heart. The upper has four,

four, and unequal. The horſe-ſhoe bat has none in the upper jaw, except two ſmall ones in the membrane of the palate: the lower jaw is furniſhed with four. When the horſe-ſhoe bat attaches itſelf to a wall, it contracts its body, and wraps itſelf up in its fur in ſuch a manner that it might be taken for a black chryſalide. The long-eared bat appears leſs careful of itſelf, and firſt makes uſe of its hind feet, and then of thoſe before, in order to affix itſelf to a wall.

The temperature of the vaults which ſerved them for a habitation was between 50° and 57° Fahr. that of the external air between 27° and 30°. M. Jurine having expoſed ſome of theſe animals to a temperature between 36° and 39°, ſeveral of them periſhed, and others fell into a ſtate of torpidity; from which he was not able to rouſe them by any touching, though a gentle current of air directed againſt them cauſed them to make a movement, by drawing back the whole body on the hind legs, and this they repeated as often as the inſufflation was renewed. M. Jurine had before obſerved the ſame effect on mice. He remarked, however, that the approach of a candle agitated and awakened them, probably on account of the rarefaction of the ambient air. A violent agitation of the air by which they are ſurrounded makes them ſpeedily take wing.

During the torpid ſtate of theſe animals no movement is obſerved which can indicate that they breathe. A ſmall horſe-ſhoe bat, a large bat of the ſame ſpecies, and a long-eared bat were placed on a ſtove, and exhibited ſigns of life at different periods; but their inſpiration and expiration were extremely irregular, particularly thoſe of the long-eared bat. There is a ſtriking difference between the poſition of theſe two ſpecies of bats when they fix themſelves againſt any object. The horſe-ſhoe bat hooks itſelf all at once, with its head down and its legs upwards; while the long-eared bat turns itſelf round quietly, in order to aſſume very often an oblique poſition.

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The author then proceeds to the experiments which the illuſtrious Spallanzani undertook before, but in which great ſcope was ſtill left for the imagination. The author ſeems to have found the deſideratum which his predeceſſor left for thoſe who might follow him in the ſame path.

He extended in an apartment ſeveral willow twigs three feet in length, at the diſtance of ſix inches from each other, and let looſe two bats, which paſſed and repaſſed between them, without touching them at all with their wings, and which, when their flight was ended, always attached themſelves to the ſame cornice. The author then cut out their eyes; during which operation, the long-eared bat ſuffered a conſiderable hemorrhage from the ocular orbits. Being let looſe in that ſtate, they ſtill flew to the ſame interſtices. Theſe being barred up, they made choice of others, through which they paſſed ſeveral times, always avoiding to touch the twigs with their wings, and for that purpoſe they paſſed obliquely.

The long-eared bat ſometimes ſtretched out its neck, and as it were made choice of that object to which it wiſhed to attach itſelf; a cuſtom which it had before it was blinded. It often applied one of its hind paws to its eye; collected the liquid which exuded from it, and then applied it with avidity to its mouth. Theſe two bats lived a long time after they were deprived of ſight. Two long-eared bats, the one blind, and the other having the perfect uſe of its ſight, were let looſe together. The blind one always followed its companion, even obſerving the ſmalleſt ſinuoſities of its courſe. The bat which ſaw, paſſed between the twigs with leſs delicacy than the blind one.

M. Jurine then extended a net with large meſhes, after making a breach in it. The long-eared bat which ſaw, paſſed through it immediately; but the blind one ſtopped ſhort, went all over the net, and, having found the breach, paſſed through without touching it, and then ſoon joined its com-

companion, which it afterwards followed wherever it flew. Of what uſe then is ſight to the bat, and what is the organ that ſupplies its place?

The author then imagined that the ſolution of this problem could be found only by anatomical reſearches. During the courſe of theſe, he found the organ of hearing very great in proportion to that of other animals, and a conſiderable nervous apparatus aſſigned to that part. The upper jaw alſo is furniſhed with very large nerves, which are expanded in a tiſſue on the muzzle.

M. Jurine then extended his experiments to the organ of hearing and that of ſmell. Having put a ſmall hood on a long-eared bat, it immediately pulled it off, and flew. He ſtopped up its ears with cotton, but it freed itſelf in the like manner from that inconvenience. He then put into its ears a maſtic of turpentine and wax. During the operation the animal ſhewed a great deal of impatience, and flew afterwards very imperfectly.

A long-eared bat, the ears of which had been bound up, flew very badly: but this did not ariſe from any pain occaſioned by the ligature; for, when its ears were ſewed up, it flew exceeding well. In all probability the animal would have preferred having its ears bound up to having them ſewed. Sometimes it flew towards the ceiling, extending its muzzle before it ſettled.

M. Jurine poured liquid pomatum into the ears of a bat which enjoyed the uſe of its ſight. It appeared to be much affected by this operation; but when the ſubſtance was removed, it took flight. Its ears were again filled, and its eyes were taken out; but it flew then only in an irregular manner, without any certain or fixed direction.

The ears of a horſe-ſhoe bat, which had the uſe of its ſight, were filled with tinder mixed with water. It was uneaſy under the operation, and appeared afterwards reſtleſs and ſtunned; but it conducted itſelf tolerably well. On being blinded, it ruſhed with its head againſt the ceiling, beat the

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ozier twigs with its wings, and made the air reſound with ſtrokes which it gave itſelf on the muzzle. This experiment was repeated on other bats with the like effects.

The tympanum of a large horſe-ſhoe bat was pierced with a pin (*trois-quart*). The animal appeared to ſuffer much from the operation, and fell down in a perpendicular direction when thrown into the air. It died next morning. The ſame effect was produced on piercing the tympanum of a long-eared bat with a needle.

The author then made very accurate reſearches on the difference between the organiſation of the brain of theſe two kinds of bats, and, after a careful diſſection, found that the eye of the long-eared bat is much larger than that of the horſe-ſhoe bat, but that the optic nerve is proportioned to it. The outer part of the ear of the former is much larger than that of the latter, but the interior part is ſmaller.

The horſe-ſhoe bat is indemnified for this difference by a greater extenſion of the organ of ſmell, as evidently appears when the external elevations and irregularities of its muzzle are examined. When it is about to take flight, it agitates its noſe much more than the long-eared bat.

From theſe experiments the author concludes, firſt, that the eyes of the bat are not indiſpenſibly neceſſary to it for finding its way; ſecondly, that the organ of hearing appears to ſupply that of ſight in the diſcovery of bodies, and to furniſh theſe animals with different ſenſations to direct their flight, and enable them to avoid thoſe obſtacles which may preſent themſelves. The author alſo found on theſe animals a particular kind of fleas.