" obſtetrices. Verum id noluit mater puerpera. " Pietati ejus obſecundavit fortuna. Lingua enim " inferior paulatim emarcuit, et in exiguam piſoque " haud majorem lingulam, quæ hodienum manet, " contracta eſt. Lingua interim ſuperior ad juſtam " crevit magnitudinem, quamplurimis longis pro- " fundiſque ſulcis diſtincta, an vulneribus laniata, " dicam! quæ parallelo ſitu poſita una cum lingua " creverunt, neque unquam coitura eſſe videntur." Nat. *Nov.* ix. 1664. Ob. 1694-5. *Mart.* 5. Æt. 31.

It appears by this Journal of himſelf that he was always infirm and ſickly. *

XIV. *Upon the* Sounds *and* Hearing *of* Fiſhes, *by* Jac. Theod. Klein *R. P.* Gedan. *F.R.S. or Some Account of a Treatiſe, intitled,* "An " Inquiry into the Reaſons why the Au- " thor of an Epiſtle concerning the Hear- " ing of Fiſhes endeavours to prove they " are all mute and deaf;" *by* Richard Brocklesby *M. D. F. R. S.*

Read March 10. 1747-8.

OUR Author in the firſt place claſſes them into two Orders, the firſt hath Lungs, the other is furniſh'd with Organs analogous to Lungs, which we call Fiſh-Ears, or Gills: All the Whale-Kind, the Dolphin, Porpoiſe, and ſuch like, have Lungs. There are two Families of the ſecond Claſs, to one of them belongs all that Tribe,

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* See the Account of *Margaret Cutting*, who ſpeaks without a Tongue, in theſe *Tranſ.* N°. 484, *p.* 621.

Tribe, which have one, two, five, or nine Air-Holes, at the Back, or Sides of the Head, or in their *Thorax*, in which concealed Gills are found: The other Family comprehends all Kinds of Fiſhes, whoſe Gills are uſually placed on each Side the Back of the Head. Our Author's Antagoniſt alleges, that all Fiſhes of both Orders are equally deaf; but that all Naturaliſts except Mr. *Reaumur* are of a contrary Opinion, that Fiſhes hear diſtinctly.

Our Author begins with an Air of Ridicule, and ſhews how far the Letter-writer is ignorant of the various Opinions, modern as well as antient. Our learned Countryman Mr. *Ray* thinks to reconcile theſe, by allowing that ſome hear, while others are deaf; but the greateſt Part allow that Fiſhes actually hear; and moſt, except *Scheuchzer*, ſeem agreed about the auditory Paſſages. But the Letter-writer denies they have any Organs of Voice, merely upon the proverbial Authority, *Mute as a Fiſh*; hence he concludes they are likewiſe deaf. But in Anſwer, 'tis replied, the ſpouting Whale hath all its internal Organs, preciſely ſimilar to the Organs of Voice in other Creatures, and therefore they may anſwer the ſame Purpoſes, nay actually ſerve this End: For when the Whales in the *Greenland* Fiſhery are ſtruck, they roar frequently ſo loud, as to be heard at two *French* Miles Diſtance.

But ſome of the firſt Family of our ſecond Claſs, as the Skate, Lamprey, Conger, and others, our Author hath heard utter ſome kind of Noiſe; and gives his Opinion, that moſt Sorts of cartilaginous Fiſhes can do the ſame. From Analogy he argues, that as no Beaſt, from the Lion to the meaneſt Ani-

mal, nor from the Eagle to the humming Bird, but can utter a Voice, ſo he thinks the ſame general Law is obſerv'd in the Oeconomy of Fiſhes: But at the ſame time our Author here ſeems to lay too much Weight upon what he ſuppoſes final Cauſes, and metaphyſical Arguments, which have in all Ages ruin'd Natural Philoſophy.

But the Letter-writer queries, whether Fiſhes may not be mute in our Air, and yet capable of ſome Voice in their own Element. Our Author takes the Noiſe which Carp and ſuch Fiſh make in hot Weather, on the Surface of the Water, to be a Voice: And this is moſt remarkable when the Male impregns the Row which the Female has before depoſited; yet this is often heard, when the Fiſh is 6 or 7 Inches under Water. Our Author further enumerates many foreign Fiſhes, and particularly our Smelt, which put alive into Vinegar hiſſes very audibly.

The Letter writer had objected againſt Fiſhes, that they have no Occaſion for Hearing, becauſe they never copulate, as other Animals do: But our Author deſcribes the Manner of Whales, which is performed as that of other Animals; and obſerves, that they bring forth their Young alive: Theſe follow the Female, and ſuck Milk from the Teats, which are placed in them near the Organs of Generation; and in violent Storms the Dam takes her Off-ſpring into her Mouth, and protects them from Danger. This laſt is common to ſeveral of the Skate-kind.

The Letter-writer alleges, That Fiſh never ſleep; but our Author aſſures us, all ſuch as have Lungs do in the Night-time, thruſting up their Noſtrils into

the open Air. For others he cannot be poſitive, as their Hiſtory is little known.

The Letter-writer premiſes two Queſtions; firſt, Whether Fiſhes have any Ears? or, If the Gills ſerve the ſame Purpoſe? and anſwers poſitively in the Negative to both: And therefore concludes they cannot hear. But our Author aſſerts, that Snakes, Frogs, Chameleons, and others of the Lizard-kind, actually hear, without any of the uſual external *Apparatus* of Hearing. For though they want the Auricles and Ears, yet have they auditory Paſſages, by which Sound is convey'd, and even internal Organs, to which the *Meatus auditorius* reaches. But our Author farther aſſerts, that all the Whale-kind, and in general ſuch Fiſhes as have Lungs, have likewiſe a *Meatus auditorius*, and the internal Organs of Hearing; and appeals to a public Diſſection of a Porpoiſe, and another Fiſh of the Whale-kind, made by himſelf; in which the *Os petroſum*, with the other Parts of theſe Organs, had been ſeparately ſhew'd; and calls in the concurrent Teſtimony of Dr. *Tyſon*, in his Anatomy of a Porpoiſe.

Thus having ſatisfied us about ſuch Fiſh as have Lungs, he goes on to conſider the cartilaginous Species, ſuch as the Skate, Ray, and kind of Lamprey, which have Organs of Generation, and copulate like Brutes; yet exclude the *Fœtus* while yet in the Egg-State: And this from Analogy, that theſe, and in general all other Fiſh, as they have Organs which ſerve them for Lungs, ſo they may have what anſwers in others to the *Apparatus* of Hearing.

In Proof of this he aſſerts, that all Kinds of Fiſh but theſe which have Lungs, are always found to have

have Stones in their Heads naturally form'd, and invariably plac'd in the ſame Situation, being join'd to the contiguous Parts with Ligaments and Nerves, which take their Riſe from the Subſtance of the Brain; and having examin'd the Head of a Pike minutely with a Microſcope, he diſcover'd the auditory Pores in the Stones, and perſuades himſelf, that three Pair of Stones are to be referr'd to this Uſe; therefore concludes, as there is ſome Analogy in the Organs, that all Fiſhes in ſome meaſure hear.

The Letter-writer farther objects, that Water is not the Medium of Sounds; and though Air is actually contain'd in all Water, yet it cannot be put into Undulations, any more than the circumambient Water; but that would require a much greater Vibration than the external Air can give. Thus, ſays he, if a Perſon immerge his Head a Foot under Water, he will hear nothing but a boiling Din; and however great a Noiſe is made in the open Air, the Event will be ſtill the ſame; and if the Water itſelf be put into the moſt violent Agitation, the Perſon will diſcover no Odds in that Senſation of his Ears from what he perceived in the ſtilleſt Water. Hence he concludes Water incapable of tranſmitting Sounds. Our Author replies, That as Fiſhes are unanimouſly agreed to be capable of ſmelling, ſo, by Analogy, it is probable they have Hearing; for Odours are convey'd by the Air, as well as Sound. But he thinks the unnatural Poſition of a Man's Head immerg'd a Foot under Water may be ſome Cauſe for that confuſed Noiſe, and oppoſes the experimental Teſtimony of Abbè *Nollet* himſelf, who went different Depths under Water, to ſatisfy

himſelf how far Sounds could be convey'd in that Medium.

At four Inches under Water he heard the Sound of a Gun diſcharged, of a Clock ſtriking, and of a Hunter's Horn: Theſe, repeated at different Depths, were heard firſt at 4, then at 8, afterwards at 18 Inches, and laſtly at two Foot. A Man's Voice was alſo heard in the ſame Manner.

At different Altitudes of Water, none of them exceeding two Feet, he could perfectly diſtinguiſh mixt Sounds, when two Bells were ſtruck, or two Pipes ſounded together.

He could diſtinguiſh under Water, very diſtinctly, Words utter'd aloud: And prov'd this Aſſertion, by declaring, when he came above Water, what was ſaid while he was under it.

All Sounds were heard more faintly, and attenuated; yet the Difference of the Sound, at 4 and 18 Inches Depth, was not anſwerable to the Difference of the Altitude of Water.

He obſerv'd at firſt, that momentary Sounds were not ſo well convey'd as continu'd; yet he afterwards determin'd, at the ſame Depth, one Tap of a Drum-head, as plainly as a continued Round. This he thinks was the ſame in a Man's Voice, and the Sound of a Pipe; but ingenuouſly owns, he was not fully ſatisfied in this Experiment; and therefore does not lay as great Streſs on its Certainty as on the former.

Laſtly, he held his Head under the Surface of the Water, ſo as barely to cover him; but could not hear the Clock ſtrike, which was audible in the open Air at 45 Feet Diſtance, eſpecially on a Plain.

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The Abbè therefore concludes, if Fiſhes do not actually hear, 'tis for want of proper Organs, and not becauſe the Medium cannot convey Sounds.

Our Author mentions the common Notion of Carp, and other Fiſh, coming out of their Holes at the Sound of a Bell to be fed; and adds a Story, which Mr. *Boyle* ſomewhere relates, that near *Geneva* a Man had a Fiſh-pond, whoſe Banks were ſo high from the Plain on which it was, that one could not look over them into the Pond; and therefore it was impoſſible the Fiſh could ſee the Perſon; yet they were at any time conven'd at certain Sounds by the Gardener, in order to be fed, as a creditable Perſon aſſerts.

The Letter-writer, having made a high Partition in a Pond, watch'd while an Accomplice behind it made a very great Noiſe, and diſcharg'd a Gun, in order to frighten the Fiſh (if poſſible) that were playing on the Surface of the Water; but they did not give any Attention; yet as ſoon as ever they came in Sight, the Fiſh immediately made off.

Our Author thinks this Objection of little Weight, becauſe the Queſtion is not, whether Fiſhes, when they ſee nothing, can be frightened by Sounds only.

Upon the Whole, our Author ſhews himſelf an experienc'd and diligent Naturaliſt, and will (if I miſtake not) be allow'd to have fully prov'd the Falſity of any Aſſertion, that all Fiſh are intirely mute and deaf.