XI. *An Account of the* Gymnotus Electricus, *or Electrical Eel. In a Letter from* Alexander Garden, *M. D. F. R. S. to* John Ellis, *Esq. F. R. S.*

SIR,

Charles-Town, South Carolina, Aug. 14, 1774.

Redde, Feb. 23, 1775.

A FEW days ſince, I went to ſee ſome very curious fiſh, which were brought here about nine or ten weeks ago from Surinam; and I was both ſurprized and delighted to obſerve their ſtrange ſhape, and experience their wonderful properties. I had before received ſome vague account of ſuch a fiſh; but I always thought, that much of what I heard was fabulous. There are five of theſe fiſhes now here, of different ſizes, from two feet in length to three feet eight inches. The following deſcription was made out from the longeſt and largeſt. It might have been much more accurate, if there had been a poſſibility of handling the fiſh, and examining it leiſurely; or if I could have had a dead ſpecimen, as many things relating to the internal and external ſtructure could in that caſe have been more exactly aſcertained. But this fiſh hath the amazing power of giving ſo ſudden and ſo violent a ſhock to any perſon that touches it, that there is, I think, an abſolute impoſſibility of ever examining accurately a living ſpecimen,

ſpecimen; and the perſon who owns them rates them at too high a price (not leſs than fifty guineas for the ſmalleſt) for me to get a dead ſpecimen, unleſs one ſhould die by accident; if that ſhould happen, you may depend on having a more exact and accurate account for the Society.

GEORGE BAKER, mariner, who brought them here, intends to carry them to England; but as it is very uncertain whether they will arrive in health and all alive, I have recommended to him to get a ſmall caſk of rum, with a large bung, into which he may put any of them that may die, and ſo preſerve them for the inſpection and examination of the curious when he arrives.

The largeſt of theſe fiſh was three feet eight inches in length, when extending itſelf moſt, and might have been from ten to fourteen inches in circumference about the thickeſt part of his body. The head is large, broad, flat, ſmooth, and impreſſed here and there with holes, as if perforated with a blunt needle, eſpecially towards the ſides, where they are more regularly ranged in a line on each ſide. The *roſtrum* is obtuſe and rounded. The upper and lower jaws are of an equal length, and the gape is large. The noſtrils are two on each ſide; the firſt large, tubular, and elevated above the ſurface; and the others ſmall, and level with the ſkin, placed immediately behind the verge of the *roſtrum*, at the diſtance of an inch aſunder. The eyes are ſmall, flattiſh, and of a blueiſh colour, placed about three quarters of an inch behind the noſtrils, and more towards the ſides of the head. The whole head ſeems to be well ſupported;

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but whether with bones or cartilages, I could not learn. The body is large, thick, and roundiſh, for a conſiderable diſtance from the head, and then gradually grows ſmaller, but at the ſame time deeper, or becomes of an *acinaciform* ſhape, to the point of the tail, which is rather blunt. There are many light-coloured ſpots on the back and ſides of the body, placed at conſiderable diſtances in irregular lines, but more numerous and diſtinct towards the tail. When the fiſh was ſwimming, it meaſured ſix inches in depth near the middle, from the upper part of the back to the lower edge of the fin, and it could not be more than two inches broad on the back at that place. The whole body, from about four inches below the head, ſeems to be clearly diſtinguiſhed into four different longitudinal parts or diviſions. The upper part or back is roundiſh, of a dark colour, and ſeparated from the other parts on each ſide by the *lateral lines*; which, taking their riſe at the baſe of the head, juſt above the pectoral fins, run down the ſides, gradually converging, as the fiſh grows ſmaller, to the tail, and make ſo viſible a depreſſion or furrow in their courſe, as to diſtinguiſh this from the ſecond part or diviſion, which may be properly called the body, or at leaſt, appears to be the ſtrong muſcular part of the fiſh. This ſecond diviſion is of a lighter and more clear blueiſh colour than the upper or back part, and ſeems to ſwell out ſomewhat on each ſide, from the depreſſion of the lateral lines; but, towards the lower or under part, is again contracted, or ſharpened into the third part, or *carina*. This *carina*, or heel, is very diſtinguiſhable

tinguiſhable from the other two diviſions, by its thinneſs, its apparent laxneſs, and by the reticulated ſkin of a more grey and light colour, with which it is covered. When the animal ſwims gently in pretty deep water, the rhomboidal reticulations of the ſkin of this *carina* are very diſcernible; but when the water is ſhallow, or the depth of the *carina* is contracted, theſe reticulations appear like many irregular longitudinal *plicæ*. The *carina* begins about ſix or ſeven inches below the baſe of the head, and gradually widening or deepening as it goes along, reaches down to the tail, where it is thinneſt. It ſeems to be of a ſtrong muſcular nature. Where it firſt takes its riſe from the body of the fiſh, it ſeems to be about one inch or one inch and an half thick, and is gradually ſharpened to a thin edge, where the fourth and laſt part is ſituated; *videlicet*, a long, deep, ſoft, wavy fin, which takes its riſe about three or four inches at moſt below the head, and runs down along the ſharp edge of the *carina* to the extremity of the tail. Where it firſt riſes it is not deep, but gradually deepens or widens as it approaches to the tail. It is of a very pliable ſoft conſiſtence, and ſeems rather longer than the body. The ſituation of the *anus* in this fiſh is very ſingular, being placed underneath, and being about an inch more forward than the pectoral fins, and conſequently conſiderably nearer the *roſtrum*. It is a pretty long *rima* in appearance; but the aperture muſt be very ſmall, as the formed excrements are only about the ſize of a quill of a common dunghill fowl. There are two pectoral (if I

may call them ſo) fins, placed one on each ſide, juſt behind the head, over the *foramina ſpiratoria*, which are ſmall, and generally covered with a lax ſkin, ſituated in the *axillæ* of theſe fins. Theſe fins are ſmall for the ſize of the fiſh, being ſcarcely an inch in length, of a very thin, delicate conſiſtence, and orbicular ſhape. They ſeem to be chiefly uſeful in ſupporting and raiſing the head of the fiſh when he wants to breathe, which he does every four or five minutes, by raiſing his mouth out of the water. This ſhews that he has lungs and is amphibious, and the *foramina ſpiratoria* ſeem to indicate his having *branchiæ* likewiſe; but this I only offer as a conjecture, not being certain of the fact. I muſt now mention the appearances of a number of ſmall croſs bands, annular diviſions, or rather *rugæ* of the ſkin of the body. They reach acroſs the body down to the baſe of the *carina* on each ſide; but thoſe that croſs the back ſeem to terminate at the lateral lines, where new rings take their riſe, not exactly in the ſame line, and run down to the *carina*. This gives the fiſh ſomewhat of a worm-like appearance; and indeed it ſeems to have ſome of the properties of this tribe, for it has a power of lengthening or ſhortening its body to a certain degree, for its own conveniency, or agreeable to its own inclination. I have ſeen this ſpecimen, which I have meaſured three feet eight inches, ſhorten himſelf to three feet two inches; but beſides this power of lengthening or ſhortening his body, he can ſwim forwards or backwards with apparently equal eaſe to himſelf, which is another property

perty of the vermicular tribe. When he ſwims forward, the undulation or wavy motion of the fin and *carina* begin from the upper part, and move downwards; but when he ſwims backwards, and the tail goes foremoſt, the undulations of the fin begin at the extremity of the tail or fin, and proceed in ſucceſſion from that backwards to the upper part of the body; in either caſe he ſwims equally ſwift. Every now and then the fiſh lays himſelf on one ſide, as it were, to reſt himſelf, and then the four ſeveral diviſions of his body abovementioned are very diſtinctly ſeen; *videlicet*, the vermiform appearance of the two upper diviſions; the retiform appearance of the *carina*; and the laſt, or dark-coloured fin, whoſe rays ſeem to be exceedingly ſoft and flexible, and entirely at the command of the ſtrong muſcular *carina*. When he is taken out of the water, and laid on his belly, the *carina* and fin lye to one ſide, in the ſame manner as the ventral fin of the *Tetraodon* does, when he creeps on the ground. I have been the longer and more particular in the deſcription of the external ſtructure of this animal's body, becauſe I think, as it is of a moſt ſingular nature, and endowed with ſome amazing properties, even the moſt minute circumſtance I was able to obſerve relating to it ſhould be mentioned.

The perſon to whom theſe animals belong, calls them *Electrical Fiſh*; and indeed the power they have of giving an electrical ſhock to any perſon, or to any number of perſons who join hands together, the extreme perſon on each ſide touching the fiſh, is their moſt ſingular and

aſtoniſhing property. All the five we have here are poſſeſſed of this power in a very great degree, and communicate the ſhock to one perſon, or to any number of perſons, either by the immediate touch of the fiſh with the hand, or by the mediation of any metalline rod. The keeper ſays, that when they were firſt caught, they could give a much ſtronger ſhock by a metalline conductor than they can do at preſent. The perſon who is to receive the ſhock muſt take the fiſh with both hands, at ſome conſiderable diſtance aſunder, ſo as to form the communication, otherwiſe he will not receive it; at leaſt I never ſaw any one ſhocked from taking hold of it with one hand only: though ſome have aſſured me, that they were ſhocked by laying one hand on him. I myſelf have taken hold of the largeſt with one hand often, without ever receiving a ſhock; but I never touched it with both hands, at a little diſtance aſunder, without feeling a ſmart ſhock. I have often remarked, that when it is taken hold of with one hand, and the other hand is put into the water over its body, without touching it, the perſon received a ſmart ſhock; and I have obſerved the ſame effect follow, when a number joined hands, and the perſon at one extremity of the circle took hold of, or touched the fiſh, and the perſon at the other extremity put his hand into the water, over the body of the fiſh. The ſhock was communicated through the whole circle, as ſmartly as if both the extreme perſons had touched the fiſh. In this it ſeems to differ widely from the *torpedo*, or elſe we are much miſinformed of the manner

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in which the benumbing effect of that fiſh is communicated. The ſhock which our Surinam fiſh gives, ſeems to be wholly electrical; and all the phænomena or properties of it exactly reſemble thoſe of the electric *aura* of our atmoſphere when collected, as far as they are diſcoverable from the ſeveral trials made on this fiſh. This ſtroke is communicated by the ſame conductors, and intercepted by the interpoſition of the ſame original electrics, or electrics *per ſe* as they uſed to be called. The keeper of this fiſh informs me, that he catched them in Surinam river, a great way up, beyond where the ſalt water reaches; and that they are a freſh water fiſh only. He ſays, that they are eaten, and by ſome people eſteemed a great delicacy. They live on fiſh, worms, or any animal food, if it is cut ſmall, ſo that they can ſwallow it. When ſmall live fiſhes are thrown into the water, they firſt give them a ſhock, which kills or ſo ſtupifies them, that they can ſwallow them eaſily, and without any trouble. If one of theſe ſmall fiſhes, after it is ſhocked, and to all appearance dead, be taken out of the veſſel where the electrical fiſh is, and put into freſh water, it will ſoon revive again. If a larger fiſh than they can ſwallow be thrown into the water, at a time that they are hungry, they give him ſome ſmart ſhocks, till he is apparently dead, and then they try to ſwallow or ſuck him in; but, after ſeveral attempts, finding he is too large, they quit him. Upon the moſt careful inſpection of ſuch fiſh, I could never ſee any mark of teeth, or the leaſt wound or ſcratch on them. When the electrical fiſh

are hungry, they are pretty keen after their food; but they are ſoon ſatisfied, not being able to contain much at one time. An electrical fiſh of three feet and upwards in length cannot ſwallow a ſmall fiſh above three or at moſt three inches and a half long. Since I wrote the above deſcription and remarks, I have had Mr. BANCROFT's Eſſay on the Natural Hiſtory of Guiana put into my hands, in which I find an account of this animal; but, as I think that he has not been very particular in the deſcription of it, I reſolved ſtill to ſend you the above account, that you might judge for yourſelf. I obſerve, that his account or deſcription and mine differ in ſeveral things; and amongſt others, where he ſays, that thoſe fiſh were uſually about three feet in length; but the one, of which I have ſent a ſlight deſcription, was three feet eight inches. This ſmall variation might indeed have happened without any error; but I am told, that ſome of them have been ſeen in Surinam river upwards of twenty feet long, whoſe ſtroke or ſhock proved inſtant death to any perſon that unluckily received it.

I ſhall be on the watch to procure a more accurate knowledge of, and acquaintance with, this animal; and if I can learn any thing farther about it, you may depend on my communicating it.

XII. *Experiments*