Some account of the Siren lacertina, and other species of the same genus of amphibious animals. In a letter from Professor Barton, of Philadelphia, to Mr. John Gottlob Schneider, of Saxony / [Benjamin Smith Barton].

SOME ACCOUNT

OF THE

SIREN LACERTINA,

AND OTHER SPECIES OF THE SAME GENUS

OF

AMPHIBIOUS ANIMALS.

IN A LETTER FROM PROFESSOR

BARTON,

OF PHILADELPHIA,

TO MR. JOHN GOTTLOB SCHNEIDER.

OF SAXONY.

NOTE.

THE following pages, though drawn up in the form of a letter to Mr. Schneider, a late celebrated writer on the AMPHIBIOUS ANIMALS, have never been seen in *manuscript* by that gentleman. Only fifty copies of the work are printed, and these will be distributed among a few of my friends, chiefly foreign Naturalists. It is my wish that the *entire* work may not, on any account, be republished by any of those gentlemen to whom I may transmit copies. I have no objection to its being carefully examined, criticised upon, and quoted, or referred to.—At some future period, I shall publish a much more finished account of the American species of Siren, or Proteus. I have already, indeed, since the original date of my letter to Mr. Schneider, in April, 1807, greatly extended my acquaintance with these animals; and have nearly completed the *anatomical* history of one of the species: and illustrated the anatomy of the parts by fine drawings. All these will ultimately be laid before the public.—The pages now circulated among my friends, may serve at least to amuse them, and to remove some of their doubts concerning one of the most curious families of animals, in that vast, various, and interesting assemblage, to which the naturalists have given the name of AMPHIBIA.

BENJAMIN SMITH BARTON, M. D.

PHILADELPHIA,
August 19th, 1808.

SIR,

VERY lately, I received, through the kindness of one of my foreign correspondents, the two first fasciculi of your *Historia Amphibiorum naturalis et literaria*. I have not yet had time to peruse the whole of the work; but having looked, with attention, into various parts of it, I do not hesitate to consider it as one of the more important works on Zoological science, that have appeared for many years. In return for the real satisfaction which your History has afforded me, I beg leave to call your attention to a few scattered facts and observations, relative to one of the most interesting subjects of investigation in the whole science of AMPHIBIOLOGY.

I cannot adopt your opinion, that the SIREN described by Mr. Ellis, Mr. John Hunter, and other naturalists, is nothing but the *cordylus* (or *larva*) of a species of LACERTA, or SALAMANDRA. I have lately paid particular attention to the history and structure of one of the Carolina species of Siren, and I am now thoroughly convinced, that this singular "Amphibious Bipes," concerning which so much has been written, and conjectured, is, in reality, a *finished* animal; which never looses its branchiae, or gills, but continues to respire by means of them, as well as by lungs, during the whole period of its life.

I am far from flattering myself, that you will become an easy convert to my opinion on this subject. Yet, I

cannot doubt, that the facts and observations which I am to communicate to you, will lead you to review, with attention, that part of your history which relates to the Siren, and to its congeneres the Proteus anguinus, the Proteus Tritonius, and several other animals, which you and others (since the first appearance of the *Tables* of Hermann) have considered as mere larvae of lacertae, or salamandrae. Should I only succeed in leading you to *doubt*, whether your favourite positions concerning these singular amphibious animals be well founded, I shall not regret the time which I have devoted to this imperfect view of the history of the American Siren, or Proteus.

If the Siren be only a cordylus, or larva, is it not remarkable, that we have never yet been able to discover the salamander into which (if I may be permitted the expression) it is ultimately converted, or transformed? For the Siren is by no means an uncommon animal, in many parts of North-America. We find it in the Floridas, in Georgia, in the Carolinas, and in Virginia. I have even pretty good authority for assigning to it a more northern latitude, than the most northern parts of Virginia. But in vain have we sought, in the great tract of country which I have mentioned, for any species of salamander, of which the Siren can, with the smallest degree of probability, be supposed to be the larva.

In South-Carolina, from whence we originally received the animal, and the earliest intimations concerning its manners and fabric, the favourite habitations of the Siren are the rice-ponds, and the adjacent muddy

grounds. These ponds and grounds are almost daily examined, in those seasons of the year in which the Sirens are most commonly seen. But neither the planters nor the negroes meet with any *large* animals of the extensive order of *Lacertae*, if we except the common Crocodyle of the country, of which it is not necessary to say, that the Siren *cannot* be the larva. It may not be amiss to add, in this place, that as our largest species of salamanders* are scarcely less ready to take the hook, when it is baited with fresh meat, worms, &c., than the eel and other species of fish, we can hardly conceive it possible, that the supposed *imago* of the Siren should, for more than a century, have completely eluded all observation, if such an animal did really exist.

I am aware, that you may not consider this as altogether a correct or philosophical mode of reasoning, on this subject. You will perhaps, say, that the larvae of some of the Amphibia are sometimes much larger than the imago, or perfect animal, which succeeds to them. I will, for a moment, admit this to be *frequently* the case. But I think you will not deem it very probable, that the Sirens, which are often from twenty to thirty, or even thirty-six and forty, inches in length, are the mere larvous representatives, or precursors, of salamanders, whose greatest length is not more than eight, ten, or twelve, inches.

I must not, however, conceal from you, that we have discovered, in the great lakes of our country, in the waters of the Ohio, and Susquehanna, and in other parts of the United-States, a very large species of Salamander,

* Salamandra horrida, &c.

which bears a considerable resemblance, in several respects, to the Siren lacertina, and some other Sirens. This species, to which I have given the name of *horrida* (Salamandra horrida), is *occasionally* seen two feet, or somewhat more, in length*. I have carefully examined it; and I candidly acknowledge, that, on the *first* rapid, glance of it, I thought it *possible*, that it might be the long-looked-for imago of the Siren. But a few minutes inquiries very fully convinced me, that the two animals are so totally distinct from each other, that we cannot, on any solid grounds, refer them to the same species.—Besides, they inhabit (generally speaking, at least) very different parts of North-America. The Salamandra horrida has never, so far as I can learn, been seen in any of those parts of Carolina, or Georgia, in which the Sirens abound. Moreover, the waters which it inhabits are, I think, very different. It prefers the clearer creeks, and other streams, which fall into the lakes, rivers, &c.

I have now before me a *living* Siren, which has been in my possession for almost one year. During this period, I have carefully inspected it, almost every day. But I cannot perceive, that any very essential change has taken place, in the appearance of the animal. The figure, the structure, and the offices, or functions, of the branchiae continue to be the same. The two feet remain precisely as they were; and no posterior set of feet has *yet* made its appearance.——Now, if our

* As this is the largest species of the genus, yet known, it may be denominated Salamandra gigantea, or S. maxima. The common names of this animal, in those parts of the United-States, &c., in which it abounds, are "Alligator," and "Water-Lizard."

Siren were nothing more than the larva of a Salamandra, as Hermann*, La Cepède†, and yourself have imagined, should we not, in the long period which I have mentioned, have seen the reptile altogether laying aside its branchiae?; or, at least, would it not be time to discover *some* material change in these appendages, either in the complexity of their structure, or in the nature and degree of the function to which they are subservient?

My Siren is about eighteen inches in length. In the public Museum of this city, I have had an opportunity of seeing, and of repeatedly examining, another specimen, two feet and a half in length. I was not able to perceive, that the branchial appendages of this large, and highly vigorous, individual underwent the smallest alteration, during the period of at least nine months, that it was kept, for the inspection of the curious, in a large vessel with water.

* Commentarius Tabulæ affinitatum Animalium, &c.

† Histoire Naturelle des Quadrupeds Ovipares et des Serpens.—It may, possibly, amuse the *cautious* naturalist to read the following observations, by the elegant French Zoologist, on the subject of the Siren. "Nous avons (he says) examiné avec soin la figure & la description que M. Ellis en a données dans les transactions philosophiques; and nous n'avons pas douté un seul moment que cet animal, bien loin de constituer un ordre nouveau, ne fût une larve; il a les caractères généraux d' un animal imparfait, & d' ailleurs il a les caractères particuliers que nous avons trouvés dans les salamandres à queue-plate." Tome Premier, 611.——Mr. Schneider, whose treatment of Mons. la Cepéde is by no means courteous, seems under the necessity of paying a kind of (coarse) compliment to him, for having, in one respect at least, made something like an approach to the truth. After passing a very severe censure upon the French naturalist's observations on the metamorphosis, &c., of the Salamanders, the great amphibiologist has the following words: "Factum igitur casu potius puto, ut suspicio Galli de Sirene lacertina Linnaei proposita, p. 611. tam bene caderet, nec a scopo veritatis plane aberraret." Historiae Amphibiorum naturalis et literariae Fasciculus Primus, &c. p. 41. Jenae: 1799.

As neither of these Sirens was found to add much to its size, in the period of ten or eleven months, it would seem to follow, that the reptile is rather slow in attaining its full growth. It is highly probable, that the one which I possess (much the smallest of the two) is now, at least, four years old. The largest specimen, which seems to have nearly reached the *maximum* size of the animal in Carolina, was, in all probability, eight or ten years old: nay, reasoning on the analogy of the growth of some of the amphibia, most nearly allied to it; and resting, in part, upon the uncommonly firm texture of the whole of the vertebral structure, I think we are safe in assigning to this individual Siren, a greater age than that which I have mentioned.——But do we know of any of the larvae of salamandrae which retain their branchial fins for *several* years? I think we do not. Indeed, if I do not greatly mistake, in all the salamanders and Water-Lizards, with which we are acquainted, the branchiae are nearly obliterated the *first* year of the animal's life*.

I may here observe, that the branchiae of Sirens which have been preserved, for several months, in strong

* Professor Gmelin throws out a suspicion, that the Proteus Tritonius and P. anguinus, concerning whose precise nature he does not venture to hazard a decisive theory, or opinion, may be mere *Gyrini*, "which undergo a more *tardy* metamorphosis" than their congeneres, among the amphibia, do. *Systema Naturae.* Tom. 1. Pars iii. p. 1056.—The same suspicion may be hazarded in regard to the Sirens. But, really, it appears to me, that it was more truly philosophical, even in the time of Laurenti (1768), to *conjecture*, that the Protei were *perfect* animals, than to *assert*, as has since been frequently done, that they are *animalia larvata.* Nor do I think there was any thing peculiarly rash or audacious in the observation of the Vienna physician, "that those who contend, that the Proteus anguinus is a mere *gyrinus*, should show the animal which proceeds from *it*: otherwise, that he would adhere to his own opinion." See Schneider's Historia, &c. Fasc. i. p. 45.

spirit of wine, or in any similar fluid, become so greatly contracted and diminished in their size, that a *rash* observer would almost be induced to believe, from this appearance of the appendages, that they do actually become obliterated, at some particular period of the animal's life.

The Siren, as Garden and Linnæus originally asserted, breathes both by branchiae, and by lungs. It breathes, however, much more frequently by the former, than by the latter, of these sets of organs. Indeed, while the animal remains in the water, the branchiae are almost incessantly in motion: but the movements are frequently merely *slightly tremulous:* at other times, they are much more considerable, and undergo a strong, convulsive-like, collapse. During these more considerable movements, one can plainly discern the three pectinated apertures, under the branchiae, rapidly opening and closing.

The under surfaces of the branchiae, especially when the animal throws them, in a curved position forward, exposing them more to the light and air, have a deep, or rather sublivid-red, colour*. I am pretty confident, that this colour is more conspicuous now than when I first received the Siren. Even this circumstance would

* At particular times, the branchiae are disposed in such a manner, that they appear to be entirely of this colour: we see nothing of the dark slate colour of their upper surface. A naturalist who had not been in the habit of attentively examining, at various periods, the Siren, might, from this temporary appearance of the appendages, seize upon the circumstance, and employ it as a permanent and specific character, in the description of the animal.—The branchiae of the Proteus anguinus are said to be "of a deep blood colour." *Schreibers.*—"Appendiculis branchiarum corallinus." *Schneider.* Perhaps, it will be found that this is not the *constant* colour.

seem to show, that the branchiae, as the animal advances in age and size, do not become of *less* consequence in the performance of the respiratory function.

It is only when the body of the Siren is more at rest in the water, that he employs his branchiae to the greatest advantage, or at least with the greatest vigour, *as organs of respiration*. Then he moves them somewhat in the manner of the gills of a fish, but much less frequently: and it is at this time that the beautiful structure (for to the most insensible naturalist the structure would appear beautiful) of these organs is most distinctly seen.—When he swims (as he often does) rapidly through the water, the branchiae, if I do not greatly mistake, are but of little use as organs of respiration. They now serve the purpose, as do his feet also, of remiges, or fins.

Now and then, the animal opens its mouth *above* the surface of the water, at which time it, doubtless, throws out a vitiated air. The number of these *pulmonary* respirations is very various, in a given time, at different periods. In warm weather, I have frequently observed them to occur about once in every five minutes: but in colder weather, they are (sometimes, at least) not more frequent than in the Lacerta lacustris; or once in every fifteen minutes.

But the Siren is capable of suspending all respiration, through the medium of his mouth, for a much greater length of time than I have mentioned. My own observations have shown me, that the animal sometimes continues *under* the water, without once

coming to the surface, for the long term of sixty-five minutes. During the whole of this interval, the body of the Siren continued almost motionless, and the movements of the branchiae were very inconsiderable.—How much longer he is capable of continuing at the bottom of the water, especially in cold weather, I have not yet learned: but I confidently presume, that sixty-five minutes is not the *maximum* term.

I have fully satisfied myself, that the Siren is capable of continuing, for a considerable length of time, *out* of the water, provided only the atmosphere, in which he is placed, be a moist one. Immediately upon pouring *all* the water out of the vessel, in which I keep my animal, he collapses his branchiae, which he closely applies to his head and neck; and ceases, untill he is returned to the water, to make any use of them, as organs of breathing*. Meanwhile, his respiration is carried on by his mouth and nostrils. In this way, that is deprived of the water, I have known the reptile to continue, without any very apparent inconvenience, for two complete hours; and I do not at all doubt, that it is capable of thus supporting itself, for a much greater length of time: perhaps for a whole day, or for several days together.

* We learn from Laurenti, that his Proteus Tritonius, when out of the water, in like manner collapses its "branchia appendiculata;" or, at least, the *villous* portion of the branchiae. "Extra aquam (says Mr. Schneider, on the authority of Laurenti) lentissime progreditur, membrana natatoria *et villis branchiarum collapsis*. Historia Amphibiorum, &c. Fasc. 1. p. 45.

As the Siren, when in its native climate, frequently retires into the mud, and as some facts even lead me to believe, that it sometimes migrates, *over land*, from one pond to another, as the eels are known to do, do we not begin to discern the final intention of Nature in bestowing upon the American animal, the two-fold respiratory system of lungs and gills?

I am far from imagining, that the views of Nature, in this complex and admirable fabric of the Siren, are fully understood. Yet, I cannot but flatter myself, that my experiments have put us in possession of something like a clue to the attainment of the truth; and I do not doubt, that future and more varied experiments and inquiries will completely unfold to us, the wise designs of Nature in furnishing the Siren (and its congeneres Proteus anguinus, &c.,) with both branchiae and pulmonary lungs.

But this interesting portion of the Siren's history cannot be completely and satisfactorily understood, until skilful naturalists, residing in the countries of which this animal is a native, shall examine, with attention, its manners and habits; until it shall be ascertained, what proportion of its life the Siren passes in the water, and what proportion on the dry ground, or upon and in muddy situations, where it cannot have the advantage of a sufficient quantity of water to admit of its swimming, and of using its gills; whether (as I have already intimated there are some reasons to believe) it performs migrations, from one water to another, over the mud or meadows, or even drier situations; in what manner it passes the winter season: whether, in other words, it be-

comes torpid, &c. These and similar points*, relative to the natural history of the Siren, must be fully ascertained, before a cautious naturalist will venture to decide upon the full object of Nature, in giving to this animal both an extensive system of lungs, very similar to those of some of the pure, or less mixed, Amphibia; and, at the same time, a kind of branchial apparatus, not very unlike that of some of the fishes; but still more nearly allied to the branchial appendages *(appendices fimbriatae)* of the cordyli of salamanders, and the larvae of some other families of animals. And I hope (as the love and study of NATURAL HISTORY are rapidly growing in the United-States), that the period is very near at hand, when all these points shall cease to be *desiderata*, in the history of an animal which has solicited so much of the attention of some of the ablest naturalists that Europe has hitherto produced: and when, of course, a better and a surer light shall be diffused over the history of the Proteus anguinus, and several other animals, apparently of the same natural family, which Linnæus and Gmelin, Schreibers, Shaw, and a number of other naturalists, have been compelled to speak of as "doubtful," or ambiguous.

There is, I confess, one circumstance, which has sometimes compelled me to hesitate, whether we yet know any thing *certain* relative to the design of Nature in furnishing the Siren with both branchiae and lungs. It is said, that the Proteus anguinus is a *constant* inha-

* Among other experiments, which I have thought of, there is one which could hardly fail to throw considerable light upon the physiology of the Siren: I mean, the removal of one, or all, of the branchial appendages, by means of ligatures.

bitant of the Sitticher—See, " from which it has always appeared to have been thrown out by the rising of the water*". This circumstance, I say, has compelled me to hestitate; because, as will be seen more fully hereafter, the Proteus and the Siren are most nearly allied to each other, in their structure, in their functions, and their manners.

But it seems highly probable to me, that future inquiries will ascertain, that the animal of Carniola, like that of North-America, is *occasionally* an inhabitant of the land (especially of the wetter grounds), as well as of the water. Should this not prove to be the case, I shall (with some degree of hestitation, indeed) relinquish my present and favourite opinion, that the Siren is truly (I mean in the *common*, as well as in the scientific, acceptation of the word) an *Amphibious* animal; and that therefore, nature has bestowed upon it that complex and varied structure, which renders the history of this reptile so interesting a subject in the eye of the philosophical zoologist.†

* Dr. Schreibers.

† It is by no means an idea of my own, that the Siren lives both in the water and upon the land. The fact was mentioned by Dr. Garden, in his original communications to Linnæus, respecting the Carolina animal. " Habitat hoc animal in *Carolinæ australis uliginosis* aquosis, ubi vivit tam in aqua, quam extra; nam ex aquis adscendit in truncos & ramos undis illapsos: cum exsiccantur paludes, ubi hospitatur, iis nempe anni tempestatibus, quibus heic per nonnullos menses non pluit, canit voce querula, anatum juniorum fere simile, sed acuta magis atque clara, ut D. Garden in litteris suis etjam narrat." See the dissertation entitled " Siren Lacertina," in the Amoenitates Academicae, vol vii. page 322, Erlangae: 1789.—Although this memorable dissertation bears the name of Abraham Oesterdam, it was, I presume, principally composed by Linnæus himself.

You observe, that I speak of the nostrils of the Siren. These apertures, in the American animal, are very distinct, large, and patulous; and it is, I think, easy to see, that they are essentially subservient to the animal's respiration. In this respect, the Siren differs very materially from the Proteus anguinus, if we can depend upon Dr. Schreibers's account of that animal: for this naturalist says, the Proteus "has no nostrils." I cannot but suspect, that future observations will show us, that the Proteus *has* nostrils, though, perhaps, very small ones. If Dr. Schreibers's observation be correct, he has furnished us with a very good *external* mark of distinction, between the Carniolian and American animals. But, indeed, we do not stand in need of this character to discriminate the Proteus anguinus and the Siren from each other.

It appears to me, that the nostrils of the Siren perform a two-fold office. They admit both water and air. While the animal lies buried in the water, I have often observed small particles of mud, &c., carried, along with the water, into the nostrils. When he swims about very rapidly, at which time I have supposed, that his branchiae are not of much use to him, as respiratory organs, he frequently puts the upper and anterior part of his head out of the water, without, so far as I have observed, opening his mouth at all. At such times, if I do not greatly mistake, he breathes almost entirely through the medium of his nostrils.

But notwithstanding it is my opinion, that the nostrils of the Siren assist this animal in its respiratory function, I must not conceal, that the internal nares

are situated at a considerable distance from the *rima*, or opening of the trachea; and that I have not been able, in the animal preserved in spirits (for I have not had an opportunity of making *this* experiment upon the more recent animal), to inflate the pulmonary sacs through the medium of the nostrils. But it is very easy, even in the animal similarly preserved, to inflate the lungs through the *rima glottidis*.

From the size and structure of his nostrils, there can be no doubt, that the Siren possesses a keen sense of smelling. He evidently employs this sense in searching for his food, among the mud, at the bottom of the waters, in which he resides: if I may presume to speak, with confidence, on this head, from what I have observed of the two animals, which have been the subjects of my patient inquiry, and numerous experiments, for many months.

How has it happened, that Professor Camper fell into the enormous error, that the Siren has *no* LUNGS? I have carefully dissected and examined a large Siren, very soon after its death, and while all the parts were still fresh, and perfect. I found the lungs, as Garden* and Hunter† had represented them, remarkably distinct, and, considering the size of the animal, *uncommonly capacious*. They consist of two entirely separate sacs,

* The following is this truly respectable naturalist and physician's description of the lungs: "*Pulmones* maximi, longissime a thorace ad anum usque per totum abdomen dorso approximati, & ligati extenduntur separati, distincti & Pulmoni utriusque lateris trachia propria, per Thoracem decurrente, inservit, & communicationem cum branchiis servat." Amoenitates Academicae, &c. vol. vii. p. 321, 322.

† Philosophical Transactions. Vol. 56. p. 307 308.

which commence at the diaphragm, to which they are attached, and running down through almost the whole length of the abdominal cavity, terminate at a small distance above the opening of the rectum, and immediately below the lower ends of two glandular—like bodies, which I suppose to be the ovaria. The posterior part of each sac, or lobe, is bound down to the root of the mesentery, except at its lower end, where it is entirely unconfined by this mesenteric structure, and floats loose in the cavity. This circumstance seems to have escaped the notice of Dr. Garden, who says, that the lungs are tied down, through their whole length. Mr. Hunter, who speaks of these organs in a very brief way*, says nothing relative to the manner in which they are atached to the mesentery.

Each sac of the lungs is convex, or rounded, exteriorly, so as to correspond, both in shape and size, with the abdominal cavity ; and is flattened, or partially concave, on the inner side, so as to contain the different viscera : for the whole of the viscera are included between the two sacs of the lungs.

I have said, that the lungs of the Siren are uncommonly capacious. In illustration of this observation, I may now remark, that in the large Siren, which I dissected, the entire length of which was thirty inches, the longest sac of the lungs was eighteen inches in length, and the

* "The lungs are two long bags, one on each side, which begin just behind the heart, and pass back through the whole length of the abdomen, nearly as far as the *anus*. They are largest in the middle, and honey-combed on the internal surface through their whole length." Philosophical Transactions, &c.

greatest diameter of either of the sacs, not less than three quarters of an inch.

The texture of the lungs is membranous, and the membrane is extremely thin, delicate, and pellucid. The whole surface of these organs is covered with numerous ramifications of blood-vessels, which give to it a reticulated appearance, especially upon the superior ends of the lungs. But these organs exhibit nothing of that cellular or parietal structure, which so remarkably characterizes the lungs of the common Salamandra, those of the family of Ranae, or Frogs, the Crotali, or Rattlesnakes, and many other animals.

In their form, as well as in their texture, we find a very striking resemblance between the lungs of the Siren and those of the Lacerta lacustris.* In the Siren, indeed, they are more uniformly of one diameter, through their whole length, than they are in the Water-Lizard. But, even in the American animal, the lungs are not, as Dr. Schreibers asserts "throughout equally wide;" and at their lower and loose ends, they are gradually attenuated, and terminate in a very narrow point.

From this unfinished, but I flatter myself correct, description of the lungs of the Siren, it must appear sufficiently evident, that these organs, though they greatly

* I beg leave, in this place, to quote the description which Ol. Jacobæus has given of the lungs of this little animal: "Duo oblongi sacculi aëri recipiendo dicati, pulmones constituunt, qui valde nitidi ac pellucentes ab initio oesophagi ductum alimentorum comitantur et ad ovaria usque protenduntur. Vasa sanguinea secundum longitudinem pulmonum cum ramis suis minutissimis decurrunt."

resemble those of some species of lacerta, are very unlike the lungs of the lacerta salamandra. Nor are they much more nearly allied to the lungs of the Proteus anguinus of Laurenti. For in this latter animal, as appears from the drawings and description of the ingenious Dr. Schreibers, the lungs, on each side, are composed, principally, of a long and very narrow duct, which this writer calls the "Pneumatic duct;" and of a capacious membranous sac, called the "Air-Bladder," or "Pneumatic Bag," into which the duct terminates. But the Carniolian and the American animal seem to agree with each other in having their lungs quite simple, without any cellular structure*.

But, to return to professor Camper.—I have sometimes thought, that he missed to see the lungs in the supposed Siren, which he examined, by reason of the contracted state into which the parts may have been brought, by the spirit in which the specimen was preserved. But, as he found ribs in the animal which was the subject of his investigation†, *and as the Siren* (like the Proteus anguinus) *is destitute of ribs*, I must con-

* A Historical and Anatomical Description of a doubtful amphibious animal of Germany, called Proteus Anguinus. By Charles Schreibers, M. D. of Vienna.—See Philosophical Transactions, &c. For the year 1801. Part ii.

† Gmelin has adopted Camper's assertion concerning the existence of ribs in the Siren lacertina. Speaking of this animal, the industrious and learned Gottingen professor has the following words: "Habitat in Carolinae paludibus,————*costata*, cauda ossiculata."—*Systema Naturae*, Tom. i. Pars iii. p. 1136.—The Siren, I say, has no ribs; but he has bones in his tail, and he is furnished with a strong, compact, and beautiful vertebral structure. In the whole of the vertebral column of a large Siren, I count fifty-seven distinct bones; and I think that, at least, one or two more have been lost, in macerating the animal to prepare its skeleton.

clude, that the great Dutch anatomist did not dissect any of those amphibious animals, which I refer to the genus Siren, or Proteus*. And yet, this supposition is not without its difficulties: for the memoirs, or papers, of Ellis, Linnæus, and Hunter were to be procured, and were, doubtless, in his possession: and the engravings which accompany the first of these naturalist's memoirs are sufficiently correct to have satisfied the anatomist of Groningen, whether he really possessed the *same* animal which the three writers, whose names I have just mentioned, have so distinctly noticed or described. There is, certainly, a great difficulty (I had almost said, an inextricable mystery) in the view of this subject: and the difficulty is peculiarly great to me, as I have never been so fortunate as to procure the memoir of Camper.

But, indeed, this industrious naturalist's theory of the Siren cannot be supported by any plausible arguments; or, at best, not by any solid facts. One cannot well refrain from smiling at his notion (which Gmelin so hastily embraced), that the two feet of the Siren are to be considered in the light of mere digitated fins†. Had Camper seen the *living* Siren, as I have done, he would not, he could not, have adopted an idea so extremely crude, and unfounded. For although the American animal uses

* The ingenious Dr. Shaw seems to assume it as a fact, that Camper did actually possess and examine the true Siren lacertina.—General Zoology, &c. Vol. iii. Part. ii. p. 606.

† Muraena (Siren) pinnis pectoralibus tetradactylis, &c. *Systema Naturae*, tom. i. pars iii. p. 1136.—I know not how many naturalists, or writers on natural history, Camper has misled. Dr. Turton has implicitly followed Gmelin; and so has the author of an useful introduction to Zoology, entitled "Elements of Natural History," &c. vol. i. page 320. Edinburgh: 1801.

his legs in swimming, he does not use them as fish do their fins: but employs them, as other animals (while swimming), employ their arms or legs.—The annexed figure conveys a very correct idea of the Siren, while in the act of swimming, in a circular vessel. (See Fig. 1.)

The supposed fins of the Siren appear to be of great use to him, in searching for his food. When I have put into the water, in which I keep my Siren, a quantity of mud or sand, I have often observed him scratching with his toes, for the worms which he was incapable of seeing, by reason of the dirt in which they were enveloped.——Lastly, I have seen, on many occasions, the Siren employing his feet, both in climbing and in walking. In climbing he uses them to so much advantage, that I have frequently found it very difficult to confine him to his vessel; to which, indeed, I should not be able to restrict him, if the vessel were not kept covered. When I have poured the water out of the vessel, or when I have placed him upon a floor, or upon the ground, he uses his feet in walking, or rather in creeping, which he does "very slowly"; even much more so than the crotalus, which is one of the *serpentes tardigradae*. What Baron Zois says of the movements of the Proteus anguinus may, with equal propriety, be said of the Siren: "It creeps very slowly"; or rather "very deliberately." "In this particular (the Baron continues), it differs from every other creeping animal, insomuch, that he is tempted to call this motion"—"characteristic of the Proteus*." But, perhaps, it is not less characteristic of the Siren.

* See Dr. Schreibers's Historical and Anatomical Description, &c. &c. p. 245.—The Proteus Tritonius likewise, as has already been observed, moves

I am not yet prepared to speak confidently concerning the food of the Siren, in his *native* ponds, and other wet places. It has been said, that this animal lives upon serpents, which he catches and holds very fast by means of his strong teeth*. I rather doubt the correctness of this relation; not merely because, in my frequent inquiries concerning the manners, &c., of the Siren, nothing of the kind has ever been mentioned to me, but because the mouth of the animal does not seem to be peculiarly adapted for the reception of such very large objects; and above all, because he always swallows his food entire, and very rapidly. But a serpent, even admitting that it were not one third the size or bulk of the Siren, could not be swallowed without some delay: and I think it evident, from the peculiar situation of the heart of the Siren, and from the structure of the adjacent parts, that any considerable delay in the reception of its food into the stomach, would essentially interfere with the movements of the heart and arteries. The provision which nature has made for a speedy deglutition, is indeed admirable.

I have been informed, that the Siren feeds upon grasshoppers (grylli) and similar insects, which either accidentally fall into the waters, or which inhabit them. He doubtless feeds upon lumbrici, and other vermes; and I presume upon small fish. Whether he eats vegetable matters I know not: but I suspect he does.

very slowly, when taken out of the water; and so does the Salamandra horrida.

* "Habitat, &c.,——serpentibus victitans, quos validis firmisque dentibus arripit et tenet." Systema Naturae.

I feed my Siren upon lumbrici, pieces of meat, &c., especially the former. He is an extremely voracious animal, particularly in the warmer weather. Yet, like many other voracious animals, he is capable of living, for many days, without any food at all.—He takes in his food with inconceivable rapidity. In this respect, as well as many others, he bears a striking analogy to the tribe of fishes. Like the fishes, the Salamandra horrida, &c., he is often caught with the hook and line. Sometimes, after swallowing several large worms, I have observed the Siren to dash himself about, in the water, with great force and quickness. Possibly, these violent motions are occasioned by uneasy sensations which the living worms excite in the stomach of the Siren.

It seeems worthy of remark, that while engaged in swallowing large worms, great bubbles of air frequently escape from the pectinated openings, which all communicate with the pharynx. And if the worm be covered with mud, the dirt is strained off through the openings, before the food enters the oesophagus. I have so frequently witnessed this latter circumstance, that I cannot but consider the branchial openings as destined, in part, to serve the office of strainers of the animal's food. This idea will, I think, seem highly probable, when it is considered how large a portion of the Siren's food is necessarily covered with mud and filth.

Mr. Ellis is of opinion, that the Siren is "capable of biting and grinding the hardest kind of food*." I grant the structure of the animal's jaws and palate seems well

* Philosophical Transactions. Vol. 56.

adapted for biting and retaining its food. But neither this structure, nor what I have observed of the living animal, lead me to believe, that it ever grinds its food at all. It is possible that the Siren, like some species of serpents that are known to me, does occasionally gnaw and tear its food. Sometimes, when the worm, which I have given my animal, was uncommonly large, he has shown himself incapable of taking it all in at once. But, in general, as I have already observed, he swallows his food with a celerity of which I am not acquainted with a similar example in the animal kingdom.

The Siren, like many other animals of the class of amphibia, appears to be very tenacious of life. I have been assured, that it often escapes into the mud, even after a considerable portion of its tail has been cut off by the spade, or by other means. The facility with which it is removed from its native climates, into the more northern climates, where it is easily kept alive, without any very exact attention to the temperature of the water, or the atmosphere, in which it is preserved, seems plainly to show, that there belongs to this reptile a certain hardihood, in which respect it appears to differ from the Proteus anguinus.—The living Siren, which is now before me, was completely recovered to health and strength, after having been, for several days, exposed in water to the temperature of about 33 or 34 of the thermometer of Fahrenheit; and even after it had been, for several hours, locked up as it were in the ice. It is true, that this rough experiment subjected the animal to great inconvenience, and even to much danger.

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I have some doubt, whether the Siren which has been the subject of my inquiries and dissections, be not specifically different from the Siren lacertina of Linnæus. It is difficult to decide this point by an inspection of the plate of the animal, which Linnæus, or his pupil Oesterdam, published in 1766. For, really, this plate is so bad, that it ought never to be quoted without a censure, and should never be referred to, in any systematic or classical work on zoology, without the affixed word *pessima*. I do not believe, that Linnæus's figure will be found to resemble any species of Siren. The branchiae, in particular, are shamefully represented.

The engravings which accompany Mr. Ellis's paper, in the *Philosophical Transactions*, are ably executed, and are infinitely more correct. But neither the large figure (A), nor the description, convey a perfect, or correct idea of the form of the Sirens which I have examined. The head of Ellis's animal is considerably too small for the bulk of the body. The ingenious English naturalist observes, "that the feet appear like little arms and hands, each furnished with four fingers, and each finger with a claw." In the drawing of the larger animal, the fingers or toes are represented gradually tapering from their origin to their ends. This is very unlike the foot, or hand, of my Siren, as is, indeed, the whole form of the leg of the Ellisian specimen. The differences between these parts, in the two animals, will be immediately perceived by comparing the annexed drawing (See Figures 1 & 2.) with that of Mr. Ellis. The more mishapen legs and feet of my Siren may be justly compared to those of the Lacerta lacustris, between which and the Carolina

bipes, I have already pointed out some striking resemblances*.

If I do not greatly mistake, Mr. Ellis has figured two distinct species of Siren. The smaller animal (B.) seems to be the Siren which I have particularly attended to. It is, certainly, upon the whole, more nearly allied to my animal than is the larger one, which, if it be correctly represented, cannot be the Siren which I have before me.—Upon the whole, although I am not yet prepared, and indeed, have not time, to exhibit a full view of *all* the differences between Mr. Ellis's large Siren and my animal, I rather incline to believe, that they are two distinct species, or at least two strong-marked *varieties*. Or, possibly, they are only the different sexes. Future inquiries will completely determine these points.

Of these two Sirens, and of two or three others of which I have some knowledge, I intend to publish, at some future (but not, I fear, very near) period, a full and particular account, illustrated by accurate engravings, for which several drawings are already prepared†. In the meanwhile, I shall only observe, that South-Carolina possesses a large four-footed Siren; and that a species (probably the very same), with four feet also, has been seen and examined by one of my pupils‡, in the neighbourhood of the Red-river, which empties itself into the Missisippi. The Louisiana animal was three feet in length, and six inches in circumference.

* See page 20.

† See the prefatory Note.

‡ Dr. Peter Custis, of Virginia.

May I flatter myself, that the time is not very distant, when you, and those other naturalists who have written so ingeniously on the subject of the Siren, will fall, however cautiously or reluctantly, into my opinion, that this reptile is, really, a finished or perfect animal; and that the American Sirens, together with the Proteus anguinus, and other similar animals of your continent, must form a genus in the vast class of Amphibia, entirely distinct from the family of the Salamanders, however nearly allied to it? But although I entertain this opinion concerning the Sirens, I do not think it will be necessary, or even proper, as some late naturalists have supposed, to retain the Linnæan order of *Meantes**, which I, at least, shall expunge from my intended work on Zoology. We shall render our arrangements in natural history too complex, and I may add too artificial, if we go on constructing new *orders* for every animal in which we observe considerable deviations of structure from the ordinary forms and structure of the animals most nearly allied to it. It is true, that an animal, such as the Siren, to which nature has given both lungs and branchiae, would seem, in a series of animal affinities, to be placed with considerable propriety, in a kind of intermediate order between the Amphibia and the Pisces. And it is possible that Dr. Pallas, had he been acquainted with the real nature of the Siren, would not have so readily proposed the abolition of the order Meantes, as I have done†.

* See Transactions of the American Philosophical Society, &c. Vol. 4.

† Professor Pallas appears to have been one of the first naturalists who conjectured, that the Siren lacertina belonged to the genus Salamandra. The memoir of this illustrious man is inserted in Nov. Comment. Petrop. tom. 19.

But in constructing our tables of the affinities of animals, we should be governed by the greatest number of affinities. With this view of the subject, comparing the external forms, the internal fabric, the places of residence, or habitation; the manners or habits; the food, &c., of the Sirens and Salamanders, it appears clearly to me, that the most proper place, in a natural arrangement of the amphibia, for the genus Siren, is immediately after the genera Lacerta and Salamandra. This arrangement will be thought the more proper, since we have now discovered Sirens with four feet: such is the Louisiana animal, even though it should be contended, that the Protei of Europe be generically distinct from the American animal. Thus, though it should be deemed proper, necessary, or convenient, to retain the order Meantes, we should be obliged to alter a part of the character of the order, as it was established by Linnæus. We shall no longer say "Pedes bini."

I am rather surprised, that professor Gmelin should think, that the proper position of the Protei, admitting them to be perfect animals, is immediately after the genus Rana and before the genus Draco*.

In regard to the name Siren, which Linnæus originally bestowed upon this Carolina animal, and which, had he lived, he would, in all probability, have bestowed also upon the Proteus anguinus (of which, it seems, he had some knowledge); and upon those similar animals of

* "Si vera sint sui generis perfecta animalia protei, a Soelmanno, omni anni tempore observati, tritonius, a Schranckio, et anguinus, ambo in lacubus Austriae interioris a Laurenti reperti, enumerati, delineati, huic loco inserendi mihi quidem videntur." Systema Naturae. Tom. i. Pars iii. p. 1056.

which we have acquired our principal knowledge since the *crepusculum vitae* of the great Swedish naturalist: in regard, I say, to the generic name Siren, I hope it will ultimately be expunged from the books of natural history; so far, at least, as it is made to apply to the "Mud-Eel" of America, and to its immediate *congeneres*. I need hardly mention to you, what were the circumstances which induced Linnæus to call the American animal Siren. He entertained the highest opinion of Dr. Garden, from whom he learned the very improbable tale, that the Siren, at a particular season, "sings, or utters, a plaintive note, considerably similar to that of young ducks, but more shrill, and clear*." I have just intimated, that I do not think there is any foundation for this part of the Siren's history. The *cantus* of the animal has never once been mentioned to me, by any of the many persons,—acquainted with the Siren in his native domains,—with whom I have conversed, on the subject of this animal. Neither myself nor others, who have assiduously attended to the two living Sirens in Philadelphia, during a period of little less than twelve months, have ever heard the animals utter a sound like that which Garden and Linnæus have mentioned. It is probable, that Garden received his information from the Negroes, who, although they, certainly, see more of the Siren than the white-inhabitants do, are not the best authorities in Natural History.

But the Siren is not wholly mute. At times, he is heard to give out a hissing noise, but no ways entitled to the appellation of cantus, or song. This noise has often been noticed, and mentioned to me by my pupils, and

* See a preceding note. Page 16.

others. From their account, I judge it to be very similar to that of the Proteus anguinus, of which Dr. Schreibers, on the authority of Baron Zois, gives the following account. " It often produces a hissing kind of noise, pretty loud, more so than one should expect from so small an animal, and resembling that produced by drawing the piston of a syringe." On this subject, I cannot venture to speak very confidently, from my own observation.

You know, Sir, what errors have been published in regard to the voice of an amphibious animal, which is, indeed, very nearly allied to the Siren. Mr. Bomare asserts, that the cry of the Water-Newt very nearly resembles that of the frog. On the contrary, Spallanzani assures us, that this animal is " quite mute." " It is only (says the illustrious naturalist of Pavia) when they (the newts) rise to the surface of the water, to expel the old air from the lungs and to inhale fresh, that the observer hears a sort of very low whistle, scarce perceptible at the distance of four paces*". I the more willingly quote this passage from the great work of Spallanzani, because I am inclined to think, that his theory of the " very low whistle" of the newt may be applied to explain the "hissing noise" of the Proteus anguinus, and of the Siren.

But if the name Siren be abolished, what generic name shall we substitute, in its place? If the Protei of Europe shall, in the progress of more extensive inquiries, appear to be finished, or perfect animals,—*as I have no doubt they will*,—there will seem to be a peculiar propri-

* Dissertations relative to the Natural History of Animals and Vegetable. Vol. ii. p. 68, 69.—English translation. London: 1789.

ety in retaining the name which Dr. Laurenti imposed upon these animals; that of PROTEUS: for what name can better express the *various* forms, and the *mixed* structure and functions, of these animals, including the Sirens? I say, including the Sirens; for whether the Protei and the Sirens be perfect animals, or mere cordyli, I am fully persuaded, that the ultimate decision of naturalists will be, that these animals must be referred to one and the same genus. And if the genus be wholly distinct from that of Salamandra, we shall have but little difficulty in forming good and appropriate names for the animals of the Sitticher-See and of the lake Czirknitz, and for the several species of American Sirens, that are already known to us. We shall take our names for these animals, from the number of their feet and toes; from the more or less elongated form of their bodies; from the structure of their lungs; from the particular countries, or the kinds of waters, which they especially inhabit; from the first describers of the species, and from other circumstances of this kind.

I know not whether you will readily excuse the freedom with which I have delivered my sentiments, concerning the Sirens and Protei. In regard to the latter animals, you will, perhaps, think, that I ought to have spoken with more reserve and hesitation; since I have never had an opportunity of seeing the Proteus anguinus, or P. Tritonius. But, in this respect, if I do not mistake, you and I are somewhat upon the same, or at least an equal, footing. You have not seen *living* Sirens, nor have you *dissected* dead ones. These advantages I have enjoyed; and, in addition to these, I have had the opportunity of comparing my observations with those

which Dr. Schreibers has published, in his excellent memoir. This memoir you could not have seen, when you published the two first fasciculi of your *Historia Amphibiorum.*

But I close this long letter with observing, that every naturalist should assume to himself the privilege of delivering his sentiments with entire freedom; and that science frequently suffers as much from an excess of reserve as from a prompt, or even ardent, decision. If I am wrong in my opinion, that the Sirens and Protei are perfect animals, and not mere cordyli, it will, at least, be acknowledged, that I have founded that opinion upon a greater body of facts and observations than were in possession of some of those distinguished naturalists, whose theory, in regard to these animals, is entirely the opposite of mine. A few years,—perhaps a few months,—will unveil all the remaining difficulties which are still attached to this curious subject. In the meanwhile, be assured of my willingness to meet the truth, in whatever light it may be presented to me: and permit me to subscribe myself,

Dear Sir,

With great respect,

Your friend, &c.,

BENJAMIN SMITH BARTON.

PHILADELPHIA,
April 19th, 1807.

EXPLANATION OF THE PLATE.

FIGURE I. Represents a birds-eye view of the Siren, or Proteus, in the act of swimming in a circular vessel of water. (See p. 23.) The two oval marks, on the anterior part of the head, represent the eyes, which are of a bluish colour, and seem to be well described by Dr. Garden, as "lurid."

FIGURE II. A *magnified* representation of one of the branchiae, exhibiting, on one side, the beautiful feather-like structure of these organs of respiration and of swimming. (See p. 12.)

FIGURE III. An under view of the Siren, while at rest at the bottom of his vessel of water, the branchiae being collapsed.—The two oval marks, near the anterior edge of the head, represent the nostrils. (See p. 17).—The *rictus* of the mouth, or lips, is also distinctly represented.

FIGURE I and FIGURE III, represent one of the Sirens (See p. 9.), upon which I made my experiments and observations, nearly one half the natural size.

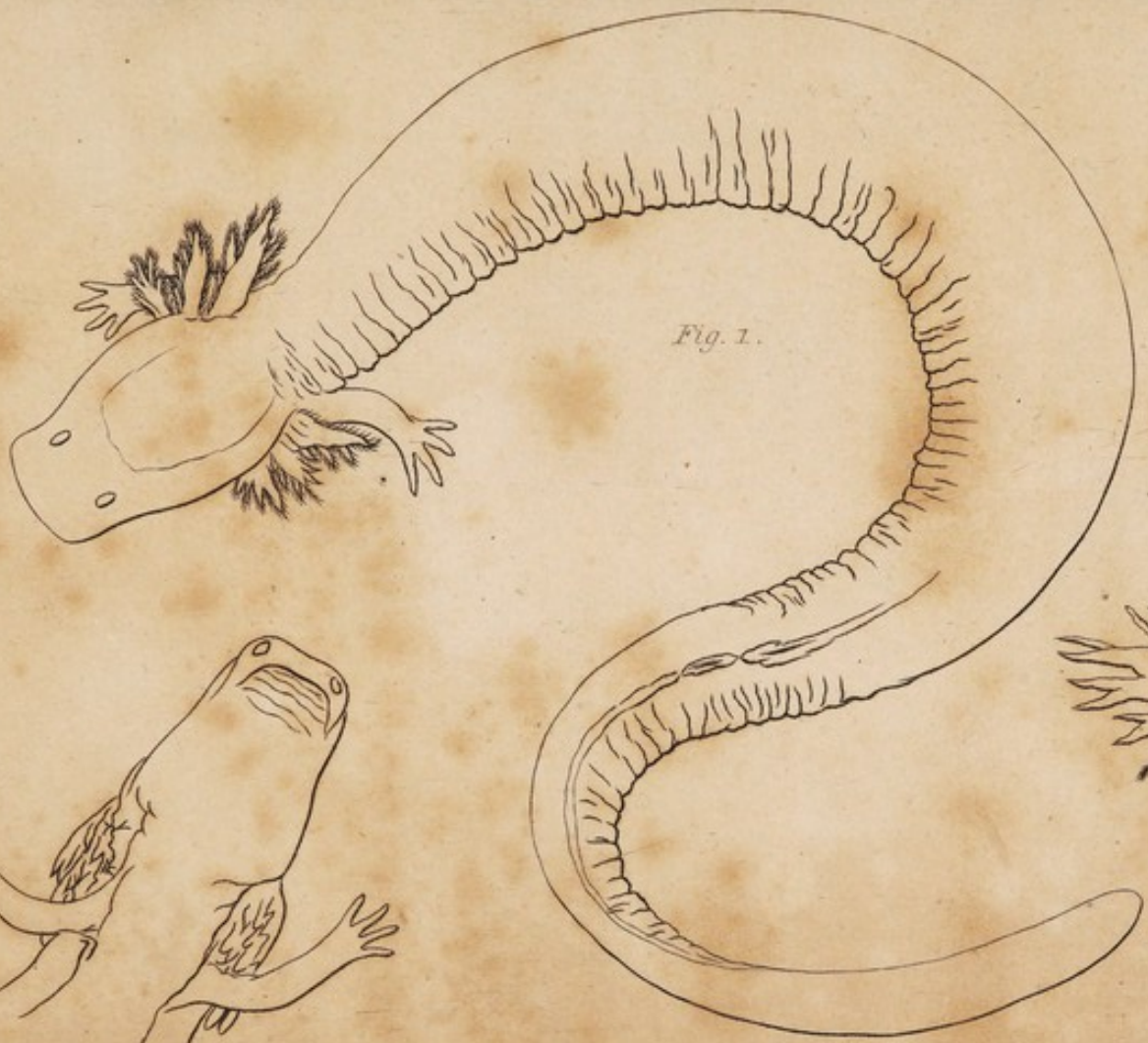

Fig. 1.

Fig. 2.

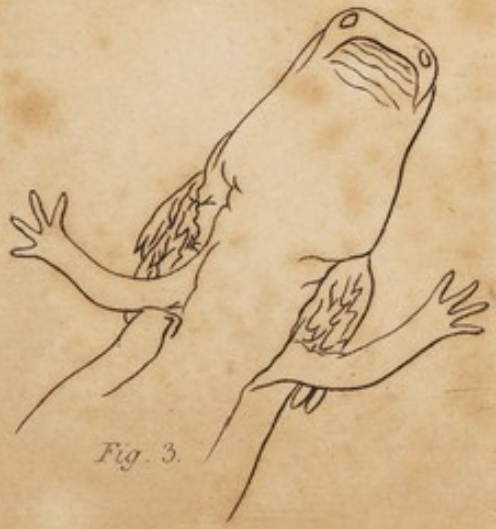

Fig. 3.

B.T anner Sc.