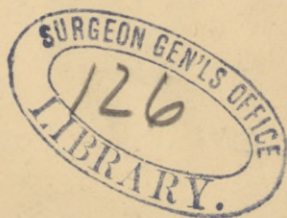
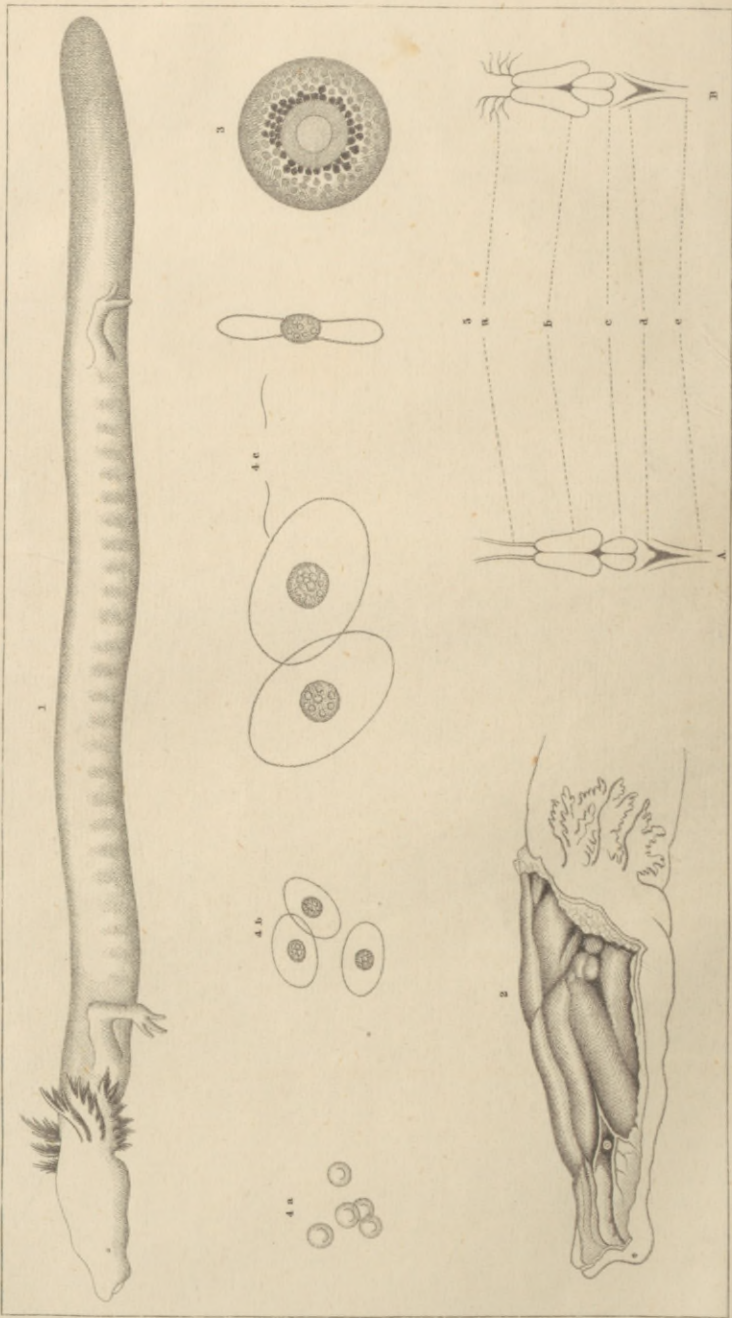



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SOME ACCOUNT
OF THE
PROTEUS ANGUINUS.




BY JOHN C. DALTON, JR., M.D.

WITH A PLATE.





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ON THE PROTEUS ANGUINUS.

IN the Austrian province of Carniola there are a large number of grottoes, the two most remarkable of which are in the immediate vicinity of Adelsberg, a small post-town, about thirty-five miles inland from Trieste. The larger of these, which is the only one usually visited by travellers, and which is justly celebrated for the extent of its passages, and for the elegance and variety of its stalactites, has its entrance on the side of a hill, about fifteen minutes' walk from the village. It is called by the inhabitants the "Grotto of Adelsberg." A small stream flows into its mouth, but disappears after a short distance through one of the numerous chasms which open into the principal passage. The grotto penetrates the hill in a nearly horizontal direction, and can easily be followed for a distance of one to two miles. It has also been explored for nearly twice that distance, but the passage is difficult and dangerous, and its termination has never yet been reached. In the waters of this cavern there are found occasionally a few crabs and fishes, of the same species as those met with outside, and which have been carried in by the stream that enters at its mouth. There is, however, another grotto, situated about a mile farther from the town, called the "Magdalena Grotto," the waters of which contain the curious species of reptile known as the "*Proteus anguinus*." This is the only place in the vicinity of Adelsberg where the animals are met with; and though they exist also in other parts of Carniola, they are more abundant in the Magdalena Grotto than elsewhere.

Unlike the "Adelsberg Grotto," this cavern receives no stream at its mouth, and penetrates the hill in a steep downward direction, instead of horizontally. After descending, for about fifteen minutes, by an exceedingly rough and irregular passage, partly rocky and partly covered with soft mud, the visitor comes to a pool of still water, varying from 12 to 18 feet in depth, according to the season, beyond which the cavern cannot be explored. It is in this pool that the *Proteus* is met with. The water apparently communicates with that of the Adelsberg Grotto; as it is always turbid when the latter is so, and vice versâ. Both caverns are, of course, perfectly dark, and can be explored only with torches. The temperature, in the latter part of August, was about 40° to 50° F., and probably does not vary much throughout the year. It is certain, at least, that in winter it is much higher in the interior of the grotto than outside. The *Proteus* is taken in small hand-nets by the peasants, who watch for the animal as he lies almost motionless near the bottom of the pool, and capture him by a sudden motion of the net. They are not

very abundant, however, and as they can be taken only when the water is perfectly clear, it is seldom that more than 15 or 20 are obtained during the course of a year. The animals should be kept afterward in obscurity, and at a temperature as nearly as possible resembling that of the grotto. It is necessary, also, to change the water in which they are kept regularly every day. With these precautions it is said they may be preserved alive for an indefinite length of time. I have myself kept one of them for several weeks without giving it any food, and at the end of that time it was as active, and nearly as well-conditioned as ever; only the branchiæ had become somewhat smaller. I am told by Mr. Fitzinger, the Superintendent of the Department of Reptiles in the Vienna Zoological Museum, that they have been kept at the Museum for over six years, without any other food than the organic matters usually existing in fresh water.

It is very commonly believed that the *Proteus* is found only in the Magdalena Grotto. This, however, is an error; as it appears, by a report of Mr. Fitzinger's to the Imperial Academy of Sciences, in Oct. 1850, that there are no less than thirty-one different localities in which the animal is said to have been found since it was first discovered in 1751. Mr. Fitzinger, himself, has seen specimens from eleven different localities. Of these the Magdalena Grotto supplied much the greater number, viz.: 312 out of 479. The reporter states that, in almost every instance, the animals coming from different grottoes, present such striking peculiarities in size, color and shape, that they cannot be considered as belonging to the same species. Accordingly, he rejects the old name of *Proteus Anguinus* and adopts instead the generic name "*Hypochthon*." In this genus he comprises seven different species, as follows:

<i>Hypochthon Zoisii</i> ,	<i>Hypochthon Laurentii</i> ,
“ <i>Schreibersii</i> ,	“ <i>xanthostictus</i> ,
“ <i>Freyeri</i> ,	“ <i>Carraræ</i> .
“ <i>Haidingeri</i> ,	

Six of these species are found in various grottoes of Carniola, and the seventh in Dalmatia. Two different species never exist together in the same locality, though sometimes the same species is found in more than one grotto. One of the principal marks of distinction is their size; the maximum length of the different species varying from $9\frac{1}{2}$ to $11\frac{1}{2}$ inches. The tint of the skin is in some species more rosy, in others yellowish. The head is pear-shaped, triangular, or more globular in form. The eyes, also, are more distinctly visible in some species than in others, and vary somewhat as to their situation.

The living specimen from which the drawing for the plate was made (fig. 1) came from the Magdalena Grotto. It belongs to the smallest of the species described by Mr. Fitzinger,

viz.: the *H. Laurentii*. Specimens of two other species, the *H. Haidingeri* and *H. Freyeri* were obtained afterwards at the Vienna Museum for purposes of dissection.

The body of the animal is cylindrical, like that of an eel, with its posterior portion compressed laterally into a kind of vertical membranous fin. There are four extremities, the anterior three-toed, the posterior two-toed. The posterior are considerably smaller and more feeble than the anterior. The first circumstance which strikes the notice of the observer is the almost entire absence of color, and the transparency of the tissues, which allow the cutaneous and subcutaneous vessels, and even the veins and arteries of the extremities to be perceived without difficulty. The heart can be distinctly seen through the skin, at the anterior part of the neck, beating 48 to 50 times per minute. The dark color of the liver, also, shows through the integument very plainly on the under surface of the abdomen. The whole aspect of the animal reminds one very strongly of the foetal condition of the higher vertebrata, particularly about the extremities, where the transparency of the integuments shows to best advantage. Notwithstanding, however, its delicacy and apparent feebleness, its motions are occasionally very rapid and energetic. They consist of swift undulating movements of the eel-like body and tail. The limbs are nearly useless during rapid progression, and remain almost motionless, applied to the sides of the body. It is only in the slow motions of crawling and turning, that the extremities are used, and then only in a feeble and imperfect manner. The gills, three in number on each side of the neck, are in the form of long tufts; each principal stem being divided into six or seven branches, and these again subdivided into fine twigs. When the *Proteus* is in rapid motion, they become distended with blood, and of a bright scarlet color, contrasting finely with the light yellowish, indefinite hue of the rest of the body. In a state of rest, however, they are often perfectly pale, like any other part of the surface. The animal occasionally lifts its head above water and takes in air by the mouth or nostrils, which, after remaining sometime in the lungs, is expelled through the branchial fissures in the sides of the neck. Notwithstanding this frequent inspiration of air, however, and the large size of the lungs, the pulmonary respiration is a very imperfect one and altogether secondary to the branchial. It is said that in a moist and cool place, as, e. g., on the floor of the Magdalenia Grotto, the *Proteus* can live many hours, carrying on its respiration by the lungs and through the skin only; but in a warm apartment it expires in a few minutes after being taken out of the water; particularly if the skin is wiped dry, as I have myself ascertained by trying the experiment. Over the whole surface of the skin, from the anterior part of the head nearly to the end of the tail,

there are minute punctiform openings, the orifices of cutaneous follicles, which exude an abundance of transparent colorless mucus. The peritoneal cavity is also filled with a similar exudation.

There are but few peculiarities about the skeleton. The bodies of the vertebræ are articulated to each other by concave surfaces as in the fishes, instead of one of the articulating surfaces being concave and the other convex, as is the general rule among reptiles. The anterior extremities consist of a cartilaginous clavicle and scapula, fused into a single piece, a humerus, radius and ulna, three carpal pieces, and three digits, the two inner ones of which have three phalanges each, and the outer one, which is shorter, only two. The posterior extremities are supported by a simple pelvic ring, resting against the sides of the vertebral column. They are composed of a femur, tibia and fibula, a tarsus composed of three pieces, precisely similar to those of the carpus, and two digits of three phalanges each. All these parts are entirely cartilaginous, or so slightly ossified that it is difficult to be sure whether there is any true bony formation or not. The snout is rather broad and thick. The nostrils open on the under surface of the upper lip, as in *Lepidosiren Paradoxa*. They are continued into a cylindrical, membranous canal, something less than a third of an inch long, situated in the thickness of the lip. There is a long row of fine, sharp, conical teeth in both upper and lower jaw; and in the upper, there is also a second much shorter row, in front of the first. The tongue is erroneously stated by R. Wagner (Comp. Anat. Vertebrata) to be wanting. It is, on the contrary, very easily seen; about one-eighth of an inch long, but consisting only of mucous membrane and adipose tissue. The animal has the vertical stomach and short intestinal canal of the allied genera. The anus is a longitudinal slit, just behind the junction of the posterior extremities with the body. The liver is a long, lobulated organ, wrapped round the stomach and upper part of the intestinal canal, and extending nearly two-thirds the whole length of the abdominal cavity. The heart, enclosed in a pericardium, is composed of a single auricle and ventricle. The arterial trunk arising from the ventricle is partially converted into a double canal by an imperfect longitudinal partition. It sends off, on each side, three branchial arteries, and the returning branchial veins unite immediately below the situation of the heart, to form a single descending aorta. The lungs are simple, elongated, thin, membranous sacs, secured by a fold of peritoneum against the posterior abdominal wall, and somewhat unsymmetrically developed. The left runs down, from its opening into the œsophagus, nearly three-quarters the whole length of the abdominal cavity; the right but little over one-half the length. The blood globules of this animal have been long known to be remarkable on account of their large size.

They can be easily found almost unaltered in the blood vessels, and particularly in those of the gills, even in specimens which have been kept for a long time in spirit. They are of a flattened oval shape, like those of the frog, with a central, white, granular, roundish nucleus, also somewhat flattened. The length of the globules varied, in the specimen examined, from $\cdot 0016$ to $\cdot 0023$ inch. The breadth is usually $\cdot 0013$, and the thickness $\cdot 0003$. As this last measurement is exactly the diameter of the human blood globule, some estimate may be made of the difference between them. In fig. 4 the blood globules of human blood, of the frog, and of the *Proteus* (*a*, *b*, and *c*) are magnified in the same proportion, in order to show their relative sizes. The muscular fibres of the body are also very large, and very distinctly striated. Their diameter varies from $\cdot 0019$ to $\cdot 0036$ inch. The nerve-fibres were not remarkably large, those from the facial measuring only $\cdot 00027$ inch in diameter.

The two most interesting peculiarities of the animal, taken in connexion with its subterranean mode of life, are the colorless condition of its skin, and the imperfect development of its visual organs. At first, the eyes seem to be altogether wanting; but on close examination, they may be discovered, in the recent state, as two minute blackish points, situated about the junction of the anterior and middle thirds of the head (fig. 1). When the animal has been preserved in spirits, it is sometimes impossible to distinguish them until the integuments have been removed. They are then found lying immediately beneath the skin, imbedded in a small quantity of adipose tissue (fig. 2). In an individual measuring $8\frac{7}{8}$ inches in length, the eyeball was $\frac{1}{3}$ th of an inch in diameter; and the optic nerve, just before joining the globe, $\frac{1}{30}$ nd of an inch. Notwithstanding its minute size, however, the eye is sufficiently well developed as to its structure. The sclerotic is covered with brownish spots, mostly hexagonal in shape, and which are more thickly crowded and deeper in shade just at the margin of the cornea, where they form a blackish ring (fig. 3). The crystalline lens is globular, and $\frac{1}{13}$ th of an inch in diameter. There were some appearances of a nearly colorless iris, lying behind the cornea, but the parts were so minute that I did not succeed in ascertaining its existence by dissection. The brain is pretty well developed, though less so than in other allied genera; and notwithstanding the imperfect condition of the eyes, the lobes which, in the brain of reptiles, are usually considered as representing the *Tubercula Quadrigenina*, are of very considerable size. The brain of the *Triton cristatus*, another naked Amphibian, with large well developed eyes, differs from that of the *Proteus* simply in being rather larger in comparison with the size of the animal, and in having a somewhat greater proportional development of the hemispherical lobes. The

following are the longitudinal measurements of the brain of a *Triton cristatus*, $6\frac{1}{2}$ inches long, and that of a *Proteus anguinus*, $8\frac{1}{2}$ inches long :

	Triton.	Proteus.
Hemispherical lobes,	5 millimetres.	$4\frac{1}{2}$ millimetres.
Tubercula Quadrigemina,	$2\frac{1}{2}$ "	$2\frac{1}{2}$ "
Cerebellum,	$1\frac{1}{2}$ "	$1\frac{1}{2}$ "

The two brains could hardly be distinguished from each other, except for the fact that the olfactory nerve in the *Proteus* runs forward for some distance as a trunk along the inner side of the membranous olfactory canal, while in the *Triton* it breaks up into branches immediately on leaving the anterior extremity of the brain (fig. 5).

It will be seen that the suppression of the visual organs in these animals is not, by any means, complete. There are, however, other creatures existing in the same localities with the *Proteus*, in which the eyes are altogether absent. Two species of Crustaceans are found in the caves of Carniola, viz: *Palæmon anophthalmus* and *Titanethes albus*, both of which are colorless, diminutive in size (not more than one inch long), and, so far as they have been examined, entirely destitute of eyes. They are supposed by some to be the natural food of the *Proteus*. I am informed by Mr. Kollar, of the Vienna Zoological Museum, that a species of spider, entirely blind, has also been discovered in the same caverns.

There is much resemblance, in regard to the condition of the eyes, between the *Proteus* and *Lepidosiren Paradoxa*. In the two specimens of *Lepidosiren*, dissected by Prof. Bischoff, and described by him in a monograph on the subject, the eyes were "hardly a line in diameter," though one of the animals measured over three feet in length. The opening of the eyelids is wanting, also, in *Lepidosiren* as in *Proteus*, and the eyeball is completely covered by the integument. So little is known, however, of the mode of life of *Lepidosiren*, that it is impossible to determine whether the cause of the imperfection be the same in both animals.

Very little is yet known with regard to the mode of reproduction of the *Proteus*; and, particularly, it is altogether uncertain whether the animals are oviparous or viviparous. Dr. Joseph Hyrtl, Professor of Anatomy at the University of Vienna, states that he has found, at the extremity of the oviduct in the *Proteus*, a gland which exists elsewhere only in the oviparous species of the naked Amphibia; so that the *Proteus* is probably also oviparous. But nothing more definite has been discovered. One German observer (von Schreibers) endeavored to ascertain this point by examining specimens of *Proteus*, taken from their caverns at every season of the year; but, according to Herr Fitzinger, he

only succeeded in finding the ovaries unusually developed in a few instances. H. Fitzinger, himself, has met with the ovaries in a state of active development in only one instance; and up to the present time, according to him, neither ova nor embryos have ever yet been discovered in the oviducts.

The female generative organs consist of two elongated, saciform ovaries, situated at the posterior part of the abdomen, directly in front of the kidneys. In the specimen measuring $8\frac{7}{8}$ inches total length, in which the generative organs were in a state of quiescence, the right ovary was 0.98 of an inch long,—the left somewhat smaller. The cavity of the organs was lined by a mucous membrane, beneath which were to be seen the whitish, globular, nearly transparent ova, varying in diameter from $\frac{1}{70}$ th of an inch downward. The oviducts were a pair of slender and perfectly straight tubes, which, commencing by a wide aperture, at some distance anterior to the ovaries, and running down on the outer and posterior aspect of these organs, opened into the cloaca, just above the orifices of the ureters.

In another specimen, however, obtained at the Vienna Museum, the organs were in a high state of development. The right ovary was 1.75 inches, the left 1.64 inches long, and they contained, together, 66 roundish, opaque ova, of a deep yellow color, and evidently just ready to be discharged. Their average size was a little less than $\frac{1}{7}$ th of an inch in diameter. The oviducts were much larger than in the other specimen, and exceedingly contorted, so that they must have attained two or three times their ordinary length. None of the ova, however, had yet left the ovaries, so that nothing new could be learned with regard to the question of viviparity.

