XI. *Further observations on Planariæ.* By J. R. Johnson, *M. D. F. R. S.*

Read March 10, 1825.

About three years since I presented to the notice of the Royal Society a few observations on the genus *planaria*. From that period to the present having had no opportunity of extending my researches to more than two or three species in addition to those formerly described, I was unwilling to trespass upon the time of the Society by any further remarks, until I had ascertained the remaining species of this genus.

A circumstance, however, attending some experiments in which I have been lately engaged, of rather a strange character, forming another interesting feature in the history of these very extraordinary animals, induces me to lay before the Society the present communication.

The circumstance to which I allude, is that of the *P. cornuta* obtaining a second or additional head by an artificial incision, thus constituting a *double headed planaria.*

At the period of my transmitting my former paper to the Society, I was not aware that any English author had written upon the same subject; but was afterwards much surprised on learning that a Gentleman of Edinburgh, Mr. Dalyell, had published an account of these animals in 1814, in a work, having for its title "Observations on some interesting Phœnomena in Animal Physiology, exhibited by several species of *planaria*." Failing to procure this work at the booksellers,

I was at length fortunate in obtaining it through the liberality of its very ingenious author, who obligingly presented me with his only remaining copy.

This Gentleman, after noticing the considerable reproductive powers of the *planariæ* in general, but more particularly conspicuous in that species he terms the *P. felina*, and which from his description I conjecture to be the *P. cornuta*, observes, that having occasionally seen some of these creatures deviate from their natural figure in having two tails, &c. (an event however of so rare an occurrence, that I have in no instance met with such in the many thousands submitted to my inspection) it occurred to him that monstrosities of this kind might be obtained by artificial means, founding the practicabily of this measure on what had passed under his reviews. One of these monstrosities he thus describes, "the planaria in relation to others was of small size, its tail was bifid, and out of the cleft grew a body, separated and distinct from the main trunk of the animal, which by some strange and anomalous proceeding had been surmounted by a head, lively and well defined. In subjecting this planaria to the microscope, numerous black specks, the supposed eyes, appeared surrounding the larger head, and they environed the margin of the smaller head also. In the course of a week or little more the posterior head had separated by spontaneous division, and had disappeared. But soon afterwards a kind of projection occupied its place; and it was not without amazement that I beheld this projection vegetate into a new head, resembling the one which had been lost. About a month having elapsed, it was well shaped and entire. My belief being thus corroborated in the probable effect of experiment,

it was reasonable to conclude, that if separating parts became complete animals, if a mutilated trunk regained the defective portion; and if a head, the most important of all organs, was evolved from every inconsiderable fragment, supernumerary parts might, by some particular operation, be produced; yet it was long before *reiterated trials* were rewarded *with success*, and I had almost determined to abandon the enquiry, conceiving that a certain nicety, of which I was not master, should be practised, and that it had been beyond my ability to detect the secret cause of failure."

Notwithstanding the unpromising commencement of this Gentleman's labours he still persevered, and at length noticed, that one of the planariæ upon which he had made an incision a little below the head, had, to quote his own words "an unnatural prominence, which interrupted the general contour of the side. October 25th, nearly four weeks after the operation, the superfluous reproduction was clearly recognised to be the rudiments of a new head. On the 18th of November the operation of nature was fully accomplished; a new and perfect body crowned by a head had grown out of the side of the parent animal, distant about two thirds of the total length from the extremity of the tail."

The work, from which the above extracts have been copied, being now out of print, I have taken the liberty of transferring the delineation of this *double-headed planaria*, under a magnified form, to the drawing accompanying this paper. Vide Plate XVI. fig. 3.

With the view of ascertaining whether, in my hands, these experiments would prove equally successful, I took the ear-

liest opportunity of putting them in practice, but with evident mistrust as to the result (not however in the slightest degree doubting the accuracy of the above report), conceiving that no circumstance of this nature had yet occurred, in the many and repeated experiments I had performed upon these animals during the past and the preceding summer.

Having a considerable number of the *P. cornutæ* in my possession, I took at least one hundred of the most active, and made an incision on the side of the body in each, but only succeeded *in one solitary instance* in obtaining the wished for result.

Looking over these planariæ after the lapse of nearly a fortnight, I discovered that the incisions had, in by far the greater number healed, so that no evident difference existed between them and perfect unmutilated planariæ. Preternatural excrescenses had taken place in several, and others had separated at the place of incision so as to become two animals, but *only one planaria*, as before noticed, exhibited the very singular and astonishing circumstance of *a double head.* The additional head was in about six weeks equally perfect and well formed with the other, although it had not yet acquired the usual deep colour. In fig. 1. is a delineation of this *double headed planaria*, such as it appeared under the microscope when at rest; fig. 2. as seen when in motion. In about two months after it had acquired this additional head, a fragment separated from the tail (the most usual place of separation) and was in progress towards its entire reproduction, when it was accidentally lost—a second, and ultimately a third fragment was spontaneously separated from the same

animal. A delineation of these as they at present appear, (magnified) is given in fig. 4 and 5. The light portions show the parts renewed.

The *planariæ* submitted to my experiments were, it must be confessed, from their long previous confinement, but ill adapted for the purpose; I think it therefore more than probable, that a different result would have followed, had these planariæ been active or vigorous, or but recently taken from their native abode.

From the number of experiments made both by Mr. DALYELL and myself, and from the very few instances in which they proved successful, it may be reasonably inferred, that the production *in the same animal* of a second or *additional* head, is a circumstance of unusual and extraordinary occurrence, and as such may not be unworthy a record in the pages of the Philosophical Transactions.

In addition to my former remarks on the *P. cornuta* and *P. torva*, I have to observe, that I kept a considerable number of each of these species the whole of the last and the former summer, and not having noticed, during that period, any other mode of perpetuating their kind, than that of their detaching small fragments either from the head or tail, I am of opinion they do not, like the other planariæ—at least those I have examined, propagate by eggs; and this may sufficiently account for the reproductive power being so very conspicuous in these species. The *P. torva*, however, does not possess this principle in so high a degree as the *P. cornuta*. In one instance, I recollect one of the latter species casting off two fragments from the tail, the very same night

it was taken, which were only prevented from becoming perfect animals, by an accidental occurrence.

Having found the *hirudo vulgaris* or common rivulet leech to produce its young in greater number when kept separate, I thought the *planariæ* might be similarly affected. To ascertain this point, I took several of the *P. cornutæ* and placed them singly in separate vessels, and in another vessel, by way of contrast, about an equal number together. During the first fortnight scarcely any fragments were detached from the latter, whilst the former, with but few exceptions, had each gone through this process; some indeed throwing off or detaching more than one fragment. This spontaneous separation occurring so soon in those planariæ kept apart, led me to think it was owing to the necessity *then existing* of continuing their species. Hence it would also appear, that this process is *at all times* under command of the animal, and may be called into action upon any particular emergency. And this I think the more evident, from the circumstance of my having lately placed three lively planariæ in the glass globe where the double headed planaria had been hitherto confined alone—that *spontaneously divided* within the short space of four days, (Dec. 24th) in the manner represented in fig. 6, 7, 8.

In regard to the planariæ placed together, although at first extremely indolent, yet they ultimately threw off as many fragments as in the former case; thus proving, that their being kept together or separate makes no further difference, than that where the demand is strong upon them to perpetuate their kind, this process is sooner brought into operation.

The following is the result of this experiment during the first month.

No. of Planariæ.		No. of Fragments.
15	placed together, threw off	16
10	separately -	13
25	produced - -	29

These 25 planariæ, now placed together, detached in the course of the second month 33 additional fragments, making a total of 62. Supposing therefore this operation to continue in full force eight months in the year, (and I find it unchecked even in the present month of January) we should have in the whole 248 fragments, an average of about 10 to each planaria; but if we allow these creatures to multiply in a double or treble degree when at liberty, and supplied with proper food, we may then form a tolerable estimate of the extent to which their reproductive powers might be carried.

In concluding this history of the *P. cornuta*, I may remark, that the smallest portion detached from the tail, so small indeed as to be scarcely perceptible, is sufficient to constitute the active principle or germ of the future animal; but in this case these animals when perfect are so extremely small, as to lead one at the first glance to believe that the parent animals produced their young *perfect* and in a living state; that they were in fact *viviparous*.

I shall close this paper by a few general observations on the *planaria nigra*, the most common of the British planariæ.

P. nigra.

Planaria oblonga, nigerrima, antice truncata.

Long. 5 *lin.* *Lat.* 2 *lin.*

Body, of a fine glossy velvety black, convex above, with an elevated ridge in the centre; plain beneath, truncated before, slightly pointed behind; two ventral foramina; numerous eyes.

This little animal, of which a front view is given of its natural size in fig. 9. is the most sluggish and inactive of all the planariæ I have yet examined. It is commonly found in ditches, attached to the under part of leaves, stones, &c.; it is often seen traversing the surface of the water in an inverted position like the *glossoporæ*.

This species, like those formerly described, is furnished with a retractile trumpet-shaped *proboscis*, issuing from a circular aperture in the middle of the abdomen, and so capable of extension, when in search of food, as to equal in length the animal itself. A delineation of this curious apparatus, (which I shall in future take as a characteristic type of the genus I am describing) is given in a magnified view of the under part of one of these planariæ in fig. 10.

This singular apparatus by means, of which these animals take their food, is not the least of the many strange features in their history; it is indeed so far removed from the common mode of receiving aliment, that doubts might well be entertained as to its real office, were it not clearly pointed out by MÜLLER, and the ingenious author of the work to which we have recently alluded.

The *P. nigra* is oviparous; each ovum, or more properly

speaking, capsule, producing from 2 to 6 young. The period at which the young are excluded varies with the prevailing temperature; the shortest period as seen by the following tables being 20, the longest 53 days, making a difference in this respect alone of more than a month.

No. of Ova or Capsules.	When deposited.	No. of young.	When evolved.	No. of days.
5	Aug. 5	16	Sept. 25	51
1	7	5	29	53
4	14	9	30	47
5	18	31	10	23
12	Sept. 2	48	22	20

27 capsules containing 109 young, being an average of four young to each capsule.

The *P. nigra*, if artificially divided in two or more parts, will have the lost portion restored in about a fortnight or three weeks. One of these under a magnified form, with a renewed anterior extremity, is delineated at fig. 11, for the purpose of showing a circular range of black specks, or what are commonly called eyes, surrounding the outer margin of the head. This species does not, as far as I have been able to ascertain, separate like the *P. cornuta* by spontaneous division; although, in common with the genus to which it belongs, it is enabled to repair any mutilation to which it may have been exposed.

J. R. JOHNSON, M. D. F. R. S.

Bristol, Jan. 11, 1825.

EXPLANATION OF PLATE XVI.

Fig. 1 and 2. *P. cornuta* (front view magnified) with an additional head, as seen when at rest and in motion.

Fig. 3. *P. felina* with an additional head and body, (probably the same species as the above.)

Fig. 4. A separated fragment from fig. 2. now become a perfect animal; the lighter portion shows the part recently renewed.

5. Another fragment from the same animal, in its progress towards acquiring a new head.

Fig. 6, 7, 8. Spontaneous divisions of the *P. cornuta.*

Fig. 9. *P. nigra,* front view; natural size.

Fig. 10. Ditto, back view, magnified; with the trumpet-shaped *proboscis* extended as in search of food.

Fig. 11. Ditto, front view magnified; showing a renewed anterior extremity, with a circular range of black specks or dots, supposed to be the eyes.

Fig. 1.

Fig. 2.

Fig. 3

Fig. 4.

Fig. 7.

Fig. 8.

Fig. 6.

Fig. 5.

Fig. 10.

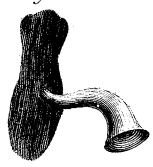

Fig. 9.

Fig. 11.