

1. Lithotritry may be the companion of lithotomy, but can never displace it completely.
2. If employed in every case, it would be inferior to lithotomy.
3. Lithotritry, by crushing, is inferior to that by successive perforation, which is superior to lithotomy.
4. The results of both modes of lithotritry, taken together, are less favourable than those of lithotomy.
5. It is impossible to say what advantage lithotomy might have if it selected its cases.
6. The cure obtained by lithotomy is perhaps more perfect than that obtained by lithotritry.

The work before us is far from being a satisfactory discussion of the subject. Nine days, the time allowed for its composition, was far too short to do it justice, and the data of which we are in possession are liable to be disputed. It may be remarked, that the question has been for some time before the French Academy, and that they have not yet pronounced any decision on it.

ART. VI.—Frederici Arnoldi, *Icones Nervorum Capitis, Heidelbergæ. Sumptibus Auctoris, 1834. Folio, cum Tabulis Lithographicis Nonis.*—*Figures of the Nerves of the Head.*
By **FREDERIC ARNOLD.** With nine Engravings, Lithographed. Folio. Heidelberg, 1834.

To the readers of this Journal, Frederic Arnold must be well known as a diligent and learned demonstrator of anatomy, and as the individual who first gave an accurate description of the otic ganglion. He is further known, we may add, for the indefatigable perseverance, and the minute accuracy with which he has studied the anatomical relations of the nervous system for several years past.

Our anatomical readers are aware, that, of most of the individual nerves of the head, the origin, course, ramifications, and distribution, have been described and delineated with much minuteness and fidelity by various able anatomists. Thus *Metzger* and *Scarpa* have described the anatomical relations of the olfactory nerves; *Zinn* has given a very correct account of the optic nerve, as well as of the third and fourth pairs of cerebral nerves; *Meckel* and *Wrisberg* have, in their account of the division, course, and distribution of the fifth pair of nerves, set an excellent example of accuracy and fidelity; *Palletta* describes minutely its motiferous or small portion, which supplies the tem-

temporal, masseter, and buccinator muscles; and more recently, *Bellingeri* has presented a history of the anatomy of this nerve and its branches, which may be pronounced to be complete in the present state of anatomical knowledge. Of the anatomy of the seventh pair or facial nerves, several important facts have been communicated by *Meckel* and *Sir Charles Bell*, and *Mr Mayo*. The auditory nerve has been studied by many, but most fully by *Cotunni*, *Meckel*, *Scarpa*, *Comparatti*, and the second *Monro*. The glossopharyngeal nerve has been described and delineated by *Andersch*, *Neubauer*, *Scarpa*, and *Wrisberg*; and the hypoglossal by *Scarpa*; and *Soemmering* has given a most accurate view of the basis of the brain, and the cerebral extremities or origins of all the nerves together.

Notwithstanding, however, the labours of these learned anatomists, no connected view of the whole assemblage of nerves of the head, in their mutual relations to each other, in course and distribution, as well as origin, has yet been given; and none, as Arnold remarks, which is worthy of the present state of anatomical and physiological science, has been yet submitted to the student of the nervous system.

Seven years ago, when he was engaged in a minute and careful investigation of the anatomy of the head, and especially of its nerves, the deficiency now mentioned was very keenly felt by Arnold; and, as these researches led him to propose several rectifications upon the anatomical history of the nerves of the head especially, and to entertain several new and ingenious views regarding their origin, mutual connections, and distribution, and as no work on all the nerves of the head in connection was extant, he was led to supply the deficiency by publishing the short description and delineations now before us.

We might, with great safety, pronounce our judgment in general terms of commendation of the manner in which M. Arnold has performed the task thus undertaken; but the accuracy and fidelity with which these nerves are represented, the precise and instructive manner in which not only each nerve, but the different constituent parts of the same nerve, are distinguished and traced, and the general importance of the work as a Neurographical Treatise, require that we should specify more minutely its characteristic merits.

In the first place, the delineations are given with the most scrupulous regard to fidelity, from preparations expressly dissected for the purpose; and the correct relative position and dimensions of individual nerves have been observed with so much attention, that sometimes a variable condition of the same part may be distinguished upon comparison of the several figures.

The author further assures us, that he has admitted into these

figures no nervous filaments, about which any doubt could arise, either as to nature or size, or any other character; and even those parts about which, as being first described as nervous by himself, some doubt might be entertained, viz. the *ganglion otticum*, he expresses the confident expectation, that time,—that is, we presume, the course of anatomical inquiry,—will finally prove to be what he represents them. He admits, nevertheless, the possibility of committing some trivial oversights on unimportant points; but all those of any consequence he represents to be perfectly correct.

We shall shortly advert to the arrangement which the author observes in describing and delineating the nerves of the head.

Commencing with the principle that, as the head is the seat of the organs of proper sensation, the nerves of the animal life predominate in this region over those of the vegetative or organic life, he adds, that, in the head, the arrangement of the two systems is the converse in number and order, of that which it is in the abdomen, in which the vegetative or organic principle is most powerful.

The nerves of the ganglia are distributed chiefly to the arteries; the cerebral and spinal nerves transmit their branches to the voluntary muscles and the organs of touch; the cephalic or superior part of the sympathetic nerve sends numerous filaments to the external and internal carotids and the vertebral arteries; while many form anastomotic communications with the nerves of the neck and brain.

As the arrangement and distinctions observed in the present work not only accord closely with several of the distinctions made by Bellingeri, Bell, and Mayo, but illustrate, in a very interesting and beautiful manner, most of the physiological principles of the first of these authors, and as this classification is the only one in which these physiological illustrations are clearly given in an anatomical treatise, we think it cannot fail to be instructive to give a short sketch of the system of arrangement, and distinction of the nerves of the head, now proposed, and so ably explained by the present author.

It is necessary to premise, that Arnold does not regard each nervous trunk as it issues, or seems to emerge, from the brain, as a separate nerve. In opposition to the usual practice of anatomists in this matter, he regards several nerves considered by others as separate, as, in truth, concurring to form one nerve. Thus, the only individual nerves which he admits are the first, the second, and the eighth pairs, i. e. the olfactory, the optic, and the auditory. The third, fourth, the small part of the fifth, and the seventh, he allows only to form a single nerve; and, in like manner, he converts the ninth, tenth, eleventh, and twelfth, into a single pair of nerves.

It is further necessary to inform our readers, that throughout the whole of his distinctions, M. Arnold adopts the theory originally proposed by Peter Frank * and Burdin, † and afterwards espoused by Kielmeyer, ‡ Dumeril, § and Goethe, || and more or less fully elaborated, illustrated, and maintained, by Oken, ¶ and Spix, ** Blainville †† and Geoffroy St-Hilaire, Carus, †† Meckel, §§ Schultz, ||| Bojanus, ¶¶ and Burdach, ***—viz. that the *cranium* is a series of *vertebrae*, formed according to the type of these bones, and presenting, consequently, the same relation to the soft parts. In the adoption of this principle, however, he confines himself to the views given by Oken, Cuvier, Carus, Spix, and Meckel, that the *cranium* consists of three *vertebrae* only, and does not appear to look with much favour on the doctrine of Bojanus, who admits four, and much less so on that of Geoffroy St-Hilaire, who believes that he can demonstrate the existence of seven *vertebrae* in each scull. It is easy to perceive, that, as it is not agreed what is the precise number of cranial *vertebrae*, it must be equally uncertain in what manner, or upon what principle, we are to enumerate, and arrange, and distinguish, the cranial intervertebral nerves.

Independent, however, of this natural difficulty in the application of this piece of osteological theory, there is yet another not less embarrassing, in the circumstance, that all anatomists are by no means agreed as to the exact lines of demarcation between the various constituent *vertebrae*; and we find one view given by Oken, another by Spix, a third by Carus, and a fourth by Meckel.

So far as we understand the distinctions established by M. Arnold, he appears to follow, with little deviation, the method of division observed by Carus and Meckel. He makes the *cranium* consist of three *vertebrae*,—the occipital or posterior, the parieto-temporal or middle, and the fronto-sphenoidal or anterior; and in this manner, consequently, he admits, as we have already stated, only two pairs of cerebral nerves. It is not quite

* Epit. de Curand Hom. Morb lib. ii. p. 42.

† Cours d'Etudes Medicales. Paris, 1803. Tome i. p. 16.

‡ Ulrich Annotationes quædam de sensu ac significatione ossium Capitis. Berlin, 1816, p. 4.

§ Magasin Encyclopédique, Tome iii. 1808.

|| Zur Naturwissenschaft, Tome i. p. 250.

¶ Ueber die Bedeutung de Schadelknocken. Jena. 1807. Isis, 1820. No. 6, p. 552.

** Cephalogenesis Munich, 1815.

†† Bulletin de la Société Philos. 1816, p. 111 and 1817.

‡‡ Lehrbuch der Zootomie. Leipzig, 1818, p. 164.

§§ Beytrage zur Vergleichende Anatomie, Band ii. Stuck ii.

||| De primordiis Systematis Ossium etc. Halle, 1818, p. 13.

¶¶ Isis, 1818, p. 301. 1819, p. 1364.

*** Vierter Bericht von der Anatomischen Anstalt zu Koenigsberg. Leipzig, 1821.

so easy to discover where he draws the intervertebral lines ; but, it is manifest, from the distinctions presently to be mentioned, that one must pass through the superior orbital fissure, or the *foramen lacerum superius* of the sphenoid bone on each side, and that the other must pass through the *foramen lacerum*, in the base of the cranium, or the occipito-temporal fissure. The nerves emerging by the former aperture, he groupes together under the head of the anterior pair ; and those emerging by the latter, he designates as the posterior pair. As in this arrangement, however, the seventh pair, which issues by the Fallopian aqueduct, and the ninth pair, or glossopharyngeal, which emerges by the anterior part of the *foramen lacerum posterius*, are not included, the author regards them as not genuine intervertebral nerves, but as rather presenting a mixed character.

It will be afterwards seen, that, in accommodating this theory to his views, he takes considerable liberties with the cranial apertures, and does not scruple to admit a greater number of intervertebral holes than, according to the theory, he is entitled to do. Thus the *foramina rotunda* and *ovalia* of the sphenoid bone, and the anterior condyloid holes, are all converted into intervertebral holes in the course of the demonstration.

The explanations now made, though neither full nor minute, are, however, necessary to enable our readers to comprehend the subsequent distinctions, and even the entire system of description and arrangement observed by M. Arnold ; and we trust that they will be of some utility in this respect. We now proceed with the distinctions of the author.

Adopting the general division established by Soemmering, which is unquestionably the best, Arnold distinguishes all the nerves of the brain into two classes,—one comprehending the nerves of the senses proper ; the other the intervertebral nerves of the *cranium*. To the former belong the first, or olfactory, the second, or optic, and the eighth pair, or the auditory nerves ; and to the second he refers all those other pairs of nerves which, like the spinal nerves, derive their origin from the brain by means of a double root, an anterior and a posterior, and emerge between the vertebral bones of the *cranium*.

The intervertebral nerves of the head he then subdivides into two pairs,—an anterior and a posterior. The anterior comprehends the third pair of cerebral nerves, and the subsequent ones as far as the seventh ; and the posterior embraces the inferior nerves, from the ninth to the twelfth pairs.

The posterior root of the anterior intervertebral nerve is the larger portion of the fifth ; the anterior root is formed by the third, fourth, and sixth pairs of nerves, and the masticatory nerve is the smaller portion of the fifth.

The anterior root of the posterior intervertebral nerve includes the eleventh and twelfth cerebral nerves; and the posterior root consists of the tenth pair only. Between both these roots, the seventh and ninth pairs hold an intermediate place; and the facial and glosso-pharyngeal nerves may, therefore, be said to be mixed nerves. Upon this principle M. Arnold exhibits the following tabular arrangement of the cerebral nerves.

		olfact. optic. acoustic.	
CLASS FIRST.		I. II. VIII.	
		Anterior intervertebral nerve.	Posterior intervertebral nerve.
		oculimot. trochle. abduct.	
CLASS SECOND.	Roots.	III. IV. VI.	XI. XII.
	Anterior.	V. masticatory part. facial.	
	Posterior.	VII.	
		Sensitive or facial.	IX.
		V.	X.

He also proposes another arrangement of the cerebral nerves equally natural; viz. of the nerves belonging to the intervertebral pairs, both anterior and posterior, and simple or motiferous, and compound or motiferous, and sensiferous. To the former he refers the third, fourth, sixth, and twelfth; and to the latter the fifth and seventh, the tenth, with the eleventh and ninth. This arrangement is placed in the tabular form in the following manner:—

		I. II. VIII.	
CLASS FIRST.		Mixed nerves.	Simple nerves.
		V. VII.	III. IV. VI.
CLASS SECOND.	The intervertebral nerves.		
	Anterior.		
	Posterior.	X. XI.	XII.
		IX.	

To each of these cerebral nerves this peculiar office is allotted, that the third, fourth, and sixth nerves move the eye, the twelfth the tongue, and that the fifth pair ministers to the sensations of the face, the nostrils, and mouth; and that the tenth pair, or pneumogastric, regulates the sensations of the stomach, *larynx*, and lungs. To the fifth pair is superadded the small or motiferous portion as a masticating nerve, and to the tenth (the pneumogastric,) is added the eleventh, as a vocal and respiratory nerve. The larger portion of the seventh is the motiferous nerve of the face; the smaller portion is a sensiferous nerve. The ninth pair consists of two parts, a large and a small; by

the former it completes sensation in the root of the tongue and *pharynx*, and by the latter it moves the *pharynx*.

The nerves of the first class, or those ministering to the organs of proper sensation, differ greatly from the other nerves of the brain in structure, formation, and vital property. They send no branches in their course; in structure they agree more with the substance of the brain than the intervertebral nerves; they proceed in the foetus, that is, in early development from the cells or chambers of the brain; and they are susceptible of peculiar irritations only, as light, sound, and odours.

The intervertebral nerves of the *cranium* agree in structure with the spinal nerves. They issue from the brain by two roots, an anterior and a posterior, the latter being provided with a ganglion, and composed of many minute filaments proceeding to the ganglia; while the former, though composed of several threads, immediately from its root forms a roundish trunk. The intervertebral nerves distribute their filaments both in their transit, and also when they enter the various organs. They neither rise from the brain, according to the author, nor from the spinal chord, but are formed by themselves in that spot in which they appear. They are susceptible of irritations of various kinds, so that they may either excite muscular motion or sensation; and the impressions are conveyed in different lines by their anterior and posterior roots. "Therefore," concludes the author, "while one series of nerves transmits the conditions of the brain and spinal chord to the organs by which motions may be affected,—and another series conveys the external impressions and affections of the organs to the central regions of the nervous system, by which sensation is excited, the intervertebral nerves may be divided into motiferous and sensiferous nerves." Our readers may remark, that this view corresponds exactly with the *associated circle of nerves and nervous communication between the brain and the muscles or organs*, taught by Sir Charles Bell, and the *Reflex Function* imagined by Dr Marshall Hall to reside in the spinal chord, and to minister to various instinctive acts, by an action reflected, as he believes, from the remote organs to the brain.

As the anterior root of the spinal nerves is conceived to minister to motion, and the posterior to sensation, it may be reasonably inferred that the intervertebral nerves of the head, now shown to be analogous to these, are also analogous in faculties; but to what extent certain of the cerebral nerves agree with the former species of root, and to what others agree with the latter, we are informed by minute anatomical investigation.

Arnold is then led to make a very near approach to what we ever have regarded, and must continue to regard, as the true use

of the nervous chords, in observing that, by means of the nerves of the head, the dynamic conjunction of the brain or cerebral portion of the nervous system, with the external parts of the head, the lungs and the stomach, is directly accomplished;—and, in accordance with this principle, he distinguishes the extremity, vulgarly called the origin, as the cerebral part or end of the nerve, and the other according to the parts with which it is connected. The cerebral nerves at once convey to the mind the objects of perception and complete sensation, and they propagate the acts of the brain to the organs, and excite motion. The different functions performed by different nerves depends at once on the difference of nature, on the peculiar condition of the parts of the brain, and on the peculiar nature of the external organ; and hence, a difference of function is observed to be associated with differences in structure. Thus the genuine nerves of the proper senses differ in structure from each other, and from the fifth and tenth pairs; and the motiferous nerves do not agree in structure with the sensiferous. In short, each part of the brain is, in its own nature, allied either to sensation or to motion, and communicates the one character or the other to the nerves attached to it. Lastly, all the organs bear in their nature an ultimate relation to one or other class of cerebral actions.

The more varied the relations of each part of the body are to the mind, the more numerous are the pairs of nerves; and the more important the organ is, the more varied are the nerves in origin and nature. The importance and number of the nerves of the head, correspond to the importance and number of the parts of that region. The brain and *cranium*, which from the first present the type of the spinal chord and *vertebræ*, are so voluminous in the human body, that the individual parts of one nerve are kept separate in origin and course, and, therefore, the scull and brain present many nervous trunks, the primitive form of which is understood only by the penetrating inquirer.

In order to understand well the constitution and nature of the nerves of the brain, M. Arnold represents attention to the following circumstances to be requisite.

I. To the three superior organs of sensation are appropriated peculiar individual nerves, which belong to one and the same class. The first pair, or the olfactory, the second, or optic, and the eighth or acoustic, are denominated GENUINE, TRUE, OR PURE NERVES OF SENSATION.

II. The other pairs of cerebral nerves present in formation the type of the spinal nerves, and are to be denominated INTER-VERTEBRAL PAIRS. Admitting only three *vertebræ* in the *cranium*, it is manifest that between these can issue only two other

intervertebral nerves, an anterior and a posterior, which, however, by reason of the variety of the parts of the head, and the size of the brain, are separated into several individual trunks.

III. The third pair, the sixth and the twelfth pair of nerves, rise from the base of the brain in the same manner as the anterior roots of the spinal nerves; the fifth and the tenth pairs in the same manner as the posterior roots; while the seventh and the ninth pair hold an intermediate place between the two. The fourth pair, the small portion of the fifth, and the eleventh pair are distinguished in their origin from the motiferous nerves.

IV. Most of the trunks of the intervertebral nerves emerge by the intervertebral holes of the head, viz. the superior orbital fissure and the *Foramen lacerum* in the base of the *cranium*, or temporo-occipital fissure. Through the former emerge the third pair, the fourth, the sixth, and the ophthalmic or first branch of the fifth. Through the latter pass the ninth pair, the tenth or pneumogastric, and the eleventh. The round and oval holes of the sphenoid bone, which are appropriated to the second and third branches of the fifth pair, and the condyloid hole, which is devoted to the tenth pair or hypoglossal, belong to the intervertebral holes, from which they are separated according to our author, solely because the scull has attained a form conformable to the brain and nerves. The tenth pair observes a peculiar course in the temporal bone, in consequence of its intimate connection with the auditory nerve, and the auditory nerve and the organ of hearing.

V. The intervertebral nerves are so distributed, that the anterior is subservient to the motions of the face, and sensitive life, and the organs comprised in it; while the posterior pertains to the pneumogastric system, the tongue, the *pharynx*, *aesophagus* and stomach, the *larynx* and the lungs. The tongue being the organ of taste, speech, and deglutition, is provided with branches from both intervertebral nerves. The muscles of the orbit are endowed with three separate nerves, rising from different parts of the brain; because from the eye the mind is reflected, by this organ various affections are evinced, and without motion the eye is void of all animation and energy. To the muscles of mastication is distributed the *nervus masticatorius*, or small portion of the fifth pair; to the muscles of the face, the facial or seventh pair; to the integuments of the countenance, temples, and neck, and to the mucous membrane of the nostrils and mouth, the large portion of the fifth pair and the small portion of the seventh are appropriated. The glosso-pharyngeal nerve is the peculiar minister of the *pharynx* and the root of the tongue, and the pneumogastric nerve holds the sovereignty of the *larynx* and windpipe, the *aesophagus* and stomach. The eleventh pair

moves the internal muscles of the *larynx*, and some muscles of the neck, by which we expire deeply. The twelfth pair is aptly denominated the motiferous nerve of the tongue, or the nerve of articulate speech, since its branches are distributed to the muscles of that organ and the *os hyoides*.

VI. In their course, several nerves of the brain form communications both with each other, and with the nerves of the neck, and with the upper division of the sympathetic nerve, because these nerves either are distributed to one and the same part, or they contribute mutually to form a series of sympathies common to one part of the body, or by union they form intermediate organs. Thus the fifth pair and the seventh, the lingual nerve and the hypoglossal, are united variously; the upper filaments of the system of ganglions, and the cerebral and cervical nerves are connected; the nerves from the cervical ganglions form with the nerves of the brain and neck, ganglions which belong to both systems of nerves;—as the ophthalmic, the nasal, maxillary, petrous and pneumogastric ganglions, the four first of which belong to the organs of the senses, while the others constitute an intervertebral tribe of ganglions of the head.

Such are the chief principles and distinctions to be kept in remembrance in the course of studying the anatomy of the nerves of the head and face. The whole of these principles and distinctions are not entirely new; for our readers are aware that they were inculcated and illustrated, as to the fifth and seventh pairs of nerves, by Bellingeri and Sir Charles Bell; and as to the spinal nerves, by the latter author and Magendie, and some other authors. To Arnold, however, belongs the merit, if merit there be, in applying these distinctions to the nerves of the head generally, and in producing an extensive general system of arrangement, according to physiological principles, of all the nerves of the head and face. In making this application, therefore, M. Arnold is unquestionably original.

It is impossible to doubt that this method of arrangement and distinction exhibits a much clearer and more intelligible view of the system of the nerves of the head than any yet given to the physiological world. They present a greater degree of order and generalization than can be obtained by any other method, in so far as they associate, by certain general principles, the organs to which nerves agreeing in structure and disposition are distributed. These views are still more beautifully illustrated in the accurate delineations published by M. Arnold.

Thus we find the third pair consists of two parts, a motiferous and a sensiferous, or gangliophorous portion, the latter being the portion which is distributed to the iris, and which, with the fifth pair, forms the ciliary nerves.

Of the seventh pair, or the communicating of the face, we find

he traces the two parts of the cerebral extremity, to the posterior margin of the annular protuberance, and the upper part of the restiform body, and to the margin of the auditory nerve, which, indeed, is also the superior part of the restiform body. It is impossible to overlook the physiological uses of this mode of connection of its cerebral end with the brain; for though this nerve is doubtless one which performs many voluntary motions, and thereby gives proof of its connection with the protuberance, it is, nevertheless, to be observed, that it gives rise to an extensive series of instinctive actions, and that, in its distribution and communications, it is connected with organs not exactly under the influence of the will; and hence the reason of its connection also with the restiform bodies. It is also important to observe, that, as the sense of hearing is connected with the developement of many of the motions of the face, and with many emotions and feelings expressed in the face, the connection of the acoustic nerve with the seventh pair is also a necessary circumstance in the arrangement of the cerebral nerves.

We may mention when on this subject, that we have in the fifth engraving a most beautiful and distinct view of the *ganglion oticum*, or auricular ganglion.

Of the ninth pair, or glosso-pharyngeal nerve, the cerebral extremity consists of two parts,—a larger or posterior, and a smaller or anterior, both connected with the restiform bodies. The connection between the filaments of this nerve and the tympanal cavity and Eustachian tube above, and the *pharynx* and tongue below, and with the *nervi molles*, is well displayed in the sixth engraving.

Of the tenth pair, or pneumogastric, we must not speak, because it would lead us into a field too extensive and complicated.

The twelfth pair, or hypoglossal, is the nerve, according to Arnold, of articulate speech. The trunk and descending branch only of these nerves are represented.

We ought not to omit to mention, that in the seventh plate is a correct and beautiful view of the ramification and distribution of the branches of the fifth pair, especially the inferior maxillary and its ganglions, while the general distribution, and especially the dental branches of the fifth pair, are very beautifully represented in the eighth plate.

In conclusion, these engravings, which are not only very accurately and beautifully done, but upon a new principle of arrangement, ought to be carefully studied by all those who wish to understand the neurotomy and neurology of the head. They reflect great credit on the author as an anatomist of great accuracy, and a physiologist of great originality.