Spina Bifida

The general subject of spinal diseases is one which, until a comparatively recent period, has been little studied or understood. Before our own times no medical writers have devoted more than a few pages to their consideration, nor attempted any such investigation of the subject as its importance justly demanded; and the means of cure they recommended have been inadequate or improper. In the rapid progress of modern medical science however, these diseases have been more attended to; and that they claim this attention in no ordinary degree, will appear not only from the scientific interest connected with the investigation, but still more from the melancholy effects of these diseases in prostrating so many of our fellow beings in languishing and painful helplessness during the tedious years of their protracted suffering, and in their extensive and fatal consequences among thousands of infants who come into the world.
The unhappy victims of hereditary disease. It would be foreign to our purpose at present to enter into any amplified observations on the general character of these diseases. It is sufficient to notice, in connection with these introductory remarks, the sad and well authenticated fact, that numbers of infants are born with a congenital malformation which is destined, in spite of all the aids of medical science, to limit their span of life to a brief period beyond which there can be little hope of its prolongation. When we reflect upon the afflicting distress thus entailed on so many families, and the constantly widening transmission of such diseases among the human race, we are urgently prompted to enquire more particularly into their sources and nature, and to examine carefully all the facts connected with them, so as to attain some satisfactory results as to the means by which they may either be contracted, alleviated, or cured. The disease which has been dis-
tunglish under different appellations by various authors, for instance Hydro-
"rachis" by Pinel, Hydro-rachia by Frank and Hydro-rachitis by Sauvages, is a con-
genital deficiency of a certain portion of the vertebral column, most often in its lumbar region, attended by a fluid
swelling or tumour over the seat of such deficiency. The term Spina
Bifida, usually applied to the disease in question by modern authors, originated in Arabia, by the Physicians of
which country it was first described. They were induced to give it this name from an erroneous belief that it was
owing to a double formation of the spinous processes of the affected bones of the column. The term is calcula-
ted to lead to false ideas respecting the true nature of the disease, inasmuch as it is in reality, due to a
deficiency either of the processes above mentioned, or of the vertebral arches.
Hence the membranes of the medulla
having lost the natural support afforded by their bony case at a particular spot, are thrust through the opening in the column, become filled with a natural secretion, and protrude between the muscles on each side of the spine. The tumour thus formed is soft and elastic, may be either transparent or opaque and varie as to shape, size, and colour. At first it exhibits no projection, there being a mere spot of a reddish or livid hue to indicate the position of the vascular deficiency beneath. It however gradually enlarges till it reaches its average size which is that of a small orange, but may be larger for of course, it will occupy a space proportionate to the number of defective vertebras. Its base may be either broad, circular, oval, or united to the spinal axis by a pedicle. Its shape also is subject to much variation, being sometimes rounded, sometimes conical, and at others pyriform.
The colour of the face must depend upon the condition of the veins, at birth, which may be either sound, thickened, ulcerated, gangrenous, or covered with fungous growths or hair tufts. The most usual colour is that of the natural skin; but it occasionally assumes a pale, brown, red, or even a livid hue. The skin generally presents a smooth and shining appearance. A remarkable case is related by Brunner in which it was so smooth and polished that the mother of the infant could see her face reflected upon it, as in a mirror, to which in fact it was compared! The skin however is not always a covering to the tumour, as cases are related in which it was wholly wanting.

The fluid contained in the tumour of Spina bifida usually partakes of the same character as that of Hydrocephalus. It resembles serum; is somewhat more liquid than the white of an egg, and like it capable of coagulation. It is generally thin and colourless.
Cationally however it is turbid, and
mixed more or less with blood. Its quan-
tity has been found to be so great in
some instances as to measure from six
to seven pints, and it may occupy
different situations in the spinal ca-
nal. In the latter respect, Andral
notices the following varieties:
1st. In the cavity of the arachnoid
membrane.
2nd. Between the arachnoid membrane
and the dura mater.
3rd. Between the arachnoid membrane
and the pia mater.
4th. Between the pia mater and the
osteous processes of the spinal canal.
5th. In a canal formed in the spinal
cord itself.
6th. In a cyst situated outside of the
dura mater.
Of these the second and fourth seem
to admit of doubt. Its most frequent
seat is between the arachnoid mem-
brane and the pia-mater i.e. in the
Occasionally also in addition to the varieties mentioned above, serous cysts filled with a limpid fluid have been found in the tumour.

As to the manner in which this fluid is secreted, there appears to be considerable uncertainty. Some have thought it to depend upon the internal surface of the tumour alone; others that it is secreted from the membranes of the medulla; while some believe that it may be accounted for by the supposition that the disease is always connected with Hydrocephalus, and that the fluid descends from the ventricles of the brain into the tumour. This however is at once set at nought by the fact that many cases occur without complication with that disease. It is probable that under certain circumstances it may originate in the walls of the tumour itself.

The fluid of Spinal bifida has been made the subject of chemical analysis.
by various authors. In 1818, Signor Branca, Professor of Chemistry in the University of Pisa, published the following results of his researches:—"It was of a slightly reddish colour: upon standing it became limpid, and had a sensibly saline taste. It was not coagulated by the action of Concentrated Sulphuric acid, alcohol, or heat; although alcohol caused a slight precipitation of whitish flakes. The addition of Nitrate of Silver produced a copious white coagulation. The action on test paper gave slight indications of the presence of an alkali. It became turbid from the addition of Oxalate of Ammonia. Upon evaporating to dryness, it left upon the sides of the vessel, a minute layer of whitish matter, and upon stopping the evaporation before dryness, small crystals spontaneously formed in large quantities, of a saline taste, from which hydrochloric acid was evolved upon adding a few drops of concentrated Sul-
Phosphoric acid.

Postock and Marcet also subjected the fluid to chemical experiment. Its component parts were laid down by the former as follows: of 100 parts,

- Water: 97.8
- Muriate of Soda: 1.0
- Albumen: 0.5
- Mucus: 0.5
- Gelatine: 0.2

And by the latter, of 1000 parts:

- Water: 986.60
- Mucus: 2.20
- Muriate: 7.65
- Carbonate of Soda: 1.35
- Phosphates: 0.20

The varieties of the tension, irrespective of the common integument, consist in most instances of the aura mater spinalis and the layer of the arachnoid membrane, with a mesh of nerves scattered upon the latter; occasionally, however, as in the case where the fluid is contained in the medulla, the pia mater will be
an additional covering. Besides the above will be found the ligamentous matter of the canal and cellular tissue.

The medullary membranes are liable to certain changes of structure during the progress of the disease. They are usually in a congested and inflamed condition, besides exhibiting various degrees of tension and thickening. The dura mater is elongated, adheres to the skin, and forms the pouch or sac of the tumour on its outer surface. The state of the membranes depends materially upon the activity of the disease: for instance, if the tumour be rapidly filled with the spinal fluid, and bursts, inflammation only, with a certain degree of enlargement will be observed. If on the other hand, the process of filling has been gradual, and the patient has lingered for some time, the walls of the tumour merely un-
dergo thickening, and but little inflammation is observed. The condition of the skin depends upon the amount of distension imposed upon it: if it be excessive, it will of course exhibit those characters which are observed to occur in other parts of the body from the same cause: namely, inflammation, ulceration, or even gangrene.

Ollivier, in speaking of the condition of the medulla epinales, remarks that in the more ordinary case, it is most frequently found in the cavity of the tumour; this however is not to be wondered at when we consider that the organ is at a certain part not merely deprived of the support of its osseous envelope, but also in many instances, of that of its retaining membranes. The medulla has
been observed in some cases, not only
to deviate from its normal course through
the spinal canal, but there are instances
related by Brunner, Sandfort and
others, in which it terminated altogether
in the tumour, leaving the lower part
of the canal quite empty.

The alterations which have as
been noticed in its structure are
consolidation, softening, diminution
of its natural diameter, and some-
times an imperfect division of the
organ into two parts, or an extension
into a kind of membrane. Otto re-
marks that in the most severe forms
of the disease, the medulla is wholly
wanting, nothing being found to oc-
cupy the spinal canal, but the mem-
branes in a degenerated and adherent
state or else forming a closed sac
filled with lymph. It has been no-
ticed also, that in all cases in which
this absence of the spinal marrow
occurred, the individual was simi-
Tangibly encephalous, or deficient in the nervous matter of the brain. One remarkable case of this kind occurred to Dr. Clark, and was recorded by him in the Philosophical Transactions for the year 1793; in this case there was not the slightest trace of the nervous system.

Experience teaches that not alone may the medulla spinalis itself undergo changes in structure and position, but that the nerves which have their origin from it may be materially interfered with both with regard to their arrangement and ultimate distribution. The origin of the spinal nerves in their ordinary state of health, takes place by two sets or bundles of filaments: one of these is denominated the anterior set, from their being seen to emerge from the anterior surface of the cord, and the other the posterior, inasmuch as
They leave it by its posterior aspect. Both sets proceed in their course outwards, being separated by the ligamentum dentatum, approach each other, perforate the dura mater spinalis by two separate apertures, and soon join to form a common spinal nerve. This nerve once more undergoes division, and subsequent subdivision into more minute filaments for the supply of its peculiar organs or organs in the animal economy. In the disease under consideration, it appears that the posterior set is liable, in certain instances, to exhibit not only various modes of origin from the cord, but also a total change in their course and distribution. Their origin from the cord sometimes take place by single filaments, which leave the canal to be distributed upon the parietes of the tumour; their course being by the aperture in the spinal canal through the fluid of the tumour. They do
not however always take a uniform course through the fluid, but having quit
ted the cord much in the same way as
those last mentioned, they may either
wind round the internal surface of
the tumour, and in so doing form a
network of filaments upon it, or else
they unite into a mass resembling
a mushroom, consisting of a stalk
made up of the fibres connected together
by cellular tissue, and a head or
expansion of the same fibres; the
latter being connected to the upper
surface of the tumour, and terminating
there. An example of the former kind
is related by Burgius; in this case
the internal surface of the tumour, for
being surrounded by fibres and bundles
assuming a columnar character, was
compared to that of the ventricles of
the heart. When such unusual distri-
tution of the nerves takes place, it
does not appear that the whole of
the filaments forming the posterior
Series are invariably implicated. But regard to their course also and the manner of their exit from the spinal canal, it has sometimes been observed that they do not always pass through the aperture in the vertebral canal, but as it were, perforate the tumour at its base, and so proceed to their destination upon its inner aspect.

The above observations may be laid down as applying chiefly to the disease when treated in the lumbar region, where the medulla is almost invariably affected by it to a greater or less extent. When the defect is situated higher up in the column, the nerves are seldom implicated, much less the medulla itself. When the nerves are affected at all, they are only the posterior set, whereas in some cases which occur in the lower parts of the canal, the whole bundle of nerves forming the last known as the Cauda Equina may enter the cavity of the tumour, and having
attached itself to its apex, return to the spinal canal again.

Although the tumour of Spina Bifida, or rather the osseous imperfection itself is usually known and described as occurring in the lumbar region, it may nevertheless be found in other situations. Its most frequent seat is in the region above mentioned, especially at the spot where the sacrum articulates with the last lumbar vertebra. Next to the lumbar, its most frequent seat is in the sacral, next in the dorsal and lastly, though very rarely, in the cervical region. Not only has it been found to occupy any one of the above situations alone, but cases have been recorded where the whole spine has been found in the so-called Bifida state; the canal being sometimes wholly deficient, at others defective in its arches and spinous processes. Moreover the malformation has at times existed at two distinct portions of the spine di-

multaneously, leaving an interval of
parts in a state of perfect integrity
between them.

Having now noticed the several
movable states of the skin, membranes,
medulla, and nerves, generally observed
as the result of the disease, as well
as its seat, we may next proceed to
review the usual conditions of the
spinal canal itself; and firstly, as
to the parts of the vertebrae which are
most liable to defect. Fleischman
in his treatise "De vitis congenitis Circa
thoracem et abdomen," reduces such de-
fects to three classes:

I. Where the whole vertebra, - body as well
    as processes - is divided

II. Where the lateral arches are imperfectly
developed.

III. Where, although the lateral arches are
developed, they are not united.

Of the above forms the first is rarely met
with, as also is the third. The second, where
the lateral arches are imperfectly developed,
is the one which occurs the most frequently, and is the essence of the defect in the disease under consideration. The malformation appears to bear a close analogy to those which are so often seen in the median line of the body, the result of a want of union between the two halves of the fetus during utero-gestation: for instance, hare-lip, cleft palate, incomplete union of the abdominal wall at the linea alba &c. with one or other of which imperfections, the infant who has spina bifida is very liable to be also afflicted. We may safely aver therefore that the malformation is due to a cessation of ossification, and to an imperfect closure of the vertebral arches during the process of their formation in utero. The extent to which the osseous deposit takes place during the course of the disease, is subject to variation in different cases, from a mere cleft in the bone to a total absence of the vertebral arches. In reference to the process here in question, it may be situated either at the seat of the spinous process, 
or in the bodies of the vertebrae. Cases of the latter description have been related, in which the intestines could be seen through the cleft; and in one instance especially recorded by Stafford, the opening was of such an extent, as not merely to permit a view of the abdominal viscera, but even to allow of defecation through the tumour. In illustration of the different degrees of osseous development in the vertebrae in infant life, the same gentleman has described the particulars noticed in the spine of a child in the museum attached to Saint Bartholomew's Hospital in London. In this case there was a large portion of the occipital vertebrae, there being no bone to be seen anteriorly to the os magnum. The first four cervical vertebrae were defective in their arches only. With the exception of a small portion of their arches, and the whole of their spinous processes, the fifth and sixth in the same region were perfectly formed. There remained
but the bodies of the seventh cervical and the first dorsal vertebrae. The dorsal vertebrae, from the second to the seventh inclusive, were perfect, with the exception of their spinous processes, which were wanting. The whole of the remaining bones of the column were deficient in their arches and spinous processes. The canal of the os sacrum was quite exposed, and there was no trace of the coccyx.

Of the various opinions which have been urged as to the cause of the cessation of ossification, none appear fully to account for it. The most plausible conjecture is that which views the defect in connection either with hydrocephalus or with the drop of the medullary membranes. The Arabsians who appear to have regarded its origin somewhat in this light, assigned the cause of the imperfection to pressure applied upon the bones by the tumour itself. That it is in all probability due to the effects of an over-distended state of the membranes
will appear by reviewing the progress of ossification in the fetal spine during intra-gestation. At the period of birth, each vertebra is composed of three distinct segments united into one by cartilage, which in time ossifies; the anterior segment, ultimately forming the body, and the two others the arches, their union in the median line posteriorly forming the spinous process which is deficient however in the fetus. The three segments at an early period of fetal life are merely cartilaginous, the first sign of their becoming ossified being the appearance of a minute artery passing towards their centre, where a small bony deposit first takes place; the segment which ultimately forms the body of the vertebra having but one centre. Of the two lateral segments having two or more. From the important duties attached to the transverse processes, namely of giving attachment to muscles destined to maintain the spine in an erect position, their ossification commences, and
is completed at an early period, whereas the spinous processes are the last parts of the vertebra which assume the bony form. At birth these latter processes are only to be distinguished by a cartilaginous formation occupying the seat of their future development. It is urged therefore as a hypothesis, that when a sufficient quantity of the fluid has collected, and has gravitated to the lower part of the spine, it may cause the portion of the dura mater to bulge out into a pouch-like form, and thus, if occurring at an early period of intra-uterine gestation, prevent the formation of those parts which are the least advanced in ossific development, namely the spinous processes; if however it take place at a later period, it may by its pressure on the cartilaginous elements of the spinous processes, arrest them, and thus force the lateral segments from each other by establishing a constant wedge of membranes between them.

One of the other causes usually adduced...
for the interruption of ossification in this disease is a shock sustained by the uterus from a fall or other accident experienced by the mother, arresting the progress of fatal development. Another view attributes it to malformation or improper action of that viscera. It appears then on the whole, from the obscurity connected with the subject, that no precise reason can be fixed upon to account for the ossaneous deficiency.

From what has already been stated in the preceding remarks, it may be needful to say, in noticing the period at which this disease mostly occurs, that it is essentially one of infantile life. It is indeed very seldom met with but in children; and such is its fatality that of those who are affected with it, few reach the age of three years, for left an adult age. Cases have been recorded, however by various authors, where the patients have lived much beyond the period of infancy; for instance, to the ages of twenty, thirty, and even of fifty years. Although usually described as a con-
Genital disease, it is not necessarily such, for there is an instance mentioned by Morgagni as having occurred in the offspring of Benga, in which a droplike tumour of the spine was developed about four years after birth.

The symptoms which are usually observed in Spina Bifida, independently of the characters presented by the tumour itself, are the following, no one of which however is invariably present in any individual instance. There is frequently a paralyzed condition, with a variable amount of motion and sensation, of the inferior extremities. A paralytic state also of the bladder and anal sphincter is not infrequently an attendant symptom. There is sometimes frequent diarrhea, convulsions, and a general debility of the system with considerable Emaciation. The tumour, if left to itself, will ultimately discharge its contents from over-distension and consequent ulceration, or even gangrene, of its parietes; death being the result of
Such an occurrence which may either take place in utero during labour— in which case the child would be still-born, — or at a period more or less remote after birth. The disease is very often complicated with other malformations and diseases. If the Spina Bifida occur in the Cervical region, it is generally accompanied with a defective condition of the occipital bone.

One of its most frequent complications is that with Hydrocephalus, the fluid of the Spinal Canal being continuous with that of the Ventricles of the brain, as manifested by the effects of pressure upon the tumour, in producing symptoms of Coma, or an evident distension of the Fontanelles, and also by the effects of alterations in the position of the body of the patient; for instance, when the patient is placed in the erect posture, the tumour is tense, but if the head be laid upon a plane lower than the trunk, it becomes flaccid. Olivier remarked that respiration also causes evident changes in the tumour, swelling.
during expiration, and falling during inspiration. Morgagni, Brunner, Mayer and others have recorded cases where the tumor in Spina Bifida was connected with Hydrocephalus. But the fluids do not always communicate; for the natural foramen of communication which exists between the sub-arachnoid space of the spinal cord, and the interior of the brain is sometimes found obstructed: instances of this kind are related, especially one by Brunner, in which Hydrocephalus and Spina Bifida occurred in the same individual, and no communication could be discovered between them. Hydrocephalus occasionally ensued subsequently to the subsidence of the tumor by artificial means. This appears to be of somewhat frequent occurrence. The other malformations which sometimes occur as complications, are a deficiency of the abdominal walls, retroversion of the bladder, imperforate anus, club-foot, and occasionally a kind of cranial...
Opina-bifida, characterized by a tumour of the same nature.

Although the diagnosis is generally easy, the tumour has nevertheless occasionally been mistaken for others of a different character, and fatal effects have followed surgical operations performed upon them. It can be distinguished from any other swelling occurring upon the spine by observing that there is a deficiency or opening at the seat of the spinous processes of the vertebra; its edges can be distinctly felt along the margin of the tumour, and the latter is capable of being pressed into the spinal canal. Some relief will also be derived from the characters of the tumour itself, being trans. parent and soft; and by the existence of fluctuation.

With regard to the prognosis, it is a generally admitted fact that of all the diseases to which children are liable, few are more fatal than the one under consideration. It has been relieved for a time
by palliative remedies; and the radical treatment even has occasionally, but very rarely, succeeded in establishing a permanent consolidation of the soft parts composing the tumour; yet, in the most favourable instances, it is difficult to establish a satisfactory, or rather a happy result from any remedial means, on account of the liability to the appearance of inflammation in the tumour, or in the contents of the spinal canal. The hope of a cure is still further decreased by the presence of any of the other malformations with which it is so frequently combined. Moreover, even after the radical treatment has succeeded, hydrocephalus is apt to recur, and soon puts a period to the patient's existence. The duration of life in this disease depends in a great measure upon the size of the tumour; the larger it is, the less favourable the prognosis. It may happen however that a patient may live to a good age with a tumour of considerable size: Cases are reported of such patients reaching the respective ages of fifteen, eighteen, nineteen, twenty, and
even of fifty years. Upon the bursting of the tumour suddenly, or upon its being incased
ually opened, death, preceded by violent con-
usions, is liable to be the immediate con-
sequence.

Prior to modern times, this disease
was considered quite incurable. Lucullus, in
remarking upon any attempts at remedy
by surgical operation, says: "Quam ca-
lamitatem, si quidem reformidet, chirur-
qa, cave tis improvida aperies quod tam
facile occidat." Their only means were ac-
cordingly directed to its temporary alleviation
by the application of fomentations, direct incised
wounds. Modern surgeons, however, under the convic-
tion that the disease if unaided would eventu-
ally and at no distant period terminate
fatally, were induced to improve upon the
practice of their professional ancestors, and
accordingly at various times recommended
measures adapted not only to the temporary
relief, but also to the radical cure of the
disease. The remedies which have been
proposed are ligatures, setons, compression,
and Puncture: the first of which, namely, the ligature was first recommended, but it appears was never put into practice by Benjamin Bell. The object of the ligature was supposed to be not merely the removal of the tumour, but "also to draw the bottom of the cyst so closely together, that it might act as a proper support beneath after the tumour had fallen off," after which he proposed the application of a truss. The practice has been found objectionable on account of the possibility of including in the ligature either the nerves or the medulla itself, from mal-distribution of the former, or uncertain course of the latter. It is also uncertain whether, after the tumour fell off, the sides would adhere, and hence the medulla and its membranes, being in an exposed and unprotected state, would be liable to inflammation, and death would be the inevitable result.

The use of the keton was discarded upon the same grounds as the last. It was suggested by Desault with the view
of admitting of a gradual escape of the fluid, and at the same time of exciting adhesive inflammation in the walls of the tumour. The leeches, issues, and counter-irritants have been proposed at parts remote from the seat of the affection by Ritter, with the object of accomplishing a radical cure by the gradual absorption of the fluid. This practice was found quite unsuitable, and has also fallen into disrepute. The next mode of remedy, a palliative one however, namely that of gentle compression, was one of a more rational character, inasmuch as it was applied for the purpose of compensating the loss of the natural support of the bony canal, to the dura mater, and the other contents of that cavity. It was introduced by Mr. Abernethy, and first carried into successful practice by Sir Tetley Cooper in the case of a lady named James Applebee, the particulars of which are as follows:—He was observed at birth with a round tumour of a transparent character, and
of the size of a walnut, situated on the
loins. There was no paralysis of the lower
extremities; the head not unusually large,
and the evacuations naturally discharged.
Thinking that the tumour was a species of
hernia, and that the deficiency of the spine
might be compensated for by external
pressure, Sir Astley Cooper applied a rol-
ler round the waist of the patient, so as
to compress the tumour. The presence
of the roller had no unpleasant influence
on its voluntary power. The evacuations
continued to be properly discharged, but
the mother noticed that the child was oc-
casionally convulsed. A piece of plaster
of Paris, hollowed out so as to admit the
tumour, and lined with loose lint, was
applied at the end of a week upon the sur-
face of the tumour, a roller was wound
about the waist to keep the plaster in
position, and as much pressure exerted
upon the tumour as the child could bear.
The above mode of treatment continued
from the 22nd of June (1807) to the month
of October of the same year, during which time the tumour was examined thrice a week, and the mother reported occasional convulsions in the patient. About the middle of October the child, being then five months old—a truss similar to that which he had been in the habit of wearing for umbilical hernia in children, was applied instead of the plaster. At the age of fifteen months it began to use its limbs, could crawl along a passage and up two pairs of stairs. At eighteen months, by some accident, the truss slipped off, the tumour which had now been reduced to the size of a small orange; and the mother observed, when it was reduced, that the child appeared in some degree dull; and this was always the case if the truss was left off for a few minutes and then reapplied. At fifteen months he began to talk, and at two years could walk alone. Sir Hotley Cooper adds: “He now goes to school; runs, jumps, and plays about as other children. His bowels
of mind do not appear to differ from those of other children. His memory is retentive, and he learns with facility. His head, previously and subsequently to the bones closing, has preserved a due proportion to the other parts of the body. The tumour is kept by the truss entirely within the channel of the spine; but when the truss is removed, it soon becomes of the size of half a small orange. It is therefore necessary that the use of the truss should be continued. When the truss is removed, the finger can be pressed through the tumour into the channel of the spine. — Although in the above ease simple pressure succeeded so well, it does not argue that equal advantage would result in every instance, inasmuch as there is a great probability of the appearance of symptoms of compression, and other ill effects.

The latest, and at the same time the most effectual mode of treatment is that which was also first recommended by Abernethy, namely frequent puncture.
of the tumour, with the application of gentle, but constant pressure upon it. The wound is healed by the first intention after every operation, in order to exclude the air, which is an important object in the treatment. In the first case in which the last-mentioned eminent Surgeon tried this measure, the skin covering the tumour was unfortunately in a diseased condition, and had lost its contractile power; so far therefore it was considered a case ill-suited for the practice which was resorted to in this particular instance. The patient died after six weeks on the accidental escape of the fluid through the wound in the pedicles of the tumour. Shortly after this a case occurred to Sir Astley Cooper. The subject was fifteen months old. The tumour, which was of the size of a billiard-ball was punctured with a needle, instead of a lancet, and its contents discharged; every fourth day; and pressure was constantly applied to it by means of a roller which passed round the body of the infant.
In this case the particles of the tumour became ultimately condensed, and a radical cure was affected, although the quantity of the fluid rather increased than otherwise during the first month.

In the above case, as in the others which occurred in the experience of Sir Astley Cooper, the instrument used for opening the tumour was the needle, which however has been found not always suitable for every case: for the fluid is sometimes too thick to pass through the opening thus formed. A vascular opening with an ordinary lancet has accordingly been recommended; some caution being requisite in closing up the lips of the wound, immediately after evacuating the fluid, by means of adhesive plaster, not only to favour adhesion by the first intention, but also to exclude the air from the interior. When the operation has been completed—and it may be repeated every day, or as often as the fluid collects—it is recommended to apply a few folds of lint or linen over the tumour by way of a compress,
and to bind it there by means of strips of adhesive plaster, and a roller round the body; the amount of tension upon the latter being gradually increased, and regulated in accordance with the feelings of the patient. It is advisable that the fluid should be evacuated at a proper time, namely before the tumour has reached the size presented by it when last opened, in order that the skin and walls of the tumour generally may test their full power of contractility.

Mr. South, in his edition of Chevlin's Surgery, concludes his account of the treatment as follows:

"The nearly always unfavourable result of repeated punctures in Spina Bifida has recently led to various modes of treatment, with a view to effect, by the removal of the sac, at the same time a closure of the opening of communication with the spinal canal as Dubourg, Savignot, and Réjard have shown, with successful result.

According to Dubourg, the tip of the swelling is to be taken hold of, raised a
little up, and a part of its base cut through with a straight knife in such a way as to form two flaps which are brought down upon the spinal column, and without at first cutting into a middle string which is generally felt and formed by the sheath of the spinal marrow. Immediately after, the rest of the base is cut off, and now but little skin remains. The pressure of an assistant's finger should prevent the escape of the fluid and the entrance of air. The edges of the wound are then to be united with two, three or four hare-lip pins and with the twisted suture. This operation is required when the swelling and the opening are of small size, and the child's health otherwise good.

**Lavignot** seizes the swelling at its base with an instrument similar to a pair of forceps before (in front of) which he cuts off the projecting mass, and then unites the edges of the wound as in the former mode.

**Beynard** surrounds the base of the tumour with a spring, into which a ligature is introduced, and ties it up. The
Tightening of the ligature is gradually increased till the inner walls of the sac brought into close contact, united, after which it is cut off, and the remaining suppura-
tive part compressed with sticking plaster. If the tied swelling be very tense a portion of the fluid may be allowed to escape by puncture.

Of these several modes of treatment that of Beynard seems preferable, as by it the too quick emptying of the fluid, and entrance of air are prevented, the union of the applied surfaces more certainly ef-
nected, and the cutting off performed, when union is produced."

It is of course highly necessary to pay attention to the general health of the patient while under treatment. The diet should be
that which is most suitable to the age of the patient, namely milk, or other such light nutriment.

Here are certain circumstances which from the great danger attendant upon any operation upon the tumour, are to be taken
into consideration before deciding as to the propriety of attempting the radical cure of this disease. If the tumors lie on the increase, and the patient be in an inflamed or painful state, and constitutional symptoms are likewise present, it may be judicious to attempt it; whereas on the other hand, the palliative mode is to be preferred if the tumors be small and do not increase in bulk, and if the walls of the tumor be unaffected with inflammation, and the patient be otherwise in a good state of health. The instances which present little or no hopes of cure are those which are complicated with other diseases, especially with hydrocephalus.

The treatment by puncture and pressure for the radical cure of spina bifida is founded upon the phenomena observed in what has been termed the "spontaneous cure" which takes place by the repeated filling, bursting, and healing of the tumor. Its walls collapse after each rupture, and corporeal lymph is thrown out from its vi-
ternal surface, which ultimately results in its organization, and consolidation of the soft parts to such an extent as to prevent them from undergoing further distension. The process by which this consolidation is effected is probably after the following manner. The skin and membrane, intertissue into the formation of the parietes of the tumour undergo certain degrees of contraction and thickening in proportion to the quantity of contained fluid; layer after layer of coagulable lymph being at the same time thrown out from the internal surface, and gradually organizing. This however is merely theoretical; for there is an opinion that the process of consolidation is analogous to that which takes place in the radical cure of hydrocele, namely that the parietes are glued together by the adhesive inflammation. The argument which precludes the possibility of this process is that the constant change of size in the tumour, from repeated distension and contraction, would prevent
the adhesion of the opposing surfaces—there are no grounds for believing that the consolidation of the tissues is ever assisted by the formation of new bone; in fact the nature of the affection, which is due to a cessation of ossification in utero, would rather lead us to doubt the possibility of its reproduction.

As was before observed, hydrocephalus often follows the artificial cure of spina-bifida; in the spontaneous cure however this sequel does not occur, for nature seems to prevent it by establishing a species of safety-valve for the escape of an undue collection of fluid. The way in which this periodical outlet of the fluid is provided for is by means of vesicles which form on the apex of the tumour. These vesicles undergo changes analogous to those which have been noticed in the swelling itself during the progress of the spontaneous cure: that is to say they become filled with fluid to distension, and ultimately burst and heal; these processes being repeated as often as relief is demanded by nature from an over-distended state of the parts.