**The treatment of Spina Bifida by a new method / by James Morton ; with a paper on The pathology of spina bifida by John Cleland.**

# THE TREATMENT

OF

# SPINA BIFIDA

*BY A NEW METHOD*

BY

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*With a Paper on the* Pathology of Spina Bifida
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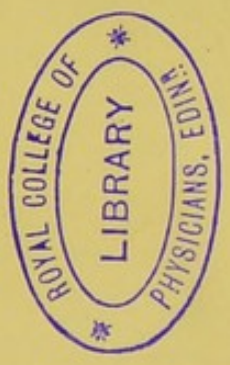




LONDON
J. & A. CHURCHILL
11, NEW BURLINGTON STREET

1887

# PREFACE TO THE SECOND EDITION.

In consequence of the accumulation of cases of Spina Bifida, which have been treated with the iodo-glycerine solution, some time ago it appeared to be necessary to issue a Second Edition of my book on that subject. After the appointment by the London Clinical Society of a Committee to report on Spina Bifida, it seemed desirable to await its verdict. That report, entitled Report of the Committee now named, "to Investigate Spina Bifida, and its Treatment by the Injection of Dr. Morton's Iodo-Glycerine Solution," has now been before the profession for many months. It is very gratifying to me to find that it endorses the treatment I recommend. In other respects it is a very able and valuable report, and has proved most useful to me in the subsequent pages, though I have not been able to coincide with all the conclusions of the reporters.

To the cases published in the first edition many new cases are added, nearly all of them presenting special points of interest in relation to the management of this dangerous malformation.

I have to express my gratitude to Professor Cleland for his aid, so cordially given, to the discussion of the

Pathology of Spina Bifida, and to those surgeons to whose kindness I am indebted for cases, with which I have taken care to associate their names.

I have also to thank the London Clinical Society, and Professor Humphry, of Cambridge, for permission given to re-issue the drawings which appear at the end of the volume.

James Morton, M.D.

199, Bath Street, Glasgow.
*March*, 1887.

# PREFACE TO THE FIRST EDITION.

The interest attaching to the cure of a malformation hitherto regarded as incurable, will be considered a sufficient justification for the reproduction of the following cases in a collected form. In the remarks added brevity has been aimed at, not, it is hoped, at the sacrifice of perspicuity. My best thanks are due to Drs. James T. Whittaker, Andrew Cunningham, and William Muir; also to Messrs. W. H. Woodburn, and Alexander Graham, surgeons, for their cordial and skilful assistance in operating, and to the pencil of the first-named gentleman am I indebted for the illustrative sketches.* Dr. John Caskie, referred to in one of the cases, died two years ago.

James Morton, M.D.

199, Bath Street, Glasgow.

1877.

* Omitted in the present edition.

# CONTENTS.


PAGE

Definition of Spina Bifida .. .. .. .. .. .. 11
Location of Tumours .. .. .. .. .. .. .. 12
Frequency of Tumours .. .. .. .. .. .. .. 14
Mortality from Spina Bifida .. .. .. .. .. .. 15
Diagnosis of Spina Bifida .. .. .. .. .. .. 16
Shape of Tumour .. .. .. .. .. .. .. 19
Size of Tumour .. .. .. .. .. .. .. .. 20
Prognosis when Untreated .. .. .. .. .. .. 23
Survival without Treatment .. .. .. .. .. .. 24
Coverings of the Tumour .. .. .. .. .. .. 25
The Sac .. .. .. .. .. .. .. .. .. 26
Contents of Sac .. .. .. .. .. .. .. .. 26
Nerves in Sac .. .. .. .. .. .. .. .. 28
Pathology of Spina Bifida .. .. .. .. .. .. 30
Recent Views of Pathology .. .. .. .. .. .. 31
Professor Cleland's Paper on Pathology .. .. .. .. 32
Projections of Bone in Spinal Column .. .. .. .. .. 40
Chemistry of Spina Bifida .. .. .. .. .. .. 46
Dr. Halliburton's Analysis .. .. .. .. .. .. 46
Treatment formerly adopted .. .. .. .. .. .. 49
Pressure .. .. .. .. .. .. .. .. 50
Collodion .. .. .. .. .. .. .. .. 51
Puncture .. .. .. .. .. .. .. .. 53
Ligature .. .. .. .. .. .. .. .. 60
Excision .. .. .. .. .. .. .. .. 64
Injection .. .. .. .. .. .. .. .. 75
Brainard's Method .. .. .. .. .. .. .. 76
New Method .. .. .. .. .. .. .. .. 77

CASES:—


| | | PAGE |
|---|---|---|
| I. | by Dr. Morton, Glasgow Royal Infirmary | 78 |
| II. | ,, Ditto Ditto | 84 |
| III. | ,, Dr. Watt, Ayr | 87 |
| IV. | ,, Ditto Ditto | 90 |
| V. | ,, Dr. Morton, Glasgow Royal Infirmary | 92 |
| VI. | ,, Mr. Angus, Newcastle | 95 |
| VII. | ,, Dr. Morton, Glasgow Royal Infirmary | 103 |
| VIII. | ,, Ditto (record lost) | 103 |
| IX. | ,, Dr. Watt | 103 |
| X. | ,, Mr. Burton, Liverpool | 104 |
| XI. | ,, Mr. Ewart, Manchester | 106 |
| XII. | ,, Ditto Ditto | 108 |
| XIII. | ,, Ditto Ditto | 109 |
| XIV. | ,, Dr. Morton | 114 |
| XV. | ,, Mr. Berry, Wigan | 117 |
| XVI. | ,, Dr. Morton, Glasgow Royal Infirmary | 118 |
| XVII. | ,, Ditto Ditto | 119 |
| XVIII. | ,, Ditto Ditto | 120 |
| XIX. | ,, Ditto Ditto | 122 |
| XX. | ,, Ditto Ditto | 125 |
| XXI. | ,, Dr. Anderson | 126 |
| XXII. | ,, Dr. Morton, Glasgow Royal Infirmary | 129 |
| XXIII. | ,, Mr. A. P. Gould, London | 131 |
| XXIV. | ,, Dr. G. W. Thomson, Lanark | 135 |
| XXV. | ,, Dr. Morton, Private | 139 |
| XXVI. | ,, Dr. McLaren, Carlisle | 140 |
| XXVII. | ,, Dr. Morton, Private | 142 |
| XXVIII. | ,, Ditto Ditto | 142 |
| XXIX. | ,, Dr. Thompson, Dumfries | 143 |
| XXX. | ,, Dr. Morton, Glasgow Royal Infirmary | 144 |
| XXXI. | ,, Ditto Ditto | 145 |
| XXXII. | ,, Ditto Ditto | 145 |
| XXXIII. | ,, Ditto Ditto | 146 |
| XXXIV. | ,, Ditto Ditto | 147 |
| XXXV. | ,, Ditto Ditto | 148 |
| XXXVI. | ,, Ditto Ditto | 149 |
| XXXVII. | ,, Dr. P. Davidson, Liverpool | 150 |
| XXXVIII. | ,, Dr. Knox, Glasgow | 150 |

PAGE

XXXIX. by Dr. Marshall, Greenock .. .. .. .. 152
XL. ,, Dr. Morton, Private .. .. .. .. .. 154
XLI. ,, Ditto Glasgow Royal Infirmary .. .. 154
XLII. ,, Dr. J. W. Cousins, London .. .. .. .. 156
XLIII. ,, Mr. F. A. Southam, Manchester .. .. .. 158
XLIV. ,, Ditto Ditto .. .. .. 159
XLV. ,, Dr. Morton, in Consultation .. .. .. .. 161
XLVI. ,, Dr. James Hamilton, Glasgow .. .. .. 162
XLVII. ,, Dr. A. Patterson, Glasgow .. .. .. .. 166
XLVIII. ,, Ditto Ditto .. .. .. 166
XLIX. ,, Ditto Ditto .. .. .. 168
L. ,, Dr. G. H. B. Macleod, Glasgow .. .. .. 169
LI. ,, Ditto Ditto .. .. .. 170
LII. ,, Ditto Ditto .. .. .. 170
LIII. ,, Ditto Ditto .. .. .. 171
LIV. ,, Dr. George Buchanan, Glasgow .. .. .. 172
LV. ,, Ditto Ditto .. .. .. 172
LVI. ,, Dr. R. Sinclair, Dundee .. .. .. .. 173
LVII. ,, Mr. E. M. Little, London .. .. .. .. 174
LVIII. ,, Mr. A. Milroy, Kilwinning .. .. .. .. 176
LIX. ,, Mr. Wm. Berry, Wigan .. .. .. .. 178
LX. ,, Dr. Hector Cameron, Glasgow .. .. .. 181
LXI. ,, Ditto Ditto .. . .. 182
LXII. ,, Ditto Ditto .. .. .. 183
LXIII. ,, Dr. Morton, Private .. .. .. .. .. 183
LXIV. ,, Ditto Ditto .. .. .. .. .. 184
LXV. ,, Ditto Ditto .. .. .. .. .. 185
LXVI. ,, Ditto Ditto .. .. .. .. .. 186
LXVII. ,, Ditto Ditto .. .. .. .. .. 187
LXVIII. ,, Dr. W. L. Strain, Rio Janeiro .. .. .. 188
LXIX. ,, Dr. Morton, Glasgow Royal Infirmary .. .. 189
LXX. ,, Dr. Morton, and Dr. Paton, Carnoustie .. .. 191
LXXI. ,, Dr. McNiven, Rangoon .. .. .. .. 193
Cases adapted for Operation .. .. .. .. .. .. 196
Time for Operating .. .. .. .. .. .. .. 197
Mode of Operating, and Articles used .. .. .. .. .. 200
Puncture .. .. .. .. .. .. .. .. .. 201
Means of Closing Puncture .. .. .. .. .. .. 203
Dressings .. .. .. .. .. .. .. .. .. 203
The Fluid Injected .. .. .. .. .. .. .. 204
Instruments employed .. .. .. .. .. .. .. 206

PAGE
Question of Reinjection .. .. .. .. .. .. .. 207
Dangers of Interference .. .. .. .. .. .. .. 207
Statistics of Results .. .. .. .. .. .. .. 212
List of Spina Bifida Preparations in the Hunterian Museum, Glasgow .. .. .. .. .. .. .. .. 214

## APPENDIX.

Manser's Case .. .. .. .. .. .. .. .. 217
Lisbon Case .. .. .. .. .. . .. .. 219
Case of Spina Bifida (?) or Encephalocele .. .. .. .. 220
Case of Cranial Meningocele .. .. .. .. .. .. 224

## PLATES.

# SPINA BIFIDA.

The term Spina Bifida, meaning literally, cloven, or divided spine, has long been understood to designate a tumour, usually congenital, in the line of the spinal column, and consisting of a protrusion of the membrane of the spinal cord, containing cerebro-spinal fluid, part of the cord itself, and often traversed by strands of nerves. A congenital hernia of the spinal membranes, and their contents. These contents, however, are not uniform; they vary considerably, which may be shown when we come to consider the anatomy of this deformity. The name refers to the condition of the spinal column itself, as permitting such protrusions, and is said to have been first applied by Nicolai Tulpius, or Nicolas Tulp, who wrote of it in 1652, and gave a very accurate description of the defect; and mentioned that he had seen six cases of it. Since his time the name has remained attached to the condition. We cannot suppose that a deformity with such pronounced symptoms was unknown before the time of Tulp; we have it on the authority of Mr. Samuel Cooper, in his "Surgical Dictionary," and of the author of the article "Spina Bifida" in the "Encyclopédie Méthodique," that it

was known to the Arabian physicians. Under the same name it has been referred to by many subsequent medical authors.

The defect seems to be, or to be produced, in the neural arches of the vertebræ. In very rare cases a similar malformation is alleged to involve the bodies of the vertebræ, when the tumour protrudes forwards into the thorax or abdomen between the halves of the vertebræ so divided. This variety we may leave out of sight at present; if amenable to treatment, no such attempt at remedy has yet been made.

The protrusions then through such apertures posteriorly are usually small at birth, though they vary very much in size, round or oval or cordate in shape, always fluctuating, often semi-transparent or translucent, and sessile, adhering by a broad base over the spinal column. It is said that in a few instances they are found to be pedunculated, but such must be rare. I have not met with any entitled to be so characterised. It is true that a few instances have come under my observation, in which, the tumour having been permitted to grow, the sides of the bulging swelling have somewhat overlapped the base; but still the base was broad, and in the true sense sessile.

## Location.

Speaking generally, such or similar tumours may occur at any part of the cranium and spinal column, sometimes containing nerve substance and sometimes not. A protrusion from a cranial aperture which

contains brain substance is named an encephalocele; one consisting of the membranes only, containing serum, is called a meningocele. In some few instances these have been subjected to injection by the iodo-glycerine solution without injury, and, in the addenda to this volume, one of the latter variety will be given in some detail, in which, after several injections, consolidation resulted. Any part of the spinal column may be the seat of what we have learned to call a spina bifida swelling, and according to site we style the protrusion cervical, dorsal, lumbar, sacral or coccygeal; and when appearing on the border line of such regions, compound terms, such as dorso-lumbar and lumbo-sacral, are employed.

Premising that the cases affecting the whole or greater part of the spine are extremely rare, the lumbar region is by far the most frequent site of these spinal herniæ; and certainly the great majority are to be found over the lower part of the spinal column, or lumbo-sacral region. The London Clinical Society's Committee have been able to report upon the position of the tumour in 236 cases, and of these 13 are placed as cervical and cervico-dorsal, 14 dorsal, 8 dorsi-lumbar, 108 lumbar, 2 dorsi-lumbo-sacral, 42 lumbo-sacral, 42 sacral, 7 coccygeal. Taking the lumbar and those beneath that region we have 201, as opposed to 35 dorsal, cervical, and dorsi-lumbar combined, or nearly six times as many. In the series of cases given in this volume, excluding 2 not stated, we have 67, of whom 51 are lumbar, 7 sacral, 8 dorsal, 1 cervical, and placing these numbers like those above we have 58 to 9, a pro-

portion of fully 6 to 1. The proportion in Demme's cases, as given in the Clinical Society's report, is 35 in the lumbar and sacral region to 20 above that; rather a curious diversity, which we must regard as accidental, in the absence of any other explanation. In an article on "Spina Bifida" in the "Dictionary of Practical Surgery" recently published, Mr. R. W. Parker states that Wernitz gives 210 collected cases, with the following analysis:— Cervical 12, cervico-dorsal 3, dorsal 6, dorsi-lumbar 9, lumbo-sacral 127, sacral 53, which, omitting the dorsi-lumbar as on the debatable ground, gives nearly nine times as many in the lumbar region as in the upper portion of the column. Mr. Parker mentions that all his own cases, nineteen in number, have been lumbar or lumbo-sacral except one, which was at the sacra-coccygeal junction. It will be noticed that from this enumeration I have excluded all cranial meningoceles.

## Frequency.

Cases presenting this malformation constitute only a small percentage of the number of births, and of this percentage various estimates have been offered. One in 1,000 births has been given as a probable approximation, and in round numbers may be accepted as near the mark. As quoted in the report by the Spina Bifida Committee of the London Clinical Society recently published, Dr. Demme is said to have found 57 cases of spina bifida in 36,148 children; and Chaussier records 22 cases among

22,293 children in the Paris Maternité. Dr. Demme's numbers thus give a proportion of 1 in 634 births, while Chaussier's show 1 in 1,013 births, or nearly so. These numbers are probably more reliable than those obtained from the public generally, who dislike to have such defects commented upon in any way.

### Mortality from Spina Bifida.

This has always been known to be great, or rather very great—so great, indeed, that the number of deaths very nearly represented the number of cases found with this malformation at birth. It does not seem possible to arrive at the exact number of infants, having such tumours, born or living at any one time or any one year. As yet, our malformations are not registered.

The figures of the Registrar-General furnish us with tolerably accurate statements of the very large number of those who die within one year of their birth, as compared with the very few that survive that period and die within five years. Thus in 1882 the deaths from spina bifida in England and Wales amounted to 647 ; of these 642 died within five years, (610 of whom died within one year), leaving only 5 who had died at a more advanced age—less than 1 per cent. Of these 296 were males and 351 females.

In Scotland, during 1881, 86 deaths are referred to spina bifida, 85 dying within five years (78 of whom died within one year), leaving only 1 for a later period of life. Of these 39 were males and 47 were females.

These figures make it evident that the period of greatest danger to infants with spina bifida is at, or soon after, birth, a proof of the necessity for early treatment.

By the courtesy of the Registrar-General of England, the Committee of the London Clinical Society is enabled to report that in 1882, "89 deaths are attributed to spina bifida in London, and of this number 86 died under the age of one year;" and in the Committee's report a table is given showing the deaths in England and Wales under one year of age from spina bifida in the three years 1881 to 1883 inclusive, which amount to 1,768, and of these 779 were males and 989 females. These figures, and others which could be quoted, show that this deformity is more frequent in females than in males.

## Diagnosis.

This is almost always easy. A congenital tumour occupying a position on the middle line of the back, over the vertebral spinous processes, is almost sure to be a spina bifida. To the experienced eye the presence of a membranous space in it, and the translucency when the coverings are thin, confirm the diagnosis. These membranous spaces are often plum-coloured, and glazed like portions of gutta-percha tissue; they do not quite resemble cicatrices, which generally are not so deep in colour. But membranous spaces and translucency may both be absent, and are so in those tumours which are covered with skin of normal appearance and thickness; in such, however, there is almost always very

distinct projection of the body of the tumour, and often no pain on handling. In very young children it is often difficult to determine whether or not there is pain when carefully handled, and it seems to me that they vary much and unaccountably in the degree of sensitiveness.

That a spina bifida tumour is almost invariably present at births will be readily admitted, yet to this there may be rare exceptions, which is shown by the following, in which it appears certain that the tumour did not grow till the age of twenty-six. The case appeared in the "Medical Times and Gazette" for October 2nd, 1858, in a letter from William Carr, Esq., Fareham: "Mrs. T., a healthy, but not robust person, gave birth to her first child, after a tedious and severe labour, at the age of twenty-six years. Soon after her recovery she noticed, for the first time, a small swelling on the upper and middle part of the sacrum, about the size of a nut. It caused her no pain or inconvenience, and she sought no medical aid in consequence. I saw it for the first time some few months after, when it was as large as a good-sized walnut. Within a comparatively short period it attained the bulk of a small egg, was soft and fluctuating to the touch, and any pressure upon it caused an instantaneous sensation to rush up the spine, and a sense of confusion in the brain, leading her to the belief that if it was continued she would fall unconscious. As the increase in size continued, and I had advised that no steps of an operative nature should be adopted, some friends induced her to consult a hospital surgeon of some celebrity, who wrote to me upon

the case, stating his opinion that the tumour was an encysted one, and that he should have no hesitation in removing it. My convictions as to its nature were, however, so strong as to induce me to protest against such a proceeding, and a consultation was the consequence.

A grooved exploring needle was introduced and some drops of fluid escaped, exhibiting the appearance of the spino-cerebral fluid, and demonstrating the intimate connection between the tumour and the cavity of the spinal column. The very small quantity of fluid which escaped produced uneasy sensations about the brain. From this time, for the four following years, the tumour increased in size. The patient was greatly distressed by its weight, and the fear she felt of receiving a blow upon the part. There were constant "strange sensations" about the head, and the gait became so unsteady as to require the support of the different articles of furniture in the room as she moved about. The bulk of the tumour was so great as to fill a padded tin shield, which she constantly wore, of the size of a quart basin. Eventually she died, worn out and exhausted by distress and suffering. I was permitted after death only to examine the tumour. On opening it as the body lay on the abdomen, about a pint of clear watery fluid escaped. The interior was lined by a membrane, exactly resembling the spinal sheath (of which it was clearly a continuation), passing through an opening in the upper part of the sacrum, through which I could easily pass the tip of my little finger."

If this be the true solution of the case, and it will be granted that it is detailed with circumstantial minuteness, it affords an instance in which a spina bifida tumour became developed in adult life, and was taken to be merely an encysted tumour by a surgeon of experience. It is possible that the sac here had existed at birth in a rudimentary state, and commenced to enlarge at the period named. The late appearance of such tumours has been noted in other cases: Lancisi saw spina bifida declare itself at the age of five years; and Opin, of Altsdorf, assures us of a case which did not appear before the age of twenty. Such instances are extremely rare, so much so that spina bifida may still be called a congenital malformation.

## Shape.

While the general appearance of the tumours is characteristic, the shape is by no means uniform. On the contrary, there is every variety in shape. Sometimes they are globular, frequently they are oval and even elongated, and occasionally, though not so frequently, irregular in shape as well as in surface. Occasionally they present a slight longitudinal furrow in the middle line, and sometimes a dimple, or depression, which has been called umbilication, and is said to indicate the part at which the cord becomes attached to the posterior wall of the sac. These depressions, however, are by no means common, and much more has been made of them than they are entitled to, at least in a practical point of view; for, although they indicate the presence of the cord and

nerves, and their attachment to or incorporation with the walls of the sac, that is not a condition of matters which would deter a surgeon from injecting any such tumours.

### Size.

Spina bifida tumours also vary very much in size, and the element of size is not without its importance. Usually they are small at birth, sometimes not longer than a small walnut, and, in the great majority of cases, rarely exceeding the size of a Tangerine orange. After birth they often grow with very considerable rapidity, and speedily attain a size which renders them formidable.

The size of a spina bifida tumour becomes an important element in the prognosis. As a general rule, the larger the tumour the greater the risk; operations, therefore, should be performed while the tumours are small. In some cases of large tumours I have endeavoured by tapping to reduce the size, such infants not having been presented till the size of the tumour stimulated the fears of the parents; but in such attempts I have not been so successful as I hoped to be, as the tumours have rapidly refilled. Tumours in which there was no apparent danger of bursting, having a covering of true skin sound and whole, have often been allowed to grow for years, and may be said to form a class by themselves, while each case may require special consideration as to its proper management. Where life is not in danger, the question of operation or not crops up, the decision of which question must depend upon the degree of deformity due to the size of the swelling, and the

inconvenience attending it, as contrasted with the dangers of the operation. There may be cases in which the mere size and position of the tumour may be such as seriously to compromise the future of the patient, and render it extremely desirable to get rid of it by almost any means. It may be a source of satisfaction to some to know that such tumours, though not devoid of risk during operation, are not, when untreated, to be regarded as exposing the patient to so much hazard to life as those in very young infants with a thin membranous covering.

But while the diagnosis of spina bifida in its ordinary forms and in its usual situations may be comparatively easy, there are rare examples of this defect in development which may readily be mistaken for tumours of a very different kind. Thus in the "American Journal of Obstetric Medicine" for 1871, Dr. T. A. Emmet mentions "a rare form of spina bifida, the sac projecting into the abdominal cavity, and of a size to present features in common with an ovarian cyst." I quote from the "Biennial Retrospect of Medicine and Surgery" for 1869-70, issued by the Sydenham Society. In the same journal it is stated by Dr. B. F. Dawson that "a case of spina bifida, presenting all the features of a lipoma," was "operated upon for the latter disease." It is added that these two cases are of unusual interest.

The name of "false spina bifida" we find in use; what does it signify? In surgical writings we find that this term has been applied to tumours that have a congenital origin, and a communication with the spinal canal, but not with the membranes

of the spinal cord. It seems to me unfortunate that any such term should be employed; it may cause some confusion. In the "International Cyclopædia of Surgery," published in 1884, Mr. Treves says, "The term false spina bifida should be applied to one tumour only—to a spina bifida whose communication with the spinal membranes, and perhaps with the spinal cord itself, has been cut off. Such a tumour is the result of the process of natural cure in cleft spine, and of it many examples have been furnished." Further on the same writer says, "It will present no evidence of communication with the spinal membranes, will be in almost every instance pedunculated, and will probably have been of some duration. There may possibly be a history to show that such a mass did at one time present all the features of a true spina bifida." Now, this is merely the history of spina bifida undergoing cure, either spontaneous or not, and the term false applied to it appears to me misleading, and therefore inappropriate. It is but fair to add, that Mr. Treves's object seems to be to inculcate the propriety of excision for such a condition, while the same proceeding is also applicable with safety to cystic and other tumours which have no communication with the spinal membranes or cord. This is a practice likely to be approved by surgeons generally.

Cystic tumours differ from spina bifida in being frequently multilocular, while spina bifida is rarely so. Such is my experience; indeed, I have not met with a multilocular spina bifida with one doubtful exception. While injection is found to

be useful in spina bifida, I believe with Mr. Treves that in cystic and similar tumours it is often inefficient and disappointing, so that removal by excision is demanded, or free incision; but I think the former preferable in most cases. But spina bifida cases do not always present tumours. These may have been present, and, bursting before or during parturition, may have disappeared as tumours; and it is alleged that after such disappearance, if the aperture closes, the swelling may in such a case reappear. There are also rare instances where only an opening is perceptible, having some resemblance to a fistula. It will be afterwards seen that to this condition Professor Cleland applies the name *non-tumescent*, thus distinguishing it from *tumescent* spina bifida.

## Prognosis.

The prognosis of spina bifida, untreated, is of the most gloomy description, nearly all who are the subjects of it dying within their first year. The Registrars-General can furnish us approximately with the numbers who die of it at this and other ages; they cannot, however, offer to us any accurate record of the number of those who survive for years, it may be in some instances for many years, and who, though bearing such a malformation, may die from other causes. There is no record of malformations at birth. We only take note of the losses occasioned by the defect. We cannot, therefore, say how many are now living in whom this condition exists. It is conceded, we may say known, that a small percentage

survives. What that percentage may be is not numerically ascertained, but an opinion has prevailed that it may be about 1 per cent., or, if more, only fractionally so. In the absence of treatment or operation of any kind, a good deal will depend upon social surroundings as to the chances of survival.

Under the treatment of the present time, the prognosis has very much brightened, many lives being now saved which formerly were given over in despair. The treatment by injection of the iodo-glycerine solution has been admitted, even by neutral reporters (those of the London Clinical Society), to save between 50 and 60 per cent.; while my own statistics justify me in placing the percentage of cures considerably higher.

### Survival with the Tumour Untreated, or Persistence of the Tumour.

The Clinical Society's report presents a few valuable tables, the first of which contains short statements regarding sixty cases not subjected to any *operative* treatment, which are well worthy of study. The Committee draws attention to this, that in this table "are found cases of patients who at the time of record were well, and had attained the age of 9, 13, 13, 17, 23, 25, 25, 25, 32, 40, and 43. Two others were aged respectively 23 and 26 at the time of death. In a certain minority of cases, therefore, the presence of spina bifida is not incompatible either with life, health, or general activity." Some of these must have undergone spontaneous cure, resulting probably in occlusion of the spinal aperture, with or

without shrinking of the tumour. On this point the same report says, "In 13 of our cases in Table I. the mode of cure of the tumour is stated more or less fully. In 8 there was a gradual shrinking of the sac and general oozing, in 4 the sac burst, and in 1 there was ulceration of the sac and general oozing." Is it not possible that where there is an ulcerated surface the discharge from that may be mistaken for general oozing? The Committee adds, "In view of the frequency with which rupture of the tumour leads to death, we are justified in speaking of the gradual shrinking of the sac of a spina bifida as its natural mode of cure." In quoting cases under variou methods of treatment I shall have to make similar observations.

### The Coverings of the Tumour.

Writers of a past period generally say that the tumour is covered by healthy skin, and certainly this has been so in those that have their habitat in the very lowest part of the lumbar region, some of which have been so low as to deserve the name of coccygeal. In the majority, however, of those cases which have been presented to me, the covering or skin (if it be such) has been more or less altered, usually much thinned—so much so as to become translucent. This has been explained in two ways: one theory is, that the skin, at first properly formed, has become thinned as the tumour increased; the other supposes that the skin has been congenitally defective, its place being taken by a thin fibrous material covering the spinal membranes. Some say that this thin fibrous material

is absent in certain cases, and that the spinal dura mater is exposed, and when it is absent the arachnoid is laid bare. I am not sure that this has been verified in any instance. The term "membranous area" is often applied to this thinned portion of the coverings.

### The Sac.

This may be said to consist of the membranes of the cord matted together, lined by the serous membrane. Its neck is formed in an opening, the result of non-union in the laminæ and spinous processes of one or more vertebræ, and is usually short,—the tumour being sessile, as botanists phrase it, making it seem as if there were no neck. In some cases it is said there is a long stalk or pedicle. I have not met with such, and am of opinion that pediculated cases must be extremely rare. It is from the gradually increasing distension of this sac and its coverings that danger arises; both become so attenuated as at last to give way, allowing that drain of cerebro-spinal fluid which speedily proves fatal, and is the usual cause of death in cases untreated.

### Contents of the Sac.

Generally these are—first, the spinal or subarachnoid fluid, a watery or serous fluid containing a small percentage of albumen, of which a fuller account will be given; and second, a portion of the cord itself, or cauda equina, or some of the spinal nerves. Part of the nerve-tissue of the cord is often found to be

expanded on the inner surface of the sac, as if glass-blown over it, and merging into it, often not very easy to trace. In a dorsal case I have seen the cord projected into the sac in the form of a curve: such projection is usually in the middle line, and closely applied to the back of the sac; which circumstance requires to be borne in mind in reference to puncture in operating.

Absence of the cord and its prolongations has been affirmed in a number of cases. There are instances recorded in which this has been verified. The cord (or nerves) is now known to be present in the majority of the cases of spina bifida, and that in the proportion of between 60 and 70 per cent. Its presence, however, cannot be ascertained during the life of the child by any mode of examination yet known to us; the same may be said concerning its absence. In a few instances, and only a few, certain appearances have been alleged to indicate the presence of nerves and their attachments. These are dimples, or small depressions,—when linear, usually in the middle line, and for that reason called central depressions,—which are supposed to indicate attachments of nerves, and in rare instances may actually do so. These and similar marks are, however, not to be relied upon. Sometimes fibrous bands are found to have caused such depressions or dimples, there being no nerve-tissue there present. It follows that an operator is not entitled to assume that there is neither cord nor nerve present, even when the tumour is of the smoothest, and uniformly so. Perhaps I ought to add that in very many of the cases which I have seen there have been no such depressions or dimples.

## Nerves in Sac.

In connection with this, it is interesting to notice the wonderful approach to accuracy of the views of writers about the beginning of the present century. Dr. John Burns, in his work on Midwifery, published in 1837, thus writes: "The medulla may either go on entire, along the sac, or terminate there, and recommence below it; but even when it seems to terminate, it often is only expanded, or spread as a lining over the sac or dilated membranes of the cord, which are thicker and more vascular than usual. When it does so, filaments are given off, which form the great nerves of the ischiatic plexus; for, although the tumour may exist anywhere, from the neck downwards, yet it usually is situated in the lumbar region."

The Committee of the London Clinical Society has bestowed great attention upon the "disposition of the cord and nerves within the sac," and this part of the report is of great interest anatomically. In it we find that, as a rule, the cord crosses the sac above its centre. The report also says, "Occasionally, however, the cord, as it emerges from the vertebral canal, becomes immediately connected with the roof of the sac without the intervention of any space." And again, "The contained cord varies in size; sometimes it seems to have its normal size, in other cases it appears attenuated from the traction made on it by the distending sac." Subsequently the reporters say that "The disposition of the nerves varies with that of the cord," and describe some of these variations, and also mention approximation and fusion of two or

more sacral ganglia as a result of backward traction, and the formation of *ganglia aberrantia* in one instance within the sac. Under the head of "Unusual Variations," mention is made of partitions in the sac, and a figure is given of a multilocular spina bifida, and it is stated that "in most cases small fenestræ or apertures of communication exist in the septa"; while it is very properly added: "that they do not result from operative interference is proved by the fact that in the cases in which they have been found most marked, no treatment had been at any time adopted." The reporters assume that "these subdivisions will have the effect of confining fluid to the space into which it has been injected." This may not prove a misfortune in such a case, if it does not prevent that effusion which we desiderate in order to close the spinal aperture; besides, it might be a safer conclusion to say that it *may*, than that it *will*, confine the injected fluid. The reporters conclude this section of their able report thus: "As a rule, all the subdivisions of the sac communicate by small, well-defined, circular openings, but they may, however, be completely closed." However interesting such investigations into the varieties of spina bifida tumours may be, these variations are so numerous, and so incapable of being discovered during life, that practitioners may leave them altogether out of account in treatment, provided that they do not fail to observe those precautions and conditions which have been found in practice to be essential to success. I have often seen one part of a sac solidify before another, but in no case could I trace such an occurrence as resulting from the presence of pre-existing partitions.

## Pathology.

The pathology of this condition is still somewhat obscure. To say that it is one of the forms of local dropsy, gives no idea of its mode of production, nor any aid towards the solution of the question, as to the tissue in which the defect originates. Is it in the bony covering of the cord, in the membranes, or in the cord itself? Anatomists seem to be agreed that the spinal cord is being developed at an earlier period in point of time than the osseous covering, and specially that in early fœtal life the spinal canal is shorter than the cord, and that the lower or conical portion of the cord is afterwards inclosed by the gradual formation of additional vertebræ. If this be true (and it is believed to be so), it affords a kind of explanation of the well-known frequency of such tumours in the lumbar region. Knowing, as we do, that membranes overfull with serum protruding through natural openings, not only prevent the closure of such, but even cause them to dilate, we may suppose a similar condition of the spinal membranes and contents to interrupt the normal osseous deposit which goes to complete a vertebra, and thus secure their own escape from their bony prison. In some cases we observe that the laminæ of the vertebræ are in some degree developed, yet not completed, and placed widely apart by the pressure of the protruded membranes and their contents. It is not necessary to say more on this point to those who are familiar with instances of the absorption of bone by the pressure of soft tumours, such, for example, as aneurisms. It must

be admitted that this explanation applies only to tumours seated in the lower part of the spinal column, and sheds little or no light upon the occurrence of such in the cervical or dorsal regions, except that it lends a colour to the supposition that a similar condition of parts may occasionally occur in the upper portions of the spinal column.

There can also be no doubt that in some systems there is a tendency to the over-abundant production of the serous fluids of the body. In early life this is seen most frequently in accumulations connected with the nerve-centres, the brain and spinal cord. We know that a hydrocephalic condition is not unfrequently associated with spina bifida. Such fluids naturally seek an exit, and may find it, their weight and pressure speedily telling upon a weak or undefended part.

The anatomical position and contents of spina bifida tumours have led to their being classified under three divisions :—

1. Spinal Meningocele, or protrusion of the membranes only.

2. Meningo-myelocele, or protrusion of the membranes together with the spinal cord and its appertaining nerves.

3. Syringo-myelocele, or protrusion of the membranes together with the spinal cord, the central canal of which is dilated so as to form the cavity of the sac, the lining membrane consisting of the expanded and thinned substance of the cord.

According to the report submitted to the London Clinical Society, the research of the reporters led them to the conclusion that by far the greater

number of cases belong to the second of these divisions, that of meningo-myelocele.

These also will be found to be more frequent, in proportion to the other two divisions, in the lower portion of the spinal column. I am further of opinion, though I cannot be dogmatic on the point, that spinal meningocele will be found to occur more frequently in the cervical region than in other parts of the spine, though we may now and then meet with an example of it in the lower sacral or coccygeal region.

On the subject of the pathology of this malformation I am favoured with the remarks by Professor Cleland of Glasgow University which I now submit.

## The Pathology of Spina Bifida.

While we are undoubtedly indebted to the Spina Bifida Committee of the Clinical Society of London for an elaborate and painstaking investigation, in which they have brought together a number of important facts, it cannot be said that the Committee has placed the pathology of spina bifida in a satisfactory position. This arises very much from the conscientious way in which they have confined their attention within what they believe to be the limits of the inquiry intrusted to them, and shut their eyes to everything but the tumours interesting to surgeons. But open spina bifida without tumour is too closely allied to some of the instances in which a collection of fluid is found for it to be safe to leave it out of account.

Open spina bifida may extend over the whole spine,

or be as limited in superficial appearance as many of the lumbo-sacral tumours. It exhibits a membranous covering continuous with the skin, and overlaid more or less by epithelium continued over it from the surrounding epidermis ; and from this membrane arise the roots of spinal nerves, in an inner and an outer series, manifestly homologous with the anterior and posterior roots of the normal arrangement. In a specimen which I have elsewhere described ("Journal Anatomy and Physiology," xvii., p. 257), the enlarged central canal of the spinal cord opened on the surface, at the upper end of a membranous area in the lumbar region, completing the proof that the membranous area was an open continuation of the central canal. Obviously the case numbered 13, and figured at Plate IV. in the Committee's report, is a quite similar specimen, though the extent of vertebral damage is not reported. The main difference consists simply in effusion into the arachnoid space, with consequent elongation of the nerve-roots passing through it. There is thus an obvious transition from mere rachischisis—what I have been in the habit of calling open spina bifida—to tumescent spina bifida, and it is demonstrated that the effusion is not necessarily the primary affection in the latter. Further, it becomes obvious that the term "open spina bifida" is as applicable to the one as to the other of these two cases, as also is the term "rachischisis," although neither term expresses the presence of a dropsical effusion in the arachnoid space in one of the cases ; and this disadvantage is more serious in cases in which the rachischisis is less manifest, while the distension of the arachnoid spaces with fluid and the consequent altered growth of the nerve-roots are

even more apparent. The usage, though followed by Recklinghausen ("Virchow's Archiv," August, 1886, p. 300), restricting the term spina bifida to cases with tumour, and rachischisis to those in which there is none, is arbitrary and inexpressive, therefore inconvenient. It is well, however, primarily to distinguish the cases in which there is no tumour from those kinds in which a tumour is present, leaving for after-consideration the nature of the tumour.

*Non-tumescent spina bifida* occurs in two forms. First, in association with anencephalus, in which case it involves the whole length of the spinal cord and column, or their upper parts; secondly, in the lower parts of the cord and column. In the cases associated with anencephalus, there are generally found more or less distinct traces of a brain, the development of which has been altered, and finally arrested, by effusion into the ventricles at an early date, but probably subsequent, as I have elsewhere shown (*loc. cit.*), to the closure of the communication between the brain and the primary optic vesicles. I have met with an instance of anencephalus and complete spina bifida in a fœtus two-thirds of an inch long. And in that instance the ruptured superficial walls of the dropsical cavity still remained, furnishing additional proof that this variety of spina bifida is really the result of dropsical effusion at a very early age. I have only once seen non-tumescent spina bifida of the lower end of the column, namely, the case already alluded to; and it is interesting to note that in that case there was hydrocephalus and extensive dilatation of the central canal of the cord. Such a case may

possibly arise from overgrowth of the superficial aspect of the cord in the early embryonic stage, before the central canal has been formed; but that is a state of matters which, although it has been demonstrated to occur, takes place so early that probably it leads to the early destruction of the embryo, and therefore I incline to think that lumbar non-tumescent spina bifida is not likely to be produced otherwise than by rupture of a dropsical sac, in the same way as happens in anencephalus. Panum figures non-tumescent lumbar spina bifida in an embryonic chick.

*Tumescent spina bifida* may be cervical, dorsal, lumbar, or sacral in position, the lumbo-sacral being the most common. The collection of fluid causing the tumour varies considerably in its relations to surrounding parts. But, broadly and practically, two kinds of tumour ought to be recognized by the surgeon—the *metaneural*, in which the collection of fluid, whatever its exact site, is behind the roots of the nerves; and the *perineural*, in which it surrounds them.

*Metaneural sacs* are of two descriptions. The fluid may be collected in a cavity formed by distension of the central canal, in which case we have what is called a syringocele; or it may be collected in the membrane, constituting what is termed a meningocele. Syringocele, I suspect, is of much commoner occurrence than is supposed by the Committee of the Clinical Society of London, who could find only two unequivocal examples among 125 specimens examined. There are eleven specimens of tumescent spina bifida in William Hunter's collection,

preserved in the University of Glasgow. One of these is skeletal, and one other is imperfect, while nine afford valuable instruction as to the nature of the sac. Three of these nine cases are metaneural, and of the three, one (jars 52 and 53) is an indubitable syringocele, the cavity extending upwards above the tumour. Two other cases are in my possession, and, curiously, both are syringoceles. One of the two is a specimen from a child on whom Dr. Morton's operation had been performed with success. It presents deficiency of the arches of the two last lumbar vertebræ. Its dura mater and arachnoid, though adherent, are separable, and in the middle is seen a cylinder, which has the roots of nerves passing horizontally out from it, and is filled with semi-transparent new tissue, continuous with that in the heart of the collapsed tumour. The other specimen is in a fœtus exhibiting a genito-urinary malformation described by Dr. Mackay before the Philosophical Society of Glasgow. In it the vertebral deficiency extends from the last lumbar vertebra down the whole way; the sac has been followed in the form of a moderate dilatation of the central canal for some vertebræ upwards, and similarly at its lowest part shows a small opening near the lower end of the sacrum, whence it is continued for a quarter of an inch further as a tube which admits a probe.

Thus it will be seen that among eleven cases, of which nine belong to the Hunterian Museum, five are metaneural; and of these five, three are syringoceles.

It is not easy to determine explicitly the exact nature of the sac in the remaining two metaneural specimens in the Hunterian Museum. One of them

(jar 47) shows in the interior, between the fourth and fifth lumbar vertebræ, a depression from which emerges, covered by the lining membrane, the lower end of the cord, and apparently some nerve-roots, while to the right of these is a communication with the arachnoid space. The other specimen (jar 49*a*) shows remains of a flocculent lining to the sac, and a mesial depression on its deep aspect, from which the right sacral nerves, which are laid bare, are seen to arise. In these two specimens the sacs may be arachnoidal or subarachnoidal; but there are circumstances which make it probable that the cord itself was the seat of the original lesion, for the cord extends down as far as the sac, and nerve-roots come off horizontally at the level of the sac, according to a law which seems, as far as I know, to be common to all cases of spina bifida.

It is difficult to understand how the mere collection of fluid in the subarachnoid or arachnoid space, finding relief by bursting beyond the limits of the spinal canal, should prevent the cord from being retracted, after the normal fashion, within the canal as development proceeds. It is a small matter, that, with so narrow a field of observation, I have not seen a meningocele communicating with the general cavities of the spinal membranes, and leaving the cord and nerve-roots normal; but I gather that the Spina Bifida Committee have met with such a thing neither among their 125 cases nor the others which their secretary has had the opportunity of studying, including William Hunter's collection. Neither does Professor Humphry seem to have met with anything of the sort ("Journal of Anatomy

and Physiology," xix., p. 507). Therefore, I think it probable that the *apparent metaneural meningocele* is a secondary affection, originally derived from an early syringocele.

The *perineural sac* appears to be much the commonest form of tumescent spina bifida, and is characterized by being traversed by nerve-roots. These appear to be most frequently arranged in two vertical rows, one on each side of the middle line; and the members of each row may be connected more or less by membrane, which may in some cases form a complete septum. The origins of the nerve-roots may be indicated on the surface by slightly depressed lines, and sometimes slight punctate depressions may indicate the origins of individual roots. In one Hunterian specimen (jar 50) the right and left roots occupy a complete mesial septum, which broadens at the deep part where the roots deviate to their respective sides. It seems perfectly possible that the effusion may sometimes be situated in the subarachnoid space, where Humphry describes it (*loc. cit.*, p. 502), but its usual situation is doubtless in the arachnoid space. When effusion takes place through the whole arachnoid space, the nerve-roots are disposed in two rows, but in the specimen just mentioned it has been poured only into the right and left halves of the space behind the nerve-roots, while the anterior space, the situation for which is within the septum, has remained undeveloped. I should not be surprised if cases were to be found with the anterior space alone expanded, and the nerve-roots thrown to the sides; or even with only one of the lateral halves of the posterior arachnoid expanded, with or without

expansion of the anterior. Adventitious adhesions may produce loculation.

In perineural cases the spinal cord joins the superficial wall at a depression known as the umbilicus, and in the line of the umbilicus there may be a spongy or vascular appearance. The vessels of this spongy part are shown in an injected specimen (jar 52) to be continuous with the pia mater, and the sponginess is a tendency to increased growth, according to the law of the development of choroid plexuses; namely, that the pia mater is hypertrophied where the nervous substance is absent. A line of similar sponginess projects backwards into the syringocele in Dr. Mackay's specimen. In some instances the tumour has, in the area bounded by the nerve-roots, a semi-transparent covering different in appearance even from the patches of thinner integument which are met with invading the more normal skin further out. In many cases this area is undoubtedly the wall of a ruptured syringocele, whether it be found communicating with the interior of the cord or not. In one Hunterian specimen (49*b*) a curious little pit is seen at the lower end, with a slight mesial groove leading into it; and in another (55) there is an umbilicus about an inch long, ending inferiorly in a blind pouch. But while perineural effusion is thus based on a burst syringocele in some instances, it is not always so. Obviously, there is no reason why there should not be an arachnoid dropsy in front of a syringocele without the latter bursting; and probably that has been the state of matters in those cases in which an unopened spinal cord is found at the surface of a spina bifida. Very

interesting in this connection is the Hunterian specimen 56, a trilobate tumour in the dorsal region, the lobes separated by the origins of nerves. At the upper part of the middle lobe is an opening, apparently caused by ulceration, into a mesial locule which one sees is continued down from the interior of the cord, forming an elongated syringocele. It is to be noted that this case, like that figured at page 13 of the Committee's report, is dorsal in situation.

I have dissected only one cervical tumescent spina bifida (*loc. cit.*, p. 259), and in it the floor of an elongated fourth ventricle lay in the fluid of the sac.

On the whole I see no reason to doubt that spina bifida, in all its varieties, implicates in the first instance the interior of the cord, even in those curious instances in which there are additional elements developed from the vertebral column.

JOHN CLELAND.

## PROJECTIONS OF BONE.

The osseous framework inclosing the cord, *i.e.*, the spinal column itself, seems to share in those variations in development which lead to such conditions as derange the normal development of the cord and its membranes. This points to the inference that the bones may sometimes occupy a causal relation towards the formation of such protrusions as spina bifida, and their associated displacements. It is now a considerable time since instances of this abnormality were first noticed; but very recently much greater attention has been given to the description and delineation of

such. They consist of osseous or osseo-cartilaginous growths, projections, or bridges, which cross the vertebral canal from before backwards, and perforate or split up the cord. The reporters of the London Clinical Society's Committee say on this point—"The most noteworthy variation in the pathological anatomy of spina bifida is one of which we have seen four examples. A fifth specimen exists in the Musée Dupuytren in Paris." In No. 22 of their report, which corresponds to No. 276 C of the Royal College of Surgeons Museum, this condition is exemplified, and in regard to the projection it is said—"This element (an osseo-cartilaginous element, which crosses the vertebral canal from before backwards, and perforates the spinal cord) abuts anteriorly against the posterior surfaces of the bodies of the twelfth dorsal and first lumbar vertebræ, with the intervening fibro-cartilage. The division of the cord occurs unsymmetrically: on the left side the anterior column is alone represented in the upper part of the division; the left lateral column is traceable for a short way on the right division. In its lower part the left division of the cord becomes nearly equal in size to the right, the lateral and posterior columns reappearing. The central canal is largely dilated above the point of division; the dilated canal traverses the upper part of the right division, the dilatation ceasing too in its lower half. Into the mouth of the sac there projects a diverticulum of the dilated right division of the cord (Plate 5)." The origins of the nerves are then named, and it is stated that "the cavity of the sac is obliterated by young

connective tissue." The clinical details, ascribed to Dr. Batterham, show that the patient was a well-nourished female child, aged three years, having a tumour which had not grown since birth; that the treatment consisted in the application of an india-rubber cord; and that death took place on the eighth day, from convulsions.

No. 23 of the same report (No. 3,485, St. Bartholomew's Hospital) presents some similar conditions in a lumbo-sacral case; namely, a process of bone which extends completely across the vertebral canal, from before backwards, immediately above the deficiency, and perforates the spinal cord. Above the perforation there is a greatly dilated central canal; there is no dilatation below the bony projection. Various other deflections of bone are noticed by the Committee, for which I must refer those who are interested to the report itself, which appears in the eighteenth volume of the "Clinical Society's Transactions."

In part iv., vol. xx. of the "Journal of Anatomy and Physiology," there appears a most interesting communication by Professor Humphry, of Cambridge, entitled "Six Specimens of Spina Bifida with Bony Projections from the Bodies of the Vertebræ into the Vertebral Canal."

These specimens have been very carefully examined and described, and show that such bony projections or bridges are sometimes multiple, that is, that more than one have been found in the same specimen. Professor Humphry, referring to specimen No. 5,915 in University College (which is mentioned in the Clinical Society's report as an

instance of partitioned spina bifida with a process of bone crossing the vertebral canal just above the sac, and lying between the halves of the cord), draws attention to this, that while "the spina bifida commences at the eleventh dorsal vertebra, the bodies of the vertebræ along the whole column are serially and numerically correct, but that the bodies from fifth to ninth, inclusive of the dorsal vertebræ, are small—some smaller than others,—and that placed behind these, in close contact with them, and dwarfing them, is a second, or supplementary, set of bodies, or apparent bodies. These are separated from one another and from the bodies in front of them by lines (apparently) of intervertebral substance, as in my own case [a specimen minutely described in the same paper]. Furthermore, at the back of these are three smaller osseous pieces, also resembling vertebral bodies, which are produced into processes projecting into the vertebral canal, and the halves of the bisected spinal cord pass on the sides of these processes." This suggests an irregular distribution of the osseo-cartilaginous substance of the vertebræ, and their connecting intervertebral tissue.

The situations of these projections in relation to spina bifida protrusions is noted thus by Professor Humphry:—"In all, except that in the College of Surgeons, and the lower one in the first case which I have described, the processes are above the spina bifida. In two, as in my specimen, they are immediately above it; in that in University College they are higher up." "The supplementary bodies, or apparent bodies, behind the normal ones,

and projecting into the vertebral canal, found in the University College specimen, resemble those in mine; but they are situated above the spina bifida, where the vertebral bodies and arches were in other respects normal; whereas in my specimen they project into the spina bifida." Professor Humphry also mentions a specimen of sacral spina bifida, taken from a male child, aged sixteen days, sent to him by Mr. Batterham, House Surgeon to the Wolverhampton Infirmary, in which he found the lowest part of the spinal column very imperfect, and describes projections there found as follows:—

"A median hard bony process arises from the back of the space between the third and fourth lumbar vertebræ, and expands like a T into a transversely flattened plate, which meets, on the two sides, the lamina of the third lumbar vertebra, and completes the arch. A similar process, consisting of cartilage and bone, projects from the back of the bodies of the first and second sacral vertebræ. It expands, and, inclining to the right, is connected with the right side of the fifth lumbar vertebra, thus bridging over the right side of the vertebral canal. The spinal cord passes in two divisions—one on either side of these median processes. The right division, passing under the arch formed by the lower median process, is connected with the back of the sac of the spina bifida." Although that on the left side has been in great part cut away, the Professor sees "reason to infer that the left division of the cord passed beneath the arch formed by the upper process, and, like that on the right side, reached the sac of the spina bifida."

By the kind permission of Professor Humphry, I

am able to give a figure of the specimen (No. 276 C) in the Museum of the Royal College of Surgeons in London, which shows this splitting of the cord due to a projection of bone. This specimen has already been partly described. Professor Humphry shows that the bodies of the twelfth dorsal and first lumbar vertebræ are fused together, and form what appears as one body, and in continuation adds—"The horizontal bony process traversing the vertebral canal passes backwards from between the bodies of the first and second lumbar vertebræ. It is broad at its base, where it appears to have encroached upon the bodies of the contiguous vertebræ, especially of that above it; and its irregularly quadrilateral extremity, which has a deep pit in its middle, occupies the ends between the laminæ of these vertebræ (the first and second lumbar), being connected to them by fibrous tissue, except on the left side, where there is bony union between it and the lamina of the second lumbar vertebra." The plate shows very clearly the relations of the parts here described, and the dilatations of the central canal both above and in the protrusion forming the spina bifida tumour.

I must refer those who desire to continue the study of this subject to the very painstaking report of the Committee of the London Clinical Society, as published in volume xviii. of the "Transactions" of that Society, and to the papers of Professor Humphry (he has given more than one) in the "Journal of Anatomy and Physiology."

### Analysis of Fluid in Sac.

The composition of the fluid withdrawn from spina bifida tumours possesses some interest both to physiologists and practical surgeons, and we find several analyses of it in the report of the Committee of the London Clinical Society. These are certainly the most complete analyses that I am aware of, and have evidently been carried out with great care by Dr. W. D. Halliburton, B.Sc., Sharpey Physiological Scholar, University College, London, in the Physiological Laboratory of that College. Without giving the full details of the report, I take the liberty of quoting the results. In the first case, a female aged nineteen years, the specific gravity was found to be 1007, which was also assumed to be the case in the second analysis.

"The composition of the fluid may therefore [referring to previous details] be thus expressed in a tabular way (the numbers are parts per 1000):—

| | |
|---|---|
| "Water | 989·75 |
| Solid matters | 10·25 |
| Proteids (consisting almost exclusively of globulin) | ·842 |
| Sugar (approximately) | ·002 |
| Extractives and soluble salts | 9·406 |
| Insoluble salts | ·218" |

The second analysis is that of fluid from a lumbo-sacral spina bifida on a female child aged eleven days. "Trömmer's test showed a distinct trace of sugar present."

"The following is the composition of the fluid (in parts per 1000):—

| | |
|---|---|
| "Water | 919·877 |
| Total solids | 10·123 |
| Proteids | 1·602 |
| Soluble salts | 7·544 |
| Insoluble salts | ·346 |
| Extractives | ·631" |

In a footnote it is added: "This proteid contains globulin, as is seen by the fact that saturating with magnesium sulphate produces a precipitate."

In the third analysis the fluid was obtained from John S——, aged thirteen weeks, and it is said that "Iodine had been injected on three previous occasions."

| | |
|---|---|
| "Water | 991·658 |
| Total solids | 8·342 |
| Proteids | ·199 |
| Sugar | ·165 |
| Extractives (*minus* sugar) | 2·863 |
| Soluble salts | 4·776 |
| Insoluble salts | ·339" |

The analyst calls attention to the diminished quantity of proteids as compared with the other specimens, and to the sugar as "*very greatly increased* in quantity," also to the diminution in soluble salts and total solids.

It is also noted that these analyses are very similar to those previously made by Hoppe-Seyler from two cases of spina bifida, which are appended as quoted from the "Physiologische Chemie," p. 601. These I here reproduce for the purpose of showing how very considerably the amount of the proteids has been found to vary.

| | Case I. | | | Case II. | |
|---|---|---|---|---|---|
| | First Puncture. | Second Puncture. | Third Puncture. | First Puncture. | Second Puncture. |
| Water . . . | 987·49 | 986·88 | 986·72 | 989·33 | 989·89 |
| Solid matters . | 12·51 | 13·12 | 13·28 | 10·67 | 10·20 |
| Proteids . . | 1·62 | 2·64 | 2·46 | ·25 | ·55 |
| Extractives and salts | 10·52 | 11·30 | 11·14 | 10·42 | 9·65 |

These analyses of Seyler's also show a notable increase of proteids after being once punctured.

It is long since sugar, or some form of dextrose, was believed to be present in the cerebro-spinal fluid—a substance capable of reducing copper salts. In a few cases attempts to substantiate or disprove this have been made by trying to obtain qualitative analyses of the fluid withdrawn, in several of the cases to be narrated. These analyses have given affirmative results in a few instances, while in others no indications of the presence of a saccharine substance could be made out. They, however, were not made by chemical experts. On this account these analyses made by Dr. Halliburton are the more valuable; they have evidently been conducted with great care, and clearly establish the presence of a saccharine body, or, at least, of some similar substance capable of reducing copper salts.

The great disparity between the specific gravity of the spinal fluid and that of the serum of the blood is also a point of interest. The fact of the former being so low in specific gravity leads us to infer that the precipitation of the albumenoid ingredients by the coagulating power of the solution used for injection cannot play a large, if any, part in closing the aperture of communication with the spinal canals.

In regard to the salts present in this fluid, it has been noted by Ranke that the fluid contains ·061 per cent. of albumen out of a total of 1·06 per cent. of solids; that these yield 82·17 per cent. of their bulk ash; and that this ash contains six and a half times more soda than potash. This corresponds with the proportionate preponderance of soda to potash in the body generally.

### Proposals for Treatment.

Till very recently the management of infants having this congenital deformity has been regarded as a task all but hopeless, death usually occurring a few days or weeks after birth, preceded, for a day or two, by the bursting of the tumour. Not very long ago Holmes wrote thus—"The progress of the disease is usually to death"; and again—"But, although the great majority of cases are speedily fatal, it is not always so"; and then he refers to exceptional cases in which a spontaneous cure took place, and to some in which the patients died of other diseases, no unpleasant symptom having resulted from the tumour. Holmes also wrote, "Active surgical treatment usually hastens death, yet cases have been known to recover after many varieties of operation." So recently as 1876 we find Bryant writing, "Palliative treatment is all that can be followed in the large majority of cases, although in exceptional instances operative interference promises to be of use." I by no means intend to accuse these surgeons of still retaining such opinions, and could fancy both might now say exactly the reverse of the above, for both have acknowledged the value of the new method of

injecting. These quotations are meant to show the state of opinion so recently as ten or twelve years ago. Down to the year 1871, like others, I regarded this condition as irremediable, believing that interference of any kind could do nothing but harm. Not that there was any paucity of proposals towards cure: these were numerous, some of them bearing the names of distinguished surgeons. But as in medicine, when diseases are incurable, the remedies proposed are almost numberless, so in surgery, when a condition presents itself which is very unmanageable, the modes of procedure recommended are also numerous. To some of these proposals it will be my duty to refer; and before doing so let me say a word about the care requisite previous to operation. This means protection. All surgeons agree that this is essential, were it only for the comfort of the child, and that its very life may depend upon careful attention to defence. The means of protection will be named in one of the succeeding pages; meantime I may say that such require to be diligently maintained till such time as the surgeon may think fit to operate, till a cure has been effected, and often for some time after that.

### Treatment by Pressure.

Pressure has been proposed, and tried in a few instances. In favour of the proposition there is the knowledge of the communication of the fluid in the interior of the sac with that in the interior of the spinal membranes. Some medical men have thought that they detected an impulse given to the sac in the fontanelles, and it has even been affirmed that, in rare examples, the fluid contents of the tumour could be

made to pass entirely within the cerebro-spinal canals. I am not able to give entire credence to this assertion, having never seen any such case, and it is evident that it can be possible only in the earliest stage of the formation of the protrusion, when the tumour and the amount of fluid are small. The occurrence of such an instance is quite conceivable, and if closure could be safely effected by pressure in any case, it would do away with the necessity for any other proceeding. The closure of the opening in the spinal column is what we aim at.

To those who have seen many such cases it must at once be manifest that pressure in any form could not even be tried in ordinary cases. It would be intolerable to the little patient, so that its maintenance would be impossible, and, if applied to the tumours we most frequently meet with, would certainly burst them. Cases, therefore, which would admit of pressure as a remedy, must be so exceptional as to demand separate consideration. Pressure has been employed in conjunction with puncture, which will be noticed immediately.

It is, I admit, a debatable point, whether it is appropriate to place under the head of pressure the treatment by collodion, yet I venture to do so, as its most manifest mode of action is by producing contraction.

### Treatment by Collodion.

In the "Medical Times and Gazette" of July 2nd, 1859, in the selections from foreign journals, there is given a "Case of Spina Bifida treated by Collodion by Dr. Behrend."

"A strong, healthy child was brought to Dr. Behrend when seven weeks old, having a swelling over the last lumbar vertebra, and the upper part of the sacrum. It was the size of a small orange, of a roundish form, with a broad base, and disappeared under pressure of the finger. The skin over it was very delicate, transparent, and of a palish red. Pressure, which caused the disappearance of the fluid, seemed to give the child pain, and induced distortion of the features, which disappeared when this was removed. The aperture in the vertebra could be distinctly felt. The author resolved to try the effect of compression by collodion; and in order that its action should not be too suddenly energetic, he mixed it with some castor oil in the proportion of three parts to six of collodion. On July 2nd, the whole surface of the tumour, and some distance beyond, were painted with this. No bandage was applied, and the parts were left freely exposed to the air for an hour and a half, a firm but yet soft and yielding covering having been formed over the tumour. Some wadding and sticking-plaster were now applied. Next day some amount of contraction was thought to have taken place, and a pencilling with eight parts of collodion to two of castor oil was performed. By the 7th of July a remarkable degree of contraction of the tumour had taken place, and it was painted with pure collodion. On the 8th there was a slight rupture observed in the shrivelled wall of the tumour, and some moisture issued; but on close examination it was believed that the rupture only implicated the layer of collodion, and did not pene-

trate within the tumour. This had now diminished to the size of a filbert, and became much flattened. A small plate of caoutchouc wrapped in muslin was laid over it and secured by a roller. This was kept on for three weeks, when nothing else was visible than the thick skin, stretched tightly over the aperture in the spine, and from which the collodion had long since become separated. The plate was directed to be worn some time longer yet, and the child when seen on October 12th seemed well and hearty, and fully developed,—the large fontanelle, which had been too open, having become diminished in size. No trace of the tumour was visible, some thickened skin and a subcutaneous mass of almost cartilaginous hardness supplying its place, allowing the edges of the bony aperture only to be very imperfectly felt. The author thinks that probably the collodion might have been used at once without the castor oil, when its influence would have been more powerful; and he suggests, under certain circumstances, the combination of lead or tannin with it, in order to produce a more immediate effect on the wall of the tumour. In the present case he considers that some calomel which, with cold applications to the head, was employed on account of a head affection which threatened to come on during the treatment, may have contributed to the rapid absorption of the fluid."

### Puncture.

It is not wonderful that this mode of treating spina bifida has suggested itself to many minds,

and were the collapse of the tumour all that is requisite, this certainly would effect it, but with much risk. The employment of repeated punctures and the intermittent withdrawal of the fluid was recommended and practised by Sir Astley Cooper, while pressure by compress and bandage was used in addition; and several cases of success were recorded by this celebrated surgeon, and one of failure. In a manuscript volume of essays, read before the Glasgow Medical Society, in 1823, which I find in the library of the Faculty of Physicians and Surgeons of Glasgow, there is a detailed record of a case successfully so treated by Alexander Angus, surgeon. "The tumour was situated over the two last dorsal vertebræ."

In the work on the "Principles of Midwifery," by Dr. John Burns, of Glasgow, published in 1837, in which he also treats of the diseases of children, we find that, after giving a palliative plan of management, he writes as follows upon the radical cure: "The second exposes the patient to great danger from constitutional irritation. It consists in repeatedly puncturing the tumour with a needle, and drawing off the water. At last adhesion of the sides of the sac is produced, and the opening from the spine is closed, the skin hanging shrivelled over it, or becoming puckered at the part." It is not a little interesting to meet, at so early a date, with such an accurate description of the conditions, which the operation I now advocate aims at producing. Dr. Burns adds, "Puncturing the tumour with a lancet and tying a ligature round the empty bag is almost invariably fatal. The palliative plan is the best."

Very gradual, but constant and continuous, drainage has occurred to some minds as a possible mode of cure, and has been put to the test of trial by some eminent surgeons, who have candidly confessed to failure, doubtless due to the escape of the cerebro-spinal fluid. Thus we arrive at the conclusion that the failures by puncture have been numerous, the successes very exceptional, and that both operators and parents have been disappointed and disheartened.

As a fortunate result after puncture, the following case deserves notice. In the "Lancet," of October 9th, 1869, it is stated that Mr. Henry Smith had recently under his care a "patient who is thirty-two years of age, and the father of four children, who had previously been affected with a large congenital swelling over the sacrum. The tumour was soft and fluctuating, extensively attached, and without any restricted base, and covered by thin and tense integument, which frequently became inflamed in consequence of pressure or of slight blows. The tumour was undoubtedly due to spina bifida, had been punctured on several occasions, but without any permanent results. Some months ago Mr. Smith again made a small puncture, and drew off 22 ozs. of transparent serous fluid. This operation was followed by acute inflammation of the walls of the cyst, and severe general reaction, which placed the life of the patient in great danger. He made, however, a very good recovery, and now presents no trace of his former lesion, with the exception of a slight fulness of the integument, and a distinct depression in the centre of the sacrum." Here, as

a sequence of puncture, we have an instance of the occurrence of that condition we seek to establish by injection, and which occasionally is known to happen in cases of hydrocele after a first tapping. In the first edition, in the appendix, I quoted a case successfully treated by Dr. Camara Cabral by repeated punctures, there called Lisbon case.

In the "Medical Times and Gazette" for October 22nd, 1859, it is mentioned that at a meeting of the Académie de Chirurgie, "a child six weeks old was presented to the meeting, at the instance of M. Huguier, that he might have the benefit of the opinion of his colleagues as to the course of treatment he ought to pursue." The tumour was sacral. Otherwise "the health of the infant was good; and there was no paralysis of the bladder, rectum, or lower extremities. Without a single exception all the members of the Society were opposed to an operation, and those who had the largest amount of experience in similar cases, were the most energetic in protesting against such a measure. M. Guersant, of the Hôpital des Enfants Malades, stated in the course of his remarks, that he had punctured fifteen or eighteen cases of spina bifida, and in each case he had had reason to regret having done so. M. Velpeau, who had operated by puncture in four cases, had been successful in only one, and that after four successive operations, followed by an equal number of iodine injections." These statements show how fatal and unsatisfactory puncture has been found as a mode of cure.

When we turn to the report of the London Clinical Society, we find that the reporters have collected

forty-six cases treated by puncture or incision, "with or without subsequent compression." "Of these thirty died, twelve recovered, two were unrelieved, and in two the result is not stated." Fourteen of the cases died of meningitis, and eight of convulsions, and the reporters give it as their opinion that "many of the cases described under the head of 'Convulsions' were probably really instances of meningitis"; and say further: "Whether this be so or not, it is obvious that meningitis is the great danger of this mode of treatment. This method of treatment is an imitation of that local change in the tumour (rupture) which most often ends fatally, and its disastrous results are therefore by no means surprising. While in many instances puncture of the sac of a spina bifida has proved entirely innocuous, it has been so much more often fatal, that it should not be undertaken even as a palliative measure." In this verdict I cordially concur. As a means of cure, *per se*, it may justly be styled disastrous.

Under the section on puncture, the following case may be placed, though it would be more correct to say that it was treated by incision. It appeared in the November number, for 1871, of the "Glasgow Medical Journal," entitled "Case of Spina Bifida treated antiseptically, by John Wilson, M.D., Physician to the University of Glasgow Lying-in Hospital," and I now give it in a slightly abridged form. Dr. Wilson says: "The infant when first brought to me was a fortnight old, and the tumour was about the size of half a billiard ball, with the usual semi-transparent gelatinous aspect. Already a few small superficial punctures had been made by a female attendant, from

which serous fluid oozed on slight pressure, but as yet they had resulted in no serious mischief. Having mentioned the circumstances of the case to my friend Dr. J. G. Lyon, and having seen the child along with him, we resolved, while keeping in view the risks incurred by all modes of treatment of such tumours hitherto reported, to make a free incision under an antiseptic veil, and to dress it subsequently, with great care, antiseptically. By the free incision, instead of small punctures which might soon close, we hoped to prevent the possibility of the cavity being even partially distended in future; while at the same, by the antiseptic, to obviate all danger of inflammatory disturbance of the cord or its membranes, the ultimate object being to secure complete obliteration of the cavity, and the formation of a firm pad over the void in the vertebral column. The plan was fully carried out, and with gratifying results. By the end of the first month from date of operation, a flattened cake of the condensed tissues had formed, which has remained firm during the four months since then." The state of tumour on May 22nd, 1871, is thus described (it was in the region of the upper dorsal vertebræ): "Integument surrounding base of tumour extends up on its sides a short distance, then abruptly gives place to thin membrane. Fluid contents begin to ooze on very slight handling, through two or three superficial punctures made by midwife. Infant evidently suffers pain whenever tumour is touched. Walls are felt to be thicker than they appear to the eye. They probably consist of many tissues, more or less altered or incomplete—*e.g.*, arachnoid, dura mater, muscular fasciculi, fasciæ, and integument. On May 25th

tumour was first moistened over the carbolized oil (1 in 8), and then opened by free longitudinal incision (about $\frac{3}{4}$ inch in length, under an antiseptic veil of surgeon's lint soaked in carbolized oil. Copious flow of serous fluid (cerebro-spinal), slightly tinged with blood, probably from the incision. Simultaneously with the removal of the lint, a large piece of carbolized lac plaster was applied, and over this another, kept in position by adhesive plaster, one edge being left comparatively free for escape of fluid. A soft folded handkerchief laid over this completed the dressing." Here there follow details of the repeated dressings, the record of very considerable constitutional disturbance, with vomiting and diarrhœa, and their appropriate treatment, till on June 26th this report is made : " Gauze changed, and tumour inspected, as there was still no trace of discharge. It was found much contracted and flattened, and incision healed. Child lively and well."

" July 24th.—Since last date the mother of the child has managed the treatment, keeping a small piece of the gauze over surface of tumour, in case there should be any oozing. Tumour contracting. Still a small patch of thin membranous covering in centre, *but no fluid in sac*. Child well and thriving."

" September 30th.—Sac obliterated, and external tumour diminished considerably since last note. On October 19th child is said to be very lively, and strong in back and limbs, and the flattened disc where tumour had been still contracting."

When the child was about a year old, he was seen by Dr. Wilson, and found to be strong and well.

It is probable that in this case the spinal opening

had closed previous to making the incision. No attempt seems to have been made to prevent escape of the cerebro-spinal fluid.

### Ligature.

Instant strangulation by ligature of the pedicle or base of the tumour of a spina bifida is said to be always fatal, and to have been proved by frequent trials. Gradual compression, as by clamp or quills, or a ligature tightened by degrees, seems more feasible, yet it has not obtained much favour, and is admitted to be far more dangerous than most other modes of treatment. This method has been combined with excision in some instances, the latter succeeding the use of the ligature or clamp. Some years ago elastic ligatures came somewhat into vogue for the removal of tumours of different kinds, and were tried on spina bifida tumours, not without instances of success.

Ligature has been employed in combination with puncture, and with success, which is exemplified in the following case, published in the "Medical Times and Gazette," October 9th, 1858, by the late Dr. J. G. Wilson. It occurred in the practice of his father, Dr. James Wilson.

"About the middle of July last (year not stated), a male infant was brought to me a few days after birth with spina bifida over the lumbar region. The tumour was about the size of a small orange, and rose by a neck nearly an inch in diameter from the middle of the lumbar vertebræ. It was distinctly fluctuating, irregular, and nodulated on the surface,

and covered by thin, delicate, and transparent membrane. The child appeared to suffer much pain and uneasiness when pressure was applied to the tumour, and required to be constantly laid on its side or abdomen. The power of voluntary motion in the lower limbs was little, if at all, impaired." "What I considered a favourable circumstance in this case was that the pedicle, or neck of the tumour, was covered with the ordinary integument; and this led me to attempt its removal by ligature, after consulting with some of my medical friends. A ligature was applied, not very tightly at first, and a new one put on every day. The tumour enlarged considerably, and it was frequently punctured with a fine needle. A large quantity of clear serous fluid exuded from the punctures, and it was not till the fourteenth day after the first application of the ligature that the sac began to shrink and shrivel up. The membranous covering became reddish and ultimately black, and came away on the eighteenth day after the application of the first ligature, leaving a raw, tender surface, about a quarter of an inch in extent. This small sore, by the use of simple water dressing, combined with pressure, gradually healed, and a firm cicatrix was formed in the space of three weeks. Before the closure of this sore, a slight fissure or defect in the spinal canal, through which the membranes protruded, was distinctly felt. The infant enjoyed excellent health during the whole time. It complained a little each time the ligature was tightened, and appeared, on the whole, less troublesome than formerly. The child was brought to me three months afterwards

for vaccination, and was in a healthy, thriving condition, with the back perfectly well."

Whether justly or not, the credit of being the first to recommend the ligature is given to Mr. Benjamin Bell, of Edinburgh. His object was to produce sloughing and subsequent adhesion of the neck of the sac, but he is said never to have tried it in practice. The method is generally deprecated, yet we find it credited with some cures. Dr. Trowbridge, of Waterton, State of New York, is alleged to have succeeded with two cases (cervical) by surrounding the neck of the tumour with a fine silver wire, and gradually tightening it so as to interrupt all circulation through it, and then cutting off the tumour with a knife on the distal side of the wire. Dr. Trowbridge "considers that those cases in which the fluid is external to the arachnoid are best adapted for the employment of the ligature." The tumours and contents are not described. These cases appeared in the "Boston Medical and Surgical Journal," and in abstract in the "Journal de Progrès des Sciences et Institutions Médicales," for 1829.

In the "Lancet" of May 17th, 1884, we find that Dr. Antonino Turretta has republished, from the "Giornale di Clinica e Terapia," of Messina, a case of spina bifida, successfully treated by the elastic ligature:—"His aid was requested for a female child two months old, apparently in good health. She had a tumour as large as a small apple in the middle line, opposite the two last cervical vertebræ. It existed at birth, and had since slowly increased. It was supported by a *pedicle* (the italics are mine), which measured an inch and a half in circumference. The

covering skin was very thin, and of a bluish-red colour. The tumour was soft, flaccid, and fluctuating; under strong pressure it diminished somewhat in size; the child cried, and slight convulsive movements were excited in the limbs. No other deformity was present, neither was there paralysis of any organ. An exploratory puncture at the base of the tumour with a trocar gave exit to a thin transparent liquid of alkaline reaction. The tumour shrank, and the aperture was closed with iodoform collodion. Distension and fluctuation were again perceptible in twelve hours. The tumour having been emptied by another puncture, its pedicle was constricted with a couple of turns of elastic ligature. At the moment of constriction the child cried, the face became livid, and some clonic convulsions were excited, but in a few hours the patient took the breast and rested. Next day vomiting was persistent; there was a tendency to coma, and twitching of the upper limbs. The condition on the third day was unchanged, and a small dose of calomel was given each day. All these symptoms had subsided on the sixth day, and the ligature with the tumour separated on the twelfth day, leaving a granulating surface which gradually contracted. The cicatrix was complete, and the child cured on the twenty-seventh day." This case possesses an interest peculiar to itself as an instance of cure by "*elastic ligature*," a procedure which certainly is not adapted to cases with a broad base. The pedicle, "which measures an inch and a half in circumference," is an unusually narrow attachment, and the history

of the treatment would lead to the conclusion that only the membranes protruded.

The London Clinical Society's report gives sixteen cases treated by ligature, of whom ten recovered and six died; and concludes the subject of treatment by ligature by declaring, "ligature of the tumour is of course inapplicable to cases of myelocele, and there is no evidence that any of the sixteen cases were of such a nature; indeed, the negative evidence is so strong as to amount to almost positive proof to the contrary. For cases of meningocele a mortality of 37·5 per cent. is higher than that obtained from other modes of treatment."

It may be right here to remark that several surgeons have advocated the application of a clamp, so as to cause separation by sloughing. This has been tried by a few. Rizzoli, of Bologna, in Italy, mentions its use in a cervical case of spina bifida, and in a case of occipital meningocele. The practice has not met with much acceptance either in this or any other country.

## Excision.

This mode of dealing with spina bifida tumours signifies removal of the entire tumour, leaving only such flaps, if they can be had, as may be sufficient to cover the space which is thus laid bare. This method of getting rid of such protrusions has presented attractions to many minds, has been proposed by not a few, and practised by some. Its chief attraction consists in its apparent thoroughness—the

complete removal of the swelling. It recurred to my mind again and again when endeavouring to plan a mode of management for the first case in which I employed the iodo-glycerine solution; but I felt compelled to abandon it, for I was satisfied that no treatment which did not secure the prevention of escape of the cerebro-spinal fluid could succeed, seeing that such escape is the main cause of the mortality of this malformation. Besides, even then I knew that parts of the cord, or its nerves, were usually present in the sacs, and attached to the sac walls, and I did not think it right to remove them. Many of the earlier proposals for excision were founded upon the assumption of the absence of the cord and nerves from the sac, and that in such circumstances the operation would be less hazardous. Their presence, however, would not necessarily prevent success, though it may increase the danger. Every well-informed surgeon knows that parts, even great parts, of the brain itself have been removed without any serious result ensuing. Some of the advocates of excision make a good deal of the condition of pedunculation, a condition which I know to be extremely rare; and I found this statement upon the fact that I have now seen a considerable number of cases, and none of these were pedunculated, but all sessile, or attached by a broad base. It is true, I have seen the swelling overlapping the base, still the latter was broad. This remark applies alike to cervical, dorsal, and lumbar cases. I believe pedunculation occurs most frequently at the two extremities of the spinal column, the cervical and the sacral. The various medical journals have chronicled quite a

number of cases treated by excision, many of which are described as pedunculated.

When consolidation has occurred spontaneously, or as the result of treatment, and the remains of the tumour are not flat, but form a projection, excision may be advisable and useful. Ample time must, in such instances, be allowed to complete the consolidation before using the knife. I have seen one such case, in which the small solid tumour which remained was very properly removed by one of my surgical colleagues in the Glasgow Royal Infirmary. Excision as thus applied ought to be quite devoid of danger, and manifestly useful as a consequent to successful consolidation, the result of injection, in order to remove any projection of the part, which might cause serious inconvenience.

Many attempts at the cure of spina bifida by excision have been made by écraseur, by clamp, and by knife. Dubourg, Tusignat, and other French surgeons have cut away part of the walls of the sac, and then united the skin across. A modification of such an operation was tried in 1857 by Mr. Borlase Childs, who "thought that much danger might be avoided by not opening the sac itself, and proposed to dissect off the skin, and remove its thinnest and central part, and then, having tucked the serous membrane into the spinal canal, to unite the margins of the skin over it." This operation Mr. Childs performed on a child aged one month, which died the fourth day after the operation, rather unexpectedly, and it is added: "No *post-mortem* could be obtained, but there was no doubt that death was due to spinal irritation." This, I imagine, signifies that the child died of meningitis.

Very recently, Dr. Mayo Robson, of Leeds, has made efforts to revive excision as a mode of cure, and has had successful cases. On March 27th, 1885, he read a paper before the London Clinical Society, entitled, "A series of cases of Spina Bifida treated by Plastic Operation." If I correctly understand his mode of operating, it seems to be a combination of ligature with excision. For the prevention of the escape of spinal fluid reliance is placed upon ligature or sutures, which in other hands have not often proved satisfactory. Mr. Robson's paper appears in the eighteenth volume of the "Clinical Society's Transactions."

In the "Dublin Journal of Medical Science" for March, 1886, there appeared "A case of Spina Bifida treated by excision by Dr. Thomas Sinclair, Demonstrator of Anatomy, Queen's College, Belfast," which terminated favourably. Omitting details, it may be stated that during its treatment Dr. Sinclair seems to have become satisfied that it contained no nervous matter. Though this case recovered, and remained well three months after, yet Dr Sinclair begins one of his sentences by saying, "As a prognosis is nearly all a surgeon can offer to many spina bifida patients," which we cannot but regard as the reverse of a compliment to his own success by excision. Probably he agrees with Erichsen, when he says he has "never known any but a fatal result follow the removal of these tumours by ligature, scissors, or knife."

Upon this practical point, the reporters of the Committee of the London Clinical Society on Spina Bifida have considered it their duty to say: "For reasons which are stated lower down, we are compelled

to regard excision of the tumour as an inappropriate treatment of spina bifida." These reasons are: "That in a large proportion of specimens of spina bifida the spinal cord is in the sac; and that, "we are not acquainted with any means by which it is possible to determine in the living subject that the spinal cord is not in the sac of a spina bifida"; and they add that these operations (ligature and excision) always expose the patient to the grave dangers attending removal of the expanded spinal cord and attached nerves.

Now, I confess that I have not the same fear of removal by knife of portions of the expanded cord and nerves. I cannot regard it, *per se*, as a fatal proceeding, probably not a very perilous one. Meningitis, and loss of too much spinal fluid, have more terrors for me. But whatever may be the relative weight of such objections, I must agree with the reporters in thinking excision, by any plan heretofore proposed, to be too hazardous to be recommended. Even the chloroform employed is hazardous, and the operation itself formidable at such an early age as three or four weeks, or a few weeks later.

Appended to the report of the Spina Bifida Committee, a table is given showing that of twenty-three cases treated by excision, sixteen recovered and seven died. Concerning these it is said that "Nerves were certainly absent from the sac in sixteen, certainly present in one which was fatal, and no mention of contents of sac in six." In reference to the frequency of the presence of the cord in the sac, the same reporters declare: "In the total of 125 specimens examined, leaving out of consideration the cases of

syringo-myelocele, it has been found that the cord enters the sac in seventy-nine cases, *i.e.*, in 63·2 per cent." This leaves something to be more fully explained in the statistics of operation by excision, as given in the report.

I trust that no one will infer from what is here said, that I regard interference with nerve tissue as of little consequence, or devoid of danger.

A most interesting example of the removal of spina bifida by excision, in a case quite adapted for it, is given in a probationary essay, by Patrick S. K. Newbigging, M.D., submitted to the examination of the Royal College of Surgeons of Edinburgh, when candidate for admission into that body. His words are: "A plan of treatment which I have seen adopted in one instance with success, is that of removing the tumour by 'excision' through its base. This practice appears to have originated with Brunner, but in his case it was unsuccessful. It is evident that cases permitting of this are of a peculiar nature; but before I enter more fully into this subject, I will subjoin an account of the case in which I saw it employed, with a description of the tumour. My father, on August 13th, 1832, was requested by his friend Professor Hamilton to visit a child in Stockbridge, which was born on the 10th, under the care of Mr. Crighton, of that place. There was a tumour situated in the lumbar region, of a pyriform shape, and attached by a narrow pedicle to the space between the third and fourth lumbar vertebræ, to the right side of the spinous processes, where a fissure could be felt. It was translucent and fluctuating, and about the size of a small orange. It could not be diminished by pressure,

nor by this was there any comatose effect produced; the child, however, evinced pain and uneasiness when the tumour was handled. The limbs were perfectly sensible, and the urine and fæces were under the control of the will. On the 14th the tumour was somewhat less tense, and displayed several points of discoloration. It was deemed proper that it should be removed, which was accordingly done by two elliptical incisions made on each side of its base or neck, when a fluid of a straw colour immediately escaped from the sac. After subduing the bleeding, which was slight, the wound was brought together by a small piece of adhesive plaster, and a pledget and bandage applied. The child suffered little after the pain of the operation had subsided: there was no symptom of paralysis, and it took the breast freely. The dressings were removed two days afterwards, when adhesion was found to have taken place in several points of the wound. The same treatment was pursued, and in a few days the wound was completely healed, and the child continued perfectly well.

"On dissecting the tumour it was found to contain the dura mater closely attached to the integuments with the arachnoid membrane, and a portion of nervous substance, which, after passing into the sac as a single cord, immediately divided into several minute fibrillæ. At the superior portion of the tumour also, a small soft tubercle of the size of a pea was observed. The fluid coagulated slightly on exposure to heat.

"As I was somewhat sceptical as to the presence of nervous matter, I showed the tumour to Dr. Knox,

who removed all doubts upon the subject by stating it as his opinion that the tumour had the character of one of spina bifida, and that the substance contained in it was of nervous structure. The tumour was afterwards shown to Professor Turner, who coincided in this opinion.

"From the detail of the symptoms of this case it appears that, although there was an obvious fissure in the vertebræ, still, by the progress of development, the tumour had become excluded from the vertebral canal, and had an independent existence. It was therefore extremely well adapted for the employment of the practice which was pursued, or for the puncture; but probably the excision was preferable, as the flap of skin after the fluid had been removed would have been much exposed to irritation. It is a plan certainly the most formidable of those I have mentioned, and is indicated only in cases similar to the one in which it was here resorted to. I shall conclude my remarks upon the treatment of spina bifida by stating that it must, of course, vary according to circumstances, and that in general the *palliative* treatment will be resorted to, although, from the cases which have been mentioned, the *radical* method of cure may be adopted with some prospect of success."

Dr. Newbigging was afterwards informed by Mr. Crighton that the child continued well until it was about seven months old, when it died of hydrocephalus, after an illness of three weeks. Notes of a *post-mortem* were lost, but these were said to show that "the third lumbar vertebra was absent, its place being occupied by a strong ligamentous band."

Under the heading, "Excision of Spina Bifida," in the "Lancet" of July 26th, 1884, Mr. R. Howson, of Snenton, Nottingham, reports the following case :—

"A child aged fourteen days was brought to my surgery, suffering from a spina bifida, the hernia being about the size of a pigeon's egg, situated over the fourth lumbar vertebra. It was covered by the whole thickness of integuments, having a narrow base, tense and elastic, and becoming very much more so when the child cried. There was no incontinence of urine or fæces, nor paralysis of the lower limbs, the child being healthy and well developed in every other respect. I explained to the mother the great danger there might be in interference; but she particularly desired, as she expressed it, 'to have something done for the child.' Having cautioned her again as to the possibility of the child dying immediately of convulsions, I proceeded to tap the tumour with one of Dr. Southey's trocars and canula, and drew off about 2 drachms of spinal fluid. I then injected 15 drops of the tincture of iodine with 45 drops of water, afterwards applying a compress over the hernia, and sent the child home with instructions to return in a couple of days, it being none the worse for the first tapping. I repeated the injection a second time, but of a strength of equal parts, again applying the compress. On the child presenting itself the third time, I was pleased to find a diffused inflammation over the parts, and a decided contraction of the tumour, and was able to make pressure over the hernia without causing any symptoms of convulsions, which led me to believe there were no important nerves implicated. I therefore injected a drachm of tincture of iodine

(B.P.), having previously drawn off a like quantity of spinal fluid; and having tightly compressed the parts, I once more told the nurse to bring the child in a couple of days, at which time I found the hernia contracted to the size of a cherry. I now applied a clamp, specially made for the case by Messrs. Woods, of York, with the intention of closing the neck of the sac, yet not sufficiently tight as to interfere with the circulation, and each day I continued to tighten the clamp. On the fourth day, with a sharp bistoury, I cut off the tumour, when there was some little hæmorrhage. I therefore simply tightened the clamp, and left it in position twenty-four hours longer, when I removed it, and was pleased to find the opening between the spinal column and the tumour entirely obliterated. From first to last the child never showed a bad symptom resulting from any portion of the operation, sleeping and taking the breast well."

This, I submit, was really a case of cure by injection. Its progress and the appearances noted after the injection were such as are usually witnessed after successful operations of that kind, and specially the inflamed condition followed by "decided contraction" of the tumour. No more than this was needed to close the spinal opening, and, to use a Bret Hartism, "the subsequent proceedings interested" us "no more," except that we may remark that a little more time might very well have been allowed for contraction.

In the "Lancet" of January 26th, 1884, it is stated that on the 22nd of that month, at a meeting of the Royal Medical and Chirurgical Society, "Mr. Walter Whitehead, of Manchester, showed a case of spina

bifida cured by operation. A married woman, aged twenty-nine, had a spina bifida the size of an egg in the lumbo-sacral region, which remained stationary, and caused no inconvenience for twenty-two years, when, owing to domestic misfortunes, she was compelled to gain her living by work of a laborious character. The tumour then commenced to enlarge, and the patient to suffer from periodical attacks of violent headache, accompanied by nausea and vomiting. Pressure on the tumour caused vertigo and transient defects of vision. At the end of eight years the attenuation of the skin covering the tumour was so extreme that rupture of the sac seemed imminent. The circumference of the tumour was 22 inches, transverse diameter 12 inches, vertical diameter 10 inches. The patient was admitted into the Manchester Royal Infirmary, July 11th, 1883. Several tentative tappings were performed, with the effect of intensifying the disturbance of the nervous system. On October 4th the actual cautery was freely applied to the entire surface and circumference of the tumour. In four days the contents of the sac were ascertained, by aspiration, to be puriform; and on October 21st the sac was laid open, and the case treated to its termination by ordinary dressing. The patient was exhibited quite cured in every respect."

No reason is given why the actual cautery was applied in this case, nor can it be supposed that the suppuration of the sac was due to it, as within four days the contents were found to be purulent. Probably before this stage the channel of communication with the spinal canal had been filled up by

fibrinous deposit, and the laying open of the sac was the best part of the practice then, for in this way the dangers arising from a large suppurating cavity were averted. Uncertainty, or rather a fear, regarding subsequent oozing has in more than one instance deterred me from following a similar course, which afterwards I regretted; in future, therefore, I would feel inclined to give patients so placed the chance, if it is not more than a chance, arising from the clearing away of a suppurating cavity.

### Injection.

This mode of aiming at the radical cure of spina bifida seems very frequently to have suggested itself to the minds of surgeons, and still seems to be least liable, of all methods, to objection. For a long time back the profession has considered it as the most likely to prove successful, and experience has long since shown that it has been much more fortunate than either ligature or excision, if not more fortunate than both put together. For injection, iodine has been the substance chiefly used; sometimes the tincture diluted, sometimes other substances. After emptying the sac like a common hydrocele, Velpeau injected with tincture of iodine and water; hence this is called the French method. The American surgeons draw out a certain amount of the fluid in the sac, and supply its place by the iodine solution; but some operators, such as Brainard, of Chicago, withdraw this mixture after a few minutes. He thus describes his own operation:—

### Brainard's Mode of Operating.

"A small-sized hydrocele trocar was carried into the tumour at its base on the right side, and six ounces of fluid drawn off; while this was flowing, pressure was made by an assistant, and as the sac was emptied the pulp of the thumb was pressed upon, and partly into, the opening in the spine, which it exactly filled, so as to close it as perfectly as possible. Half an ounce of a solution (five grains iodine; fifteen grains iodide of potass to the ounce of distilled water), at the temperature of the body, was then injected through the canula, and after a few seconds allowed to flow out; distilled water at the temperature of the body was thrown in to wash out the iodine, and two ounces of the fluid first drawn from the sac, and kept at the same temperature, were reinjected, and the canula withdrawn. From movements of the child, some bubbles of air passed into the sac, and as these could not readily be brought out, they were left."

I had read the above before entering upon the treatment of my first case, but thought it then, as now, quite inadmissible. It appeared to me a very hazardous mode of proceeding, and, as I hope to show, unnecessarily so. In very few cases could the half of *six* ounces be drawn off, so that I suspect that the description applies not to infants a few weeks old. Nothing is more certain than that the complete removal of all the fluid in the sac is in the highest degree dangerous, if not absolutely fatal. Its reinjection does not remove the objection. I

believe that chloroform was employed in this operation, and this must add to the danger; it ought not to be given in the case of very young infants, if at all, in any case of spina bifida. I say *if at all* advisedly, for the pain inflicted is but slight, and whatever materially affects the brain and nervous system ought to be withheld. Should a fatal result ensue at the time, it would not be possible to say whether it should be ascribed to chloroform or the shock of the operation.

## New Method.

What I ventured to call, in the first edition, a *new method*, is substantially a mode of injection; but a new fluid is used now, called the iodo-glycerine solution. This solution, however, must be used under certain precautions, the most important of which is the prevention of the continuous loss of the subarachnoid or cerebro-spinal fluid, which must be regarded as essential to the integrity of the brain and spinal cord, being a necessary part of the contents of the spinal canal. This point will afterwards be more carefully discussed.

The iodo-glycerine solution is named so from its components, which are, ten grains of iodine, and thirty grains of iodide of potassium, dissolved in an ounce of glycerine; the last, glycerine, being chosen as the solvent on account of its colloidal character. The quantity of this solution employed in any one case will depend upon the size of the tumour to be operated on; and, as will be noticed further on, a medium-sized trocar and canula should

be used, chiefly because the iodo-glycerine solution, not being a thin fluid, will not pass readily through a very small canula.

The mode of procedure which I have adopted and adhered to will be stated in detail after narrating the cases. The experience gained in conducting these has been suggestive of a number of slight modifications in regard to minor matters of management. I wish to repeat here, however, that what occurred to me as the chief defect in former attempts at cure, was the absence of any provision for preventing the escape and loss of the spinal fluid.

In now submitting the histories of many cases, I beg to explain that it has seemed to me proper to give the cases in the first edition precisely as there stated. I am aware that this involves a little repetition, but it has the compensating advantage of showing how I was led to adopt this mode of dealing with spina bifida tumours, and the gradual growth of that reliance we now place upon it as a means of rescue from almost certain death, and of permanent cure.

The cases will be found placed nearly in chronological order, being set down almost in the order in which they came under my observation. The attention of practitioners will be directed to any point, or points, which may be found illustrated in the histories of the various cases.

### Case I.

*Abstract of a Clinical Lecture published in the "British Medical Journal," 6th April*, 1872.

John Kelly, aged two months, was admitted into ward seventeen of the Glasgow Royal Infirmary

on October 2nd, 1871. This child had a tumour opposite the upper lumbar vertebræ, globular in shape, of about the size of a small orange, and presenting the usual appearances of a case of spina bifida. Its covering was thin, so that it was quite translucent; and at the child's birth it was about half its present size. The mother stated that the tumour felt harder and fuller when the child cried. Moderate pressure upon it did not cause much inconvenience or suffering; and the child never had convulsions, and seemed in all other respects quite healthy; the fontanelles being neither more open nor more full than usual at the same age.

On October 12th the tumour was punctured with a grooved needle, and rather more than half of its contents—a pale straw-coloured fluid—was removed. It was then covered with lint dipped in oil, and over this cotton-wool; and, to fix the whole and afford a slight pressure, a broad elastic band was passed round the waist of the child. The sac speedily refilled, and on the 18th it was punctured a second time, and again it refilled.

On October 24th the tumour had regained its former size; and to-day it was punctured with a moderate-sized trocar and canula. After it had been half-emptied, a small portion—probably nearly half a drachm—of the following solution was injected:

℞ Iodi. gr. x.; Potass. Iod. ʒss.; Glycerine ℥j. Solve.

On October 26th the child continued well, having no bad symptoms, and being only a little "fractious."

In the swelling a portion of a soft substance could be felt rather to one side.

On November 2nd the mother was allowed to take the child home for a day or two; on the 6th she returned to the Infirmary, when it was evident that some degree of refilling had taken place. The tumour was again injected with a small portion of the iodine solution. How much actually entered the sac it is impossible to say. The child, however, continued quite as well as before; and on November 23rd he was again brought up and shown to the Clinical Class, when the tumour was found to be smaller and harder than formerly, without any appearance of redistension with fluid.

On December 7th the child was again shown at the hospital, and now the swelling presented the appearance of a shrivelled bag of skin, darker in colour than the adjacent integument, somewhat resembling a corrugated scrotum, and affording reason to believe that there was now complete closure of the opening of the spinal membranes. The health of the child was perfect, his mother affirming that he never was so well and comfortable as he was now.

On January 8th, 1872, the child was again brought to the hospital, merely to show that he continued quite well.*

*Remarks.*—In commenting on this case before the Clinical Class, a short account was given of the usual appearances presented by such tumours, and the ordinary coverings and contents were noted. Refer-

* The patient was shown to the members of the Medico-Chirurgical Society at their meeting on the 1st of February (1872).

ence was also made to the deficiency in development of the osseous portion of the spinal canal, as the origin of the name, which of itself conveys no idea of the importance of the contents; and remarks were further made to the following effect:—It is in reality a local dropsy, consisting of a collection of serum within the serous covering of the spinal cord; and, too often for the safety of the patient, there is also a portion of the nerve-structure of the cord, which has left its proper line and lies extended under the serous lining of the sac, just under the skin, running, as it were, round or half-round the circumference of the swelling, which is often globular, as in this instance. It is this condition chiefly which renders interference with such cases hazardous, and which presents, to the mind of the surgeon, the possibility of the nervous matter of the cord being so disturbed, as to lead to very violent and dangerous manifestations of the effects of irritation of such tissues, in the form of convulsions, which not seldom terminate fatally. Even when left to nature, the rule seems to be, that the subjects of such malformations die, and that early—within the first or second year. To this it is well known there are exceptions, still it is the rule. Attempts are usually made by relatives, under professional advice, to protect the part by the use of hollow cup-like shields, lined with cotton, and most carefully attended to; but the result is disappointment, so far as life is concerned. These tumours are far more common in the lumbo-sacral region than in all the other portions of the spine put together; and this is an example of one in the lumbar region.

*Treatment.*—Allusion has just been made to the palliative or protective treatment, as we may venture to call it; and we now turn our attention to the modes of attempting the radical cure, and give shortly our reasons for adopting the plan which has been so fortunate in the present instance. Though it may be true that active surgical interference usually hastens death, yet cases have recovered after various kinds of treatment. The presence of the cord, and the free communication with the serous covering of the spine and brain, are the chief obstacles to success. Inflammation of the cord or its membranes, and gangrene of the cord, causing paralysis, may occur, speedily ending in death. Even when left untouched, the skin often ulcerates, the sac bursts, and palsy and convulsions cause death. A spontaneous cure has been known to take place, the orifice of communication having closed, the tumour becoming a closed cyst, and remaining innocuous, or, it may be, removed. Rupture of the sac has even been followed by recovery. Three modes of interference present themselves—1st, Injection; 2nd, Ligature; 3rd, Excision; and of these three modes it may be said that each of them has been effected by a variety of means and appliances, which it is not my purpose to enumerate at present. Suffice it to say that I resolved to adopt the first of these, as, in my opinion, the least dangerous of the three. It will be noticed that twice I punctured the sac with a grooved needle, and drew off a considerable quantity of the fluid. These may be called tentative measures, to ascertain whether the membranes could be pierced

with safety; and, no suffering or derangement of function having followed, I felt encouraged to use an *iodine* solution of some density. Not that I for a moment imagined that it could not be conveyed along the serous cavity or the serous lining of the spine; still, to my mind, it offered one element of greater security. In forming this solution, I resolved to use glycerine as a solvent; for this reason, that it is a fluid of less diffusibility than a spirituous or even a watery solution. The strength of the solution may be noted, but then it must be observed that, in using it, the sac was purposely only half-emptied of its serum when the iodine solution was injected, so that the then iodurettted contents of the sac presented a very dilute solution. When the repetition of the injection was made, somewhat more of the iodine solution was used; but part of it escaped and was lost, so that, as the report states, it was not possible to correctly estimate the amount retained. A degree of solidification followed the first injection; and after the second it became complete, and now remains so, the part admitting of ordinary handling without inconvenience or discomfort to the child.

A line of treatment very similar to this has been followed by several of the American surgeons, and with instances of success; but statements are discordant with regard to the proportion which the successes bear to the failures. Several British surgeons have also operated successfully in a limited number of cases and by various methods, and most frequently by injection with iodine as the coagulating or stimulating agent; but I am not aware of glycerine having been used as the solvent on any previous occa-

sion, and I may indulge the hope that others may be induced to try it.

From what I have seen of such cases, it is my belief that the fluid should not be allowed to be drained away completely from the sac: this leads to fatal results; and, where a puncture has been made, the aperture, however minute, may be closed and guarded by a layer or layers of collodion, especially when subsequent oozing is feared or perceived.

### Case II.

The child who is the subject of the following report was brought under my notice by Dr. Robert Grieve of this city, about fourteen days after its birth; the most prominent part of the tumour was then slightly ulcerated. The mother was directed how to defend it and dress it properly. The following report of it was written by my assistant, Mr. John Caskie:—

Ann Ross, aged two months, had a tumour situated over the lower lumbar vertebræ. At birth it was small, but had gradually increased in size. Some time ago it showed signs of ulceration; but these healed up, leaving thickening and cicatrices of different colours. On admission, the tumour was as large as a middle-sized orange, and cylindrical in shape. At some parts it was reddish, and at others bluish in tint. It was semi-transparent, fluctuant, and somewhat wrinkled on the surface. It became tense when the child cried. On looking through it several striæ were seen passing over its internal surface. On March 27th, 1872, it was tapped with a grooved needle, and about three ounces of a fluid

resembling cerebro-spinal were drawn off. The child did not suffer; and, as the fluid continued to exude, the opening (which was made upon the right side towards the top) was closed by means of collodion. On April 1st the child was in fair condition, had no diarrhœa, took the breast well, and was in all respects healthy. On April 2nd the tumour was again tapped, and about two ounces of fluid were drawn off. After the tapping the fontanelle was depressed, but by night it was again normal. The child continued well, and no leakage took place. The tumour was dressed with a small piece of oiled lint. On April 5th the tumour was tapped with a small trocar and canula, and half its contents were drawn off. About two drachms of a solution of iodine in glycerine were slowly injected, and the tumour was dressed with oiled lint. The child suffered a little from shock at first, but soon recovered. It continued well during the day, taking the breast well. The fontanelle was for a time depressed. At night the tumour was half-filled, and the fontanelle was nearly nominal. The lower limbs were found, on examination, to be quite normal, as regarded colour and temperature. On April 6th the tumour was about three-fourths of its former size. The contents were thicker, but no distinct coagulation had taken place. The child continued well. On the 8th slight ulceration was observed over the top of the tumour. It was diminished in bulk, and was now only half its former size. The child had complete power over the lower limbs, and was well. The tumour continued to diminish; and on the 16th consolidation had taken place at the upper portion, and the other parts felt firmer than formerly.

The ulceration had not increased, but there was slight discharge of pus from under the skin that covered it. On the 25th the tumour was nearly on a level with the surrounding skin, and only distinguishable from it by its livid colour. Over its centre there was a small triangular depression, from which a small slough was taken by Dr. Morton. The child was in all respects healthy, and had complete power over its limbs.

On the 6th of April, 1872, in the "British Medical Journal," there is an account of the first and only other case which I have treated in the manner here noted, so that both have been successful. The composition of the iodine solution will also be found there stated. The procedure adopted may be here restated thus: 1. Two tentative tappings are made with a grooved needle, with an interval of four or five days between each. 2. The tumour is tapped with a small trocar and canula, allowing about half the contents of the sac to escape, and about a drachm of the iodine solution is injected; rather more was used in this case, but I think less might have sufficed. The after treatment may be said to consist in dressing with some bland substance, as oil or lard; cleanliness and care, so as to avoid local injury or irritation.

Prevention of the complete escape of the cerebro-spinal fluid I believe to be of the greatest importance; hence the use of collodion in this case, which answered the purpose admirably. The presence of this fluid is essential to the functional, if not to the structural, integrity of the spinal cord and brain; and when it is allowed to drain away the child speedily succumbs. On this point I can speak with some experience; besides, soon after treating the case

already published, a child was sent into the Infirmary having a similar tumour in the dorsal region, which was punctured by the grooved needle, but not injected, the spinal fluid continued to exude, and from this alone the child sank and died. The idea of using the collodion did not occur to me till too late, but this mishap caused me to direct my assistant to watch the case now given, and use the collodion if necessary, and it forms an apt illustration of the success of such a mode of closing the puncture; after the second puncture the collodion was not required.

To my mind the satisfaction attending the success of this case is enhanced by the circumstance of its being the second of two cases treated in precisely the same way; and these were the only two treated by the injection of the glycerine solution, which I was induced to adopt, as being less diffusible than a watery or spirituous solution.

How far this mode of treatment may be applicable to the cases in which the congenital defects exist above the lumbar region, I will not at present endeavour to define, but surely it is not too much to say, that if by it we can save lives when we have a lumbar tumour to deal with, we are not to be debarred from attempting to deal with those in the dorsal or cervical regions, provided the extension of our line of operations be prudently conducted.

### Case III.

*Treated by Dr. Watt, and published in the "British Medical Journal" of April 26th, 1873.*

The following case of spina bifida occurred in my practice some time ago, and was considered an

excellent opportunity for testing Dr. Jas. Morton's method of treatment by the injection of a solution containing ten grains of iodine and thirty grains of iodide of potassium in an ounce of glycerine: this, with Dr. Morton's cases, make three treated in this manner, all of which have been successful:—

On June 18th, 1872, Mrs. M'R., an anæmic woman, was delivered of her third child, a small and weak boy of full time. In the position of the three, four, and five lumbar spines was a sessile, semi-transparent, flesh-coloured, fluctuating tumour, as large as an ordinary sized hen's egg, and so sensitive that simple contact with the finger brought on fits of crying, during which the investing membrane became very tense. On firm pressure with the finger, a vacant space, bounded at the sides by bony ridges about half an inch apart, was found in the usual position of the vertebral spines; and, when viewed by transmitted light in a darkened apartment, cords were seen passing near the surface. A pad of cotton-wool was placed over it under a firm binder, and the child was daily seen for a week. It moaned almost constantly, slept little, and took the breast badly. Its legs dangled, and no voluntary attempt was made to move them—slight movement of the toes being the only reflex action from tickling its soles, and the sphincters seemed very weak.

On August 2nd the tumour was much larger, measuring eight inches in circumference. The most prominent part was ulcerated superficially; the lower border overhung the sacrum. Two drachms of clear fluid were removed by Wood's syringe (which was

used throughout), care being taken to avoid the nerve-cords. The cotton pad and binder were replaced; and the child was ordered to have half a teaspoonful of spirits in water every three hours.

On August 3rd the tumour was one-half less; from the needle aperture drops of clear fluid still oozed, and from the soaked condition of the pad and binder a constant escape must have been going on. The child looked much exhausted, but had had no convulsive symptoms.

August 11th.—The tumour was as large as before interference. From its upper edge, a second quantity of two drachms was removed. The child was kept with the face down upon the nurse's knee, with the back uncovered; and the aperture closed in a short time.

August 17th.—A third quantity of two drachms was removed, and half a drachm of Dr. Morton's solution was injected. The child cried immediately. The spirits and water was continued.

August 18th.—The child had slept very little, and appeared very weak. The tumour was unchanged in size, and along the left border a faint blush was present, which faded in a few days.

August 26th.—The tumour was slightly decreased; the membranes were lax, and the fluctuation was less distinct.

September 13th.—The tumour was nearly level with the back, and was replaced by a large half-dried resistent scab. The child was firmer; the legs never moved together, but when the soles were tickled one or other leg was drawn up a short distance. The sphincters were more under control.

February 21st, 1873.—A cake of firm condensed

tissue occupies the site of the tumour. The child was much grown, plump and thriving. It may be remarked that, even although the tumour and the cavity of the spinal membranes communicated, as shown by the nerve-cords in view, and the greatly depressed fontanelle after the first withdrawal of fluid, yet no irritation spread along the cord from the injected solution, and the result must be considered successful.

### Case IV.

*Treated by Dr. Watt, and published in the "British Medical Journal," January 31st, 1874.*

E. G., aged three years, was brought to me in April last, with a spina bifida tumour in the lumbar region, which, wholly covered by true skin, stood out with a prominence of nearly four inches, and measured thirteen and a half in circumference. It was very sensitive to the touch, became tense when the child cried, and palpation discovered a perfectly fluid condition of its contents. It was slightly pendulous when the child was erect, and gave her a ludicrous, although at present rather fashionable, appearance when dressed—the projection at her age being unlooked for.

Her mother stated that it was like a walnut at birth, and had increased gradually; that she walked at two years; was now active, although not firm on her legs, and easily knocked over; that she enjoyed excellent health, but was constantly annoyed by escapes from the bladder and rectum; and that she had always been advised to let it alone.

The treatment of this—my second successful case

—was by the same method as that described in the "Journal" of April 26th last, viz., by injection of Dr. Jas. Morton's solution of iodine and iodide of potassium in glycerine, and was briefly this:—Two tentative tappings with a medium canula, of respectively twelve and ten ounces of clear fluid, were made, with an interval of eight days, both being followed by an irritable and feverish condition of the child, and gradual refilling of the tumour to its original size. Ten days after, other ten ounces were removed, and half a drachm of the solution injected. The opening was instantly closed on each occasion by a layer of lint soaked in flexile collodion. This last operation in a few days made the tumour tender, and caused the child to be feverish, restless, and extremely excitable, with decrease of appetite, milk and soups alone being taken. Ten days after the first injection the tumour was very slightly less, and eight ounces were then removed, followed by the injection of half a drachm of Dr. Morton's solution. This gave rise to even more severe irritative symptoms of the nature described; but a fortnight later showed the tumour only one-third of its original size, although still sensitive and painful when interfered with. At that time about five ounces were removed, followed by a third injection of half a drachm; this caused cessation of any further formation of fluid, and a gradual absorption began which, at the end of twelve weeks from the first interference, presented a roughened, darkened, hardened, and thickened condition of skin, quite normally sensitive to the prick of a needle, replacing the tumour and closing the spinal aperture with an apparently gelatinous mass.

The treatment extended over nearly seven weeks, and the measured fluid removed amounted to forty ounces—a larger quantity, to my knowledge, than from any previously successful case. Half a drachm of the solution was deemed sufficient for each injection, owing to the large extent of the sensitive surface to be dealt with; and the irritative symptoms developing therefrom quite justified the precaution taken.

This, my second case, with Dr. Morton's, make *four* successes, all that have been so treated; and, without appearing too confident of further success, the result is very hopeful and gratifying to the introducer of this method of treatment.

The patient is now very active on her feet (amusing herself, and standing as much consequent fatigue daily as her healthy companions), growing rapidly, and the sphincters are now almost wholly under control, cold sea-water baths being persevered with.

### Case V.

*As reported in the "British Medical Journal" of October 24th, 1876.*

On two former occasions I recorded in the pages of the "British Medical Journal" two cases of spina bifida in the lumbar region, both cured by injecting the iodo-glycerine solution, which I employ; and subsequently my friend, Dr. Watt, of Ayr, has narrated other two cases treated by the same method and the same liquid, and terminating equally happily.

I have now the pleasure of recording an equally fortunate result in the case of a child presenting a

similar deformity, or rather a similar congenital defect, in the upper dorsal region.

On June 22nd Dr. Thomas Smith asked me to see a case of spina bifida with him. The patient, a little girl named Christina Morrison, aged seven weeks, was rather delicate, and did not seem to be thriving as well as the mother could wish. The tumour, which was present when the child was born, was globular in shape, about the size of a peach, not pedunculated, elastic, and semi-transparent. It was situated rather high up, being immediately over the seventh cervical and first dorsal vertebræ, and, as a consequence, greater care was required in its treatment. It was said to have burst, and a quantity of clear fluid to have escaped. The opening seems to have closed; and, the fluid accumulating, the swelling became larger than ever. Some time before the case was brought under my notice, the child was presented in the wards of a large surgical hospital, but nothing was attempted in the way of cure or treatment.

June 23rd.—The tumour was tapped by means of a fine trocar and canula, and a quantity of fluid drawn off. At this tapping, a small quantity of the iodo-glycerine solution was injected, and the puncture carefully closed by means of collodion. Besides a little paleness, no appearance of shock was manifested, the child speedily taking the breast. Towards evening the child became restless, and did not sleep during the night. It cried occasionally. As the morning wore on it became calmer, and then had a refreshing sleep. The fluid again accumulated, showing that the injection had not fully answered my purpose.

On July 3rd the tapping and injection were repeated. This time no effect was produced upon the child. It took the breast, and slept soundly and well, and, in fact, behaved as if nothing had happened more than usual. A good deal of serum and blood escaped after the injection, and it was with much difficulty that I could get the puncture closed. This I ultimately managed by means of a cotton rag soaked in collodion.

July 25th.—The child was visited to-day, and the mother said that ever since the last operation the child had done well; the tumour gradually diminished in size, and the health of the child was greatly improved. It has complete power over its limbs, and seemed to delight in using them. The mother remarked that "the bairn" never enjoyed such good health. The tumour was about the size of a large strawberry, and of light purplish colour. It was quite solid. The surface was irregular and puckered up, something like a child's scrotum which had been exposed to cold; or, rather, like a bulky raisin. On August 18 the child continued well.

This case, and the other four to which allusion has been made, are the only cases which have been subjected to this mode of treatment, and all have proved fortunate. Though the cases are still few, the uniformly successful results are most encouraging, and may induce others to try and increase the number of cures. Success in every instance it would, I fear, be Utopian to expect; but if success become the rule and failure the exception, this mode of treatment may be held to be the safest hitherto made known in the management of such a dangerous congenital malformation.

### Case VI.

*As reported in the "British Medical Journal" for April, 1875, by Mr. Angus, of Newcastle.*

Having lately cured a case of spina bifida, on the plan advocated by Dr. Morton, of Glasgow, I beg to add my testimony in favour of his treatment. On November 1st, 1874, I attended Mrs. T., in labour with her second child, which was born a few minutes after my arrival. It was a plump well-nourished boy. Over the three upper lumbar vertebræ was a tumour, of the size of a peach, which had ruptured with the expulsive efforts of parturition, and part of the contents had escaped from the sac. Careful that too much fluid should not drain away, I applied a pad of cotton wool over the opening, and a broad binder. Two days afterwards it had partly refilled, and, when the child cried, became tense. It was semi-transparent, and had a pinkish appearance, except at the upper part, where, on each side, there was a bluish spot, about the size of a sixpence, which, the mother remarked, were like two eyes. The child cried whenever firm pressure was made over the tumour. The nature of the case having been explained to the parents, they were anxious for the operation to be done. On November 19th I punctured the sac with a grooved needle, and drew off part of the fluid, a cotton-wool pad and binder being applied. The operation was repeated four days afterwards. On neither occasion did the child suffer from constitutional disturbance. On the 28th, after drawing off half the contents through the needle of a subcutaneous syringe from the bluish spot, at the upper and

left side of the tumour, I injected through the same needle half a drachm of the iodo-glycerine solution (previously warmed at the fire to liquefy it). Flexile collodion was painted over the minute opening, and a piece of lint dipped in olive oil, with a pad of cotton wool laid on it; the binder firmly securing the whole. The child cried lustily after the operation, and in about ten minutes suddenly turned pallid in the face, the nurse exclaiming that it was dying. Fifteen drops of brandy in a teaspoonful of water were given, and the little fellow was soon sleeping soundly in his mother's arms.

Gradual thickening of the contents took place, and on January 4th, 1875, complete consolidation was present in every part, except the bluish spot on the right side, where a little fluctuation was felt. Fifteen drops of Dr. Morton's solution were injected into it with the subcutaneous syringe; and by the end of the month the cure was complete. The child is now (March 20th) in good health, the only appearance noticed on the back being a corrugated and hard condition of skin over the site of the former tumour.

The following was read as a communication to the Surgical Section of the British Medical Association at the annual meeting in Edinburgh, August, 1875.

Previously to October, 1871, it was the habit, with others as well as myself, to regard cases of spina bifida as hopeless, and to discountenance the idea of surgical interference. It was well known that they had been dealt with in a variety of ways, some of these reckless and rash, others more or less prudent,

almost all proving in the end unfortunate. It was also known that in some few instances a spontaneous cure had taken place, but these were truly, like angels' visits, few and far between. It was universally admitted that very many died, in truth by far the greater number, the precise numerical proportion being difficult to arrive at; the conviction being general that only a very small percentage lived for any great length of time. As a proof of this the prognosis usually given was a very hopeless one, and seldom falsified by the result.

So entirely had this view of the malformation taken possession of practitioners, that it was the custom to limit their efforts to what was called the palliative treatment, such as protection or defence from injury, carried out in various ways, so as to avoid ulceration and bursting of the sac, with its fatal ending. Up till the date mentioned I was a follower of the do-nothing system; but on October 2nd, 1871, a case was presented in the Glasgow Royal Infirmary, which prompted me to reconsider the question, more especially as the child was otherwise healthy, and I felt a strong desire to give it a chance. On turning my attention to the numerous methods previously employed, too numerous to mention here, it appeared to me that injection was the safest, as that could be effected without permitting the complete escape of the fluid contained in the protrusion. The kind of fluid to be injected next demanded consideration, when it occurred to me that a solution of iodine, less diffusible than either a spirituous or watery solution, would best suit my purpose, as being less likely to permeate the cerebro-spinal fluid with

rapidity, and therefore less likely to cause shock or bring on convulsions. With these views I caused the following solution to be prepared, which is now known as the iodo-glycerine solution :

℞ Iodi gr. x. ; Potassii Iodidi gr. xxx. ; Glycerine ℥j. Solve.

From half a drachm to two drachms of this fluid have been used, according to the size of the spinal protrusion.

Previous to injecting, I considered it prudent to make a tentative puncture, to ascertain whether such interference would be tolerated, and followed this course in the first case and most of the others. To close the openings made both by grooved needle and by trocar, collodion and flexile collodion have both been used, and have served the purpose, so that either may be employed. This mode of treatment was first employed by me in October, 1871, and the details of the case are given in the abstract of a clinical lecture which appeared in the number of the "British Medical Journal" dated April 6th, 1872, after having been shown to the members of the Glasgow Medico-Chirurgical Society on February 1st of that year.

The second case was shown to the same Society on May 30th, 1872, and was published in the journal named on June 15th succeeding.

Dr. J. R. Watt, of Ayr, successfully followed the same plan in two cases ; one of which appeared in the "British Medical Journal" of April 26th, 1873, the other in that of January 31st, 1874, with a well executed photograph of the patient after cure.

Another case treated under my own care is published on October 24th, 1874, in the same journal.

More recently a case has been treated by Mr. Angus, of Newcastle, which appeared in the "Journal" for April 17th, 1875; and in a private note with which he favoured me, he expressed his confidence in the method employed if conducted with due care.

Since the beginning of this month (July, 1875) I have treated another case with the like good fortune, and without a disagreeable symptom. The fluid was twice analysed by Professor Ferguson, of Glasgow, but gave no indication of the presence of sugar.

During the past winter a large cervical spina bifida was presented to me, which was several times injected without any appearance of shock or suffering, but it ultimately succumbed to convulsions caused by the continued escape of the subarachnoid fluid. The domestic circumstances of the mother demanded her presence at home, and unfortunately she was allowed to leave the hospital with her child, and the following night the mischief took place; and, though the flow was stopped, it had already prostrated the child. Every reasonable effort was made to obtain a *post-mortem* examination, but without success. I may mention that several analyses of the subarachnoid fluid withdrawn from the child were made, resulting in doubtful indications of the presence of sugar, or of some glucose matter which reduced copper oxide. At present I have under consideration another instance of this defect in the lumbar region; the child is about ten days old, and it has not yet been interfered with.

But the question may be put: How is the cure produced? or, What is the *modus operandi* of this solution when injected? The reply which most readily suggests itself is, that it is analogous to the

process occurring in the tunica vaginalis, consequent upon the operation for the radical cure of hydrocele.

Though the quantity of albumen in the subarachnoid fluid is small, a coagulum seems to form; adhesive lymph may be produced or deposited, and, at all events, arrest of further collection of fluid results from successful injection. This may be accompanied, or followed, by closing of the opening or channel of communication between the spinal canal and the protrusion.

The anatomy of this defect at once presents itself as a matter for consideration; and on this point I have made some inquiry, and have been rather disappointed to find that anatomists of very prolonged experience had little or nothing to offer me in the way of personal observation of its dissection. Figures of the parts have been given in books, with appropriate descriptions. All authors seem to agree in the local deficiency of the spinal canal, and the protrusion of the covering of the cord, containing a quantity of the spinal fluid and the cord (or portions of its immediate branches), though it has been affirmed that occasionally the latter is absent. I am not aware upon what evidence this statement rests, and meantime prefer to believe in its presence, while awaiting further investigation.

Such belief may induce caution in treatment, though it need not lead us to doubt the possibility of cure, as a recent writer in the "British Medical Journal" seems to do. To assume the absence of the cord, or parts of it, in seven consecutive cases, is so entirely beyond the range of probability as to be altogether inadmissible, while possibly it was

present in all. At the same time I shall feel personally indebted to any one who may procure authentic information on this point, such information as may amount to a demonstration or dissection of parts. I am able to show you here a dorsal case, or rather a preparation of it. The child died, exhausted by the escape of the cerebro-spinal fluid; no attempt having been made towards cure. The cord is seen projecting into the tumour, and attached to its walls. I am glad to say that as yet I cannot show an injected case, that is, a dissection of a case after successful injection, however much that may be regretted in an anatomical point of view. On this point authors write very much as follows, which can be seen in Dr. Churchill's work on "Diseases of Children," and there given on the authority of Dugès: "The condition of the spinal marrow is of considerable interest. Ollivier states that, when the case is not complicated with hydrocephalus, he has generally found the spinal marrow traversing the sac unaltered, except that in some cases it seems lengthened. But if coexistent with hydrocephalus, or if the canal of the spinal marrow be distended with fluid, the cord may be flattened out, as it were, so as apparently to line the sac. In some few cases," continues Dr. Churchill, "the spinal cord seems to have left the canal, and to be contained within the tumour, forming what some authors have properly called hernia of the spinal marrow. This happens only when the deficiency is at the lower end of the spine."

In a lecture on pathological anatomy published in London this year, Drs. Wilks and Moxon write: "A

funnel-like depression or umbilicus on the middle of the tumour, will generally signify the point of insertion of the spinal cord on the walls of the sac." This is worthy of recollection by those about to operate. There is evidently some variety in the position of the cord and the distribution of its branches.

The statistics of the operation at the present time are the following:—This mode of injection has been employed in ten cases. Of these seven have been successful, and entirely so, the cases being uncomplicated by paralysis or any other deformity, and, so far as known to me, remain well.

Of the other three, one has been already referred to as dying from a preventable cause (Case VIII.), a well known danger; another occurred in the hands of Dr. Watt (Case IX.), who states that the child was otherwise diseased at the time; and the third is the case published by Mr. Burton at Liverpool (Case X.), manifestly a case in which the spinal protrusion was but a small part of the whole deformity; though, seeing the child *in extremis*, he considered it his duty to give it even a forlorn chance. We are thus in the position of recording 70 per cent. of cures, and at the worst 30 per cent. of mortality; and, when we revert to the past history of spina bifida, such a result is sufficiently gratifying. I ought to add, however, for the encouragement of others, that all my own lumbar and dorsal cases have proved fortunate hitherto; that they will always do so I am not sanguine enough to expect, though I can now approach their management with less misgiving. I have been exceedingly pleased to find that this method of treatment has succeeded in the hands of others, and have to thank

Dr. Watt and Mr. Angus for the publication of their cases.

In managing a case of spina bifida the following points are important :—

1. The child should be in a thriving condition.

2. Make a tentative puncture with a grooved needle.

3. Draw off not more than half of the fluid contents.

4. Carefully close the puncture by collodion or otherwise, so as to prevent further escape of fluid.

5. When proceeding to inject, use a trocar with canula of a medium size, not too small, otherwise the glycerine solution will not run readily through the canula.

6. The parts must be carefully handled and protected by the nurse, and the injection repeated, if required.

P.S.—At the Edinburgh meeting, in August last, Professor Pirie, of Aberdeen, drew my attention to a wet preparation of a similar case, in which a nerve passed through the sac, and was attached to the outer wall of it.

It will be perceived that Cases VII., VIII., IX. are here referred to, though not in detail. Case VII. was treated by myself; the history of it resembles those already given. Case VIII. will be more fully given for reasons to be stated, while the other was one of Dr. Watt's.

### Case X.

*The following is Mr. Burton's case, as narrated by himself.*

On September 16th I was asked to see a child, born the day before, and said to be "not right." On examining the child, it appeared to be a feeble, not well nourished infant. It had a large fluctuating tumour over the last dorsal and two upper lumbar vertebræ. The legs and feet were much deformed, there being talipes varus of both feet, while both legs and feet were rotated ninety degrees outwards, principally through unrestrained action of the sartorius. Both legs, and especially the right, were flexed on to the belly, by unrestrained action of the rectus. There was paralysis of the levatores ani, so that the natural fold of the buttocks was wanting, and the anus appeared as a slight protuberance on a tolerably smooth rounded surface. There appeared to be paralysis of all the muscles of the backs of the legs and thighs, and tickling of the soles of the feet gave rise to no movements. Fæces appeared to be constantly escaping from the rectum, as the surface of the tumour gave signs of irritation from friction; and, as there were no likelihoods of the child becoming stronger, I decided not to postpone the operation of injecting the solution of iodine in the manner successfully followed out by Dr. Morton. On the 18th, in company with my friend Mr. W. H. Moore of this town, I drew off three drachms of clear fluid, and, taking great care that the needle should not cross the middle line, lest it should come into contact with the spinal cord, I then injected half a drachm of Morton's solution. Neither

part of the operation seemed to give much pain. The child cried a little just as the fluid was being injected, but stopped as soon as the needle was removed; and, after laying on a pad of carded cotton, kept *in situ* by means of a soap plaster, it was put to the breast, and sucked well. I ordered fifteen drops of brandy every three hours. On the 19th I was told that the child had not been well, that it had sucked once only during the night. The tumour had partly refilled. The eyes were fixed and convulsively drawn down, the arms were rigidly extended forwards, and the hands clenched; whilst the child started convulsively on the slightest noise or movement. I ordered two grains of bromide of potassium and four minims of tincture of hyoscyamus in water every four hours. On the 20th, the child had not sucked since I saw it last, and was in severe convulsions. I had it turned on its belly to look at the tumour, which was in about the same state as on the preceding day, and when it was turned back it had ceased to breathe.

It will be observed that this was an unfavourable case for operation, as paralysis was so general; however, no better result could be looked for by letting it alone, and, as the operation had been so successful, it appeared to be the only means of doing it any good. No *post-mortem* examination was made. I have thought it my duty to report the case, as the subject of the treatment of this complaint by injection of iodine is now under discussion, and the method has up to this time met with uninterrupted success.

### Cases XI.—XIII.

*Notes of three Cases of Spina Bifida treated by Iodine Injection, by J. H. Ewart, Surgeon to St. Mary's Hospital, Manchester, and published in the Liverpool and Manchester Hospital Reports.*

"Spina bifida until quite lately has been looked upon as an almost incurable disease, and surgeons have, as a rule, preferred doing nothing to running the risk of causing death by operative interference. Our text-books, too, advocate the same cautious 'do nothing' treatment, and merely name the various plans of treatment that have been employed, only to be followed by various objections to each of them. The profession have therefore much to thank Dr. Morton for, in having revived in a modified form the treatment of spina bifida by iodine injections, and also for the clear manner in which he has stated the results of his operation. As his cases, or rather their treatment, has called forth some criticism, I think the following reports will not be without interest, and will add a certain amount of evidence to that already adduced in favour of the method Dr. Morton advocates. The solution used consisted of

Iodine, grs. x.; Pot. Iodi. grs. xxx.; Glycerine, ℥j.

"Case I.—The child, one day old, was brought to St. Mary's Hospital on October 29th, 1874, suffering from spina bifida situated in the lumbar region. Nothing was done at the time, and the child was seen again on the following day, when the tumour was tense and the surface ulcerated. A fine canula was introduced, and some pale straw-coloured fluid drawn off, and a pad applied.

"November 4th.—Tumour refilled, surface ulcerated. At this time the measurements of the tumour were as follows:—Long diameter, $1\frac{7}{8}$ in.; transverse, 2 in.; circumference, $2\frac{1}{2}$ in.; the lower border of tumour, $1\frac{1}{2}$ in. from anus. The tumour was punctured at its lowest part, and about half an ounce of pale fluid, almost white, drawn off. It was intended to inject half a drachm of Dr. Morton's fluid into the sac, but, owing to a defect in the syringe, and the thickness of the fluid, not more than fifteen minims found its way into the sac. The injection seemed to cause no inconvenience, but I should add that no nerve structures could be demonstrated in the sac.

"November 6th.—Tumour partially refilled; feels harder, especially at and around the point of puncture. Canula again introduced, and half an ounce of deep straw-coloured fluid withdrawn. Thirty minims of Morton's fluid were injected into right side of tumour, and no bad result followed.

"November 11th.—The mother states that the child was convulsed for half a day after last operation.

"November 13th.—Child seems perfectly well; tumour harder.

"November 27th.—Thirty minims again injected.

"December 3rd.—After last injection the child was slightly convulsed; ulcerated surface healed; tumour feels more solid. Injection repeated.

"January 6th, 1875.—Lower part of tumour consolidated and shrivelled; upper portion of skin thin and distended; the canula was introduced at this point, and some thick gelatinous fluid escaped. Thirty minims of solution injected.

"January 16th.—Tumour firmer; a small portion of skin in centre ulcerated; applied on lint a saturated solution of tannin.

"June 10th.—Since last note nothing has been done to the tumour beyond applying the tannin to ulcerated surface. The tumour is quite hard; pressure on it causes no pain. The child's lower limbs seem properly developed, and reflex action is present.

"October 23rd.—Child was seen to-day, having been in the country since last report. Tumour is quite firm, the upper part being somewhat prominent. The child's legs seem weak, and it has slight talipes varus of both feet; this condition of the feet had hitherto escaped my notice, but the mother states that it has existed since birth.

"Case II.—A healthy-looking female child, one day old, was brought to St. Mary's Hospital on January 16th, 1875, suffering from spina bifida. The mother is twenty-three years of age, the child her first; she went her full time, and had a natural labour, lasting seven hours. The tumour is situated in the lumbar region, and is soft and fluctuating (instead of tense as in Case I.), is broader at its upper part, and hard lower (shaped like the heart in a pack of cards, without the notch), and measures transversely two and a half inches, longitudinally two inches. The tumour was tapped on right side, and three drachms of highly albuminous fluid withdrawn; half a drachm of Morton's fluid was injected, and with no apparent discomfort to the child.

"January 20th.—Skin over the tumour considerably thickened; child has experienced no inconvenience from previous tapping, which was therefore repeated,

and two drachms of fluid withdrawn, half a drachm of Morton's fluid being substituted.

"January 27th.—No ill effects from the previous proceedings; tumour decidedly firmer; surface ulcerated; injection, and lint soaked in tannin solution applied.

"February 10th and 17th.—The child was seen on both Tuesdays, but nothing done beyond paying attention to the superficial ulceration of the tumour.

"February 20th.—The ulceration has healed; base of tumour contracted and puckered; apex fluctuating, and skin thin; at this point it was punctured, but no fluid escaped, and ten minims of Morton's fluid were injected.

"June 3rd.—Since last note the tumour has not been touched; the child was seen to-day, the first time for two months, and found suffering from hydrocephalus. The mother states that her child was quite well a fortnight ago; the tumour is hard and contracted, and resembles a puckered scrotum.

"June 4th.—The child died. No regular *post-mortem* could be obtained, but the lower part of the spine was removed for examination. I regret to say that the gentleman who kindly undertook the examination of the specimen has been prevented by pressure of work from completing his task. I hope, however, at some future time to place the result of the examination on record.

"Case III.—On June 23rd, 1875, a female child, one day old, was brought to St. Mary's Hospital with spina bifida. The mother states that this is her fifth child, the four preceding ones being perfectly healthy. The tumour occupies the lumbar

region, and is flat except at the upper part; skin very thin, the superficial veins large; tumour measures one and a half inches both ways. Reflex action is wanting; tickling the feet produced no movement. Tumour had been ruptured, probably in the labour, and fluid was exuding. A canula was introduced on left side of tumour, and half a drachm of Morton's fluid injected, without any apparent inconvenience to the child; a compress of lint soaked in tannin solution applied.

"June 25th.—Child seems perfectly well; moves its legs. Tumour firmer; no oozing; dressing re-applied.

"June 30th.—Child reported as being restless; seems well. Tumour firmer; surface ulcerated; dressed with zinc ointment.

"August 10th.—Since last report the child has been seen several times, and dressing of zinc ointment applied; child has been perfectly well; tumour is quite hard, and level with the surrounding skin. Has very little improvement in legs; holds them abducted and crossed as *in utero*. The child died suddenly the same day at 10 p.m., in convulsions. No *post-mortem* allowed.

"Out of three patients, therefore, two died, and, even allowing that the treatment caused death, the success of the one case, and the almost hopelessness of a spontaneous cure in spina bifida, would, to my mind, justify the operation.

"But was the operation, or were the effects of the operation, in either case the cause of death? I think one may answer in the negative. Surely the length of time that elapsed between the last operative

interference (five months in the one case, and six weeks in the other) would put this out of the question; moreover, Case II. died of chronic hydrocephalus, which disease, we are told, is a frequent complication of spina bifida. In the 'Lancet' of October 16th, 1875, Mr. West, of Birmingham, reports a case of meningocele associated with spina bifida, which he cured by simple tapping, no injection being used; the child died some months afterwards of chronic hydrocephalus, and Mr. West considers that the means employed for the cure had no part in producing the morbid condition which caused death, and in this opinion I think all must concur.

"The exact cause of death in Case III. is uncertain. The child was seen on the day of its death, and showed no appearance of disease. Had the treatment contributed to the fatal result, this would, I think, scarcely have been the case.

"So, granting my conclusions to be correct, the three cases now reported really amount to three cases of spina bifida cured by injection of iodine solution. And this brings me to the question of the solution to be used. The ordinary tincture of iodine has hitherto been the fluid generally employed, but the results with this have been far from satisfactory. Is the spirit in the tincture the cause of failure?—as it differs materially only in this respect from Dr. Morton's fluid. Holmes, in his 'Diseases of Children,' relates a complicated plan of injection made use of by Brainard, of Chicago, in seven cases, the solution used being composed of

Iodine grs. v., Pot. Iodi. grs. xv., Aqua ℥j.;

and Brainard claims success in all the cases not associated with hydrocephalus, namely, three. The same author tells us that M. Debout cured five cases out of ten with Velpeau's solution (one part of iodine, one part of iodide of potassium, and ten parts of water).

"Dr. Morton's solution will be seen to differ from Brainard's and Velpeau's in the quantity of iodine used, and the article (*? solvent*) employed, and its only drawback is its thickness, causing a difficulty if a small canula be used. This trouble occurred to me in Case I.; but I see that Dr. Morton, in a communication read at Edinburgh before the British Medical Association, especially points out this inconvenience, and advises the use of a medium-sized canula.

"Then, as to the child's state of health, and the age at which the operation may be undertaken. Dr. Morton says, 'The child should be in a thriving condition.' May I suggest that the time for operation would depend more upon the state of the tumour than upon the state of the child's health? A very tense tumour, or one already ruptured, should surely be treated at once; and I would advocate the same expedition in all cases, seeing how easily the tumour might be ruptured, and the disastrous effects of any great quantity of cerebro-spinal fluid escaping. Indeed, Dr. Morton owes the death of what would probably have been a successful case to this very cause, and I found no bad results from the early treatment of my cases.

"Is a tentative puncture necessary? I think not. It may be useful, to prevent the rupturing of a tense

sac, and for this reason was resorted to in Case No. I., as no solution was at hand. The plan I have adopted is to puncture the tumour at its side with a fair-sized trocar and canula, allow the sac to empty itself to a certain extent, and then, with a syringe fitting the canula, inject the fluid. This method is simple, and requires only one puncture.

"The number of times that the operation is to be repeated is also of some moment, as each additional puncture must to some extent increase the risk to life. Looking over the reported cases, I find only once was it considered necessary to repeat the operation more than twice; once often sufficed.

"These facts, and the success of my third case with one injection, have forced upon me the conclusion that my six punctures in Case I., were an excess of zeal, and in future I shall certainly pause a longer time than I have hitherto done before repeating the injection.

"These three cases bring the number treated by Dr. Morton's method up to thirteen. Out of these, *eight* are reported as cured and living, and in good health; *two* cured, but dead from causes not connected with the operation; and three died whilst under treatment —a total result most encouraging."

Nothing can be more gratifying to me than to learn of the success of this treatment in the hands of others; and though these remarks of Dr. Ewart's are somewhat laudatory, I trust that my repetition of them will not be ascribed to that quality alone. I regard them as worthy of quotation, because the criticism which he offers is extremely fair, and is such that, I am glad to say, I can concur in the

whole of it. With a view to the ultimate success of the case, it is important that the child should be in a thriving condition; but, when immediate danger threatens from the condition of the tumour, it is quite proper to give the child the chance of being saved. In advocating a new mode of dealing with spina bifida, it seemed to me to be a right thing to define narrowly the characters of cases likely to prove successful, and to do this in such a way as to lessen the chances of discredit being brought upon our proceedings, by attempting the cure of cases otherwise hopeless. This was the line of reasoning pursued in my own mind when writing and speaking on my earlier cases. The tentative punctures I have now abandoned as unnecessary, and at first they were used as feelers, to make sure that interference would be tolerated. From what I have already seen, I am satisfied that one injection will frequently prove sufficient.

### Case XIV.

*Case of Spina Bifida, treated by the Iodo-Glycerine Solution, and published in the "Lancet" of December 2nd*, 1876.

In the beginning of September last (1876), Dr. Milroy, of Kilwinning, informed me by note that, a few days before, he had attended at the birth of a child, which was the subject of spina bifida in the lumbar region, and wished to know when it would be proper to operate upon it. To this the reply was, that it would be well to allow the child to be fairly over the accidents of birth, unless there was reason to fear the speedy bursting of the tumour, and the consequent draining-off of the spinal fluid.

When nearly a fortnight old, the child was brought to Glasgow, to be under my care, and this was then done from a fear that an ulcerated or abraded surface on the most prominent part of the tumour might possibly result in perforation of the sac and escape of the fluid, which is known to be so fatal. This abraded surface was more than an inch in diameter.

On September 14th I saw and examined the tumour, and on the day following operated on it by puncture and injection of the iodo-glycerine fluid, which I have used and recommended for such cases. As the sac was neither very large (the size of an ordinary peach) nor very full, little escape of the serous fluid was permitted, and about half a drachm of the iodo-glycerine solution was injected. Collodion was, as usual, applied to the opening, and over that a square inch of lint dipped in collodion, which effectually closed the wound. No disagreeable symptoms followed; the sac seemed in part to solidify, and soon appeared to be about half the size it was previous to the operation.

Watching it from day to day, it did not seem to shrink readily or so quickly as I could wish, and on September 26th it was again punctured and injection attempted. The size of the swelling at this time was so much reduced that I was very cautious in pushing the trocar into it, and the canula had so little hold and space that it slipped out when I tried to inject a little of the solution by placing the nozzle of the syringe in the opening; but I suspect that very little, probably only a few drops, obtained admission. Collodion and lint were applied as before. Next

day the whole tumour seemed slightly inflamed, and from that date has continued gradually to solidify. By the 4th or 5th of October the abraded surface had completely healed, and on the 12th the parents were permitted to return with the child to their home in the country.

It occurred to me that collodion might aid in producing, or favouring, that corrugation of the skin which is known to take place in favourable cases, and a piece of lint covered with it was laid over the tumour. Whether this expectation may be well founded, we cannot at present say, but the application is sufficiently safe, and, indeed, somewhat protective.

The following is, in substance, the report of it sent to me on October 24th :—"Child well; tumour shrunk a good deal. Has a thick cord of skin, a little raised, all round it. There is still about the breadth of a shilling of thin bluish-coloured skin covering the centre of it, but it feels firm to the touch underneath, and is nearly quite flat."

This is now the fourteenth case of spina bifida (of which we have any account) which has been subjected to treatment by injection of the iodo-glycerine solution, and of these eleven have proved successful. In all the lumbar cases which I have treated it has been uniformly fortunate, and lumbar cases are known to be much more numerous than dorsal and cervical put together.

CASE XV.

*Treated by Dr. Berry, of Wigan, and published in the "Lancet."*

SIR,—On February 9th, 1876, Mrs. C—— was delivered of a male child, which had spina bifida in the lumbar region; the skin over it was quite firm, and a cure was attempted by strapping and sheet-lead as a pad. This plan failed. I resolved to treat it by injection with the iodo-glycerine solution of Morton

May 3rd.—Child now three months old; tumour larger and conical, having a circumference at the base of seven inches, and from base to apex a height of one inch and a half. I introduced a small trocar, drew off about four drachms of serous fluid, injected about one drachm of the solution, and sealed the small opening with a pledget of lint and collodion. The child was somewhat restless, and cried at times during the night, although there was very little fever. The tumour seemed to get more tense for a few days, and the walls more solid.

May 14th.—Tumour smaller. I drew off from half an ounce to six drachms of fluid, and repeated the injection.

May 21st.—Tumour smaller; feels more solid at the base. I drew off about four drachms of fluid, and repeated the injection.

May 31st.—Tumour is much smaller; communication between it and the cord closed, for it cannot be emptied by pressure, and when the child cries there is no perceptible increase. I again drew off about four drachms of fluid, and re-injected the tumour.

July 20th.—The tumour is solidified, and has shrunk to about one-fourth of its original size. It will, I have no doubt, shrink more; but the cure may be said to be complete, as there is no communication between it and the membranes of the cord.

The child is of poor stamina, and is brought up with the bottle. This artificial feeding appears to upset its stomach every now and again, for it suffers periodically from vomiting and purging.

The child died from marasmus on September 29th. At the time of its death the skin was a little prominent over the seat of the tumour. The cure was, however, perfect.

### Case XVI.

Mary Jennings, aged seven weeks, was admitted into the Glasgow Royal Infirmary on January 4th, 1877.

Patient has a spina bifida tumour in the lumbar region, with paralysis of both legs, and talipes varus of both feet, and is altogether a weakly child. The mother states that a fortnight after the birth of the child there was an escape of thin dark blood from the tumour, and that the tumour, which before had been large, and darkly transparent, has since become smaller and more like the surrounding parts.

January 14th.—Child is improved in health, and the tumour showing signs of spontaneous cure. The mother was directed how to dress the part, and to take the child home and return in a few weeks. February 11th, patient was readmitted, and on the 3rd of March again left the hospital. On the 13th the child was again presented, and the report is—

"The child has improved in health, and has power of movement in the lower extremities"; and on the 17th left, promising to return.

Though it is not positively ascertained that spontaneous cure took place in this instance, yet all the indications of its likelihood were present. It will be noticed that, from some cause or other (it might even be an injury), some change had taken place in the tumour, causing the discharge mentioned, the diminution of the tumour, and the approach to an appearance like that of the skin around it.

### Case XVII.

Isabella Harper, aged nine weeks, was admitted into the Glasgow Royal Infirmary on March 31st, 1877.

Patient is suffering from spina bifida. Shortly after birth there was said to be a depression in the lumbar region, about the size of a florin, which in two days became swollen and prominent.

At first it was oval and egg-shaped, then it became round and about the size of half an orange. At present it is circular, three inches in diameter, and an inch and a half in height. To the touch it is fluctuant; purple and yellow in colour, becoming red at the base. Slight movement in the lower extremities.

April 2nd.—Child operated on in the theatre by Dr. Morton. A small trocar and canula introduced, and a portion of the fluid drawn off, which was set aside for analysis. The tumour was then injected with a drachm of the iodo-glycerine solution (Morton's) and the puncture closed with lint and collodion. After the operation the tumour had a flaccid and

collapsed appearance. The lower extremities were not seen to move.

April 3rd.—4 a.m.: Child restless and cross, refusing milk, and evidently suffering. 10 a.m.: Child easier; tumour has a tense, red, swollen, inflammatory appearance.

April 4th.—Child irritable, cross, with tendency to convulsions. Tumour almost entirely red; no purple patches.

April 5th.—Child much better; takes its food well, and sleeps much. Liebig's extract of meat made into soup, and mixed with milk, sugar, and water, was ordered.

On the 6th tumour is said to be red and tense, and on the 7th described as smaller and flaccid.

8th.—Child eating and sleeping well. Tumour more flaccid, lighter in colour; cuticle is thickening.

Similar reports are entered in the ward journal on the 10th and 16th; and on the 21st: Tumour fast disappearing. Child in good health, but no perceptible movement in lower extremities.

### Case XVIII.

*History of a Case of Lumbar Spina Bifida, presented at the Royal Infirmary on 1st August, 1877, and, to suit the circumstances of the mother, then operated on, as given by Dr. A. Muir Smith, of Govan.*

Dear Sir,—The following is the history of the child Allen, who was treated on the 1st inst. (August) for spina bifida:—

"The day after the operation, the mother noticed the paralysis of the lower limbs (previously perfectly healthy), which still continues. Along with this

there was apparently paralysis of the sphincters for a few days, as both fæces and urine were constantly dribbling. The bowels have improved under the use of chalk mixture, and the urine is also better retained. The child looks pale and emaciated, and little likely to survive. It moaned much for three days after the operation, and still seems pained when moved. It eats (*drinks ?*) heartily and sleeps a great deal—the mother fancies, too much. The tumour is somewhat firmer and smaller, the skin enclosing it being slightly puckered, instead of being tense as when seen by you. I have seen the child twice or thrice a week, and have directed the mother to take it to the Infirmary for your inspection the first fine day, at the same hour as before."

After alluding to the unfavourable domestic circumstances in which the child was placed, owing to the conduct of the father, and the slovenly habits of the mother, the note thus concludes :—

"The operation seems so far successful as regards the tumour, although the general health of the child seems lower than before.

"With, &c.,

"I remain, yours truly,

(Signed) "Alexander Muir Smith."

My remembrance of this case is, that the tumour was not large, and the child puny and ill-nourished—a not unfrequent condition in patients of a low grade. In regard to paralysis as a result of interference, that, I suspect, we must lay our account to meet occasionally; if seldom, that is all that we can reasonably hope for.

CASE XIX.

Margaret Stewart, aged two and a half years, was admitted into the Glasgow Royal Infirmary on December 4th, 1877. This patient was brought to the hospital to be treated for a tumour situated over the upper part of the sacrum and lower lumbar vertebræ. It measures about four and a half inches either way. The skin over it is natural in colour. The tumour has been present from birth. When first observed it was small in size, but it has grown with the growth of the child. The general health is very good, and the girl is able to run about freely.

A consultation having been called, it was agreed that it was a case of spina bifida, and, with the consent of the parents, Dr. Morton decided to operate. This was done on December 7th, when, having made the preparations usual on such occasions, after tapping and drawing off a small quantity of the fluid, about a drachm of the iodo-glycerine solution was injected, and the puncture sealed with collodion. Patient, who had given only slight evidence of pain when the puncture was made, was observed to be expiring: there was no perceptible convulsion; it seemed as if the shock of the injected fluid had at once paralysed the powers of life.

*Post-mortem Examination reported by Dr. Foulis.*—Tumour in sacral region measured four inches and three quarters either way, and was dimpled; adipose tissue very thick over tumour. Only the tumour and parts adjacent were removed, and from the sac reddish fluid and blood-clot escaped. On examining the parts removed, consisting of the last lumbar and

four upper sacral vertebræ, together with the sac of the tumour and part of the cauda equina, it is observed that the arch of the last lumbar vertebra is expanded, so as to enclose a larger foramen than natural; the arch, however, is quite complete. The arches of the sacral vertebræ are awanting, and here there is a wide gap, from which the tumour projects in the form of a globular bag, connected, as by a pedicle, to the lower end of the spinal membranes. The wall of the sac is fibrous and firm. Closely connected to the surrounding tissues externally, its inner surface is smooth and shining. From the pedicle of the sac there stretch nine or ten nerves, which pass across the interior of the sac, and are inserted into the posterior wall at various points. Traces of blood-clot can be seen lying among the nerves at the neck of the sac. A bristle passes easily from the sac into the membranes of the spinal canal. The site of the puncture by the trocar did not touch the point of insertion of any of the nerves.

*Remarks.*—This case affords several valuable lessons. In the first place, it is natural to conclude that, the further such protrusions are from the encephalon, the less likely are the subjects of them to be endangered by surgical procedures. It will be admitted that experience has given sanction to this deduction, which may be accepted as a general rule, for nobody now can doubt that lumbar cases can be manipulated with greater safety than dorsal or cervical protrusions. This immediately fatal result is a proof that it is not always so,—that there are exceptions; and, even among those, instances which produce little inconvenience except from the size of the swelling. Secondly,

we would naturally conclude that, when the spinal deficiency occurs so far down as the sacrum, the opening of communication with the spinal cavity (I mean the intra-membranous space) would be smaller; and possibly this may be true in a number of instances. That a degree of patency greater than usual existed in this girl's spinal column, was made evident by the post-mortem examination. Several preparations shown to me by Dr. Foulis, our pathologist, suggest the thought that such a state of parts may not be very rare.

Then again we may be allowed to criticise the operator, and no one will object to the severity of the criticism, seeing that I occupied the position. Relying upon past immunity, in the treatment of lumbar cases especially, and emboldened by success, the operator probably injected rather too much fluid, and, it may be, with less caution than in previous instances, just as familiarity with danger is known to render men less careful. The subsequent dissection showed that the puncture fortunately was made at the part where there was least of the nervous expansion; and though the fluid was slowly injected, it is possible that more of it was used than was required or was consistent with the production of so slight a degree of shock as to be safe. To expect that no such cases would ever occur would betray an amount of ignorance of the delicacy of the structures concerned, and of their importance to life: our duty is to take every precaution and use every means to render them as few as possible.

CASE XX.

Charlotte Bolton, aged eight months, was admitted into the Glasgow Royal Infirmary on the 19th March, 1878. The child has a tumour in the lumbar region, about 3 inches long and 2 inches broad, apparently a spina bifida protrusion.

March 22nd.—Dr. Morton punctured the tumour with a trocar and canula, and drew off about an ounce of fluid. He closed the puncture with collodion, and over that laid a small piece of lint saturated with collodion; then applied a pad of lint over the whole tumour, and then a flannel binder.

April 6th.—The tumour is still about the same size, and still fluctuant. Dr. Morton again punctured it, drew off a small quantity of the fluid, and injected half a drachm of the iodo-glycerine solution, closing the opening, as formerly, with collodion, and also applying a piece of lint moistened with collodion.

April 11th.—The tumour is a little smaller and firmer. Patient has had no bad symptoms since the operation, but if anything seems more lively than it was previously, and to-day was dismissed for a time.

May 1st.—The child was brought up to-day by its mother, who says that it has been keeping well since it was dismissed. The tumour is in the same condition as when she went out. The mother was advised to bring the child up on an early day, and, if necessary, have it again operated on. It is now safe from the fatal danger of the bursting of the tumour, and escape of spinal fluid.

CASE XXI.

In July, 1878, a gentleman from the east of Scotland called upon me, stating that a child of his, now eleven months old, had been the subject of spina bifida.

The medical attendant, though at first disinclined to interfere, was induced to operate after having perused my small book on the treatment of this defect, and to his kindness I am indebted for the following record of the case:—

"X. was born in August, 1877, a well-developed, healthy female child, but had a small tumour situated opposite the fourth and fifth lumbar vertebræ, about the size of a full grown plum, presenting the usual appearance of a spina bifida. Its covering on the centre was thin and glistening, and of a bluish colour; towards the outer border it was thicker, more resembling the surrounding skin. The tumour gradually increased in size, notwithstanding the child grew vigorously. Having read Dr. Morton's published cases successfully treated by injecting the tumour by iodine suspended in glycerine, and thinking mine a favourable case, I determined to operate. About the beginning of November, when the child was nearly three months old, I punctured the tumour with a moderate-sized trocar and canula, and more than half its contents were drawn off, the fluid being of a pale straw colour; after which I injected half a drachm of the 'iodo-glycerine solution.' I then carefully withdrew the canula, and at once placed a small piece of lint, soaked in a strong solution of collodion, over the puncture, to prevent the escape of the injected fluid.

This caused the child to cry bitterly for a time, but no serious symptoms followed. The tumour gradually became red and inflamed, but this did not spread beyond to the surrounding parts. In about a week after, all irritation had subsided, and the child seemed to be in good health. The tumour was less in size than before the operation, especially on the side where punctured. Again, about the 1st of January, 1878, I punctured the tumour on the opposite side, and treated it as formerly. All went on well as before until the month of February, when the child suffered from teething, the anterior fontanelle became enlarged (bulged ?), and the left eye squinted. At this time I simply drew off all the fluid that was in the tumour, which seemed to give relief. It never filled again so full, but in April I again emptied the tumour, and injected it as before. All went on well, and now the tumour is perfectly solid, and the child in good health."

On August 14th, 1878, the child was shown to me, and I noted as follows:—The cure is complete: the child is plump and thriving, and has complete power of limbs and sphincters, except some incontinence of urine, and I learn that at this date (October 10th, 1878) it continues so.

In the year 1880 this child was again shown to me, and then remained well. This record remained as above until, on June 25th, 1884, I wrote Mr. ——— asking if he could send his daughter to Glasgow to be seen by Mr. Parker, when I received the following reply :—

"June 27th, 1884.

"My Dear Sir,—Your letter of the 25th inst.

reached me here, where I am now living. I regret it will not be convenient to bring my girl to Glasgow on Monday, but if you or the party referred to in your note were to visit us, Mrs. ——— or I would be glad to let you see her. In this case, however, give us some notice beforehand, please, in case of being absent from home. I have much pleasure in stating that my daughter is in excellent health. So far she has escaped entirely infantile diseases, and is as nice a little lass as you could find in many parishes. She runs all over without any support whatever, and, although very heavy for her legs, she rests little all day long, being ever on the move. We have discarded all bandages or other support, excepting on one limb; on that she has steel supports on each side up to under the knee. As she grows in size and strength, however, the other matter of which I spoke to you—non-retention of urine—does not wear off. This is a source of much trouble and anxiety to us, and we would be glad if something could be done for that. We are happy, notwithstanding, to see her so well and strong otherwise. We were very dubious (especially after the unfavourable opinion of our own doctor) if she would ever pull through. Thanking you for the interest you manifest in her case, "I remain,

"Yours faithfully,"

"Dr. Morton, Glasgow."

I am not at liberty to give the name. This is a case in which the father of the girl obtained a copy of the first edition of this book, and prevailed upon the local surgeon to undertake the operation, which he conducted successfully.

CASE XXII.

Annie Maitland, aged three weeks, was admitted into the Glasgow Royal Infirmary on May 9th, 1878. Report: Child has a large swelling in the lumbar region, almost as large as a cocoa-nut; it is fluctuant, but tense, particularly when she cries. This morning Dr. Morton removed some clear and colourless fluid with a trocar and canula. Some difficulty was experienced in closing the aperture with the collodion, but that was ultimately effected by passing a fine wire through the edges, and twisting it. On the 15th the tumour was again punctured, three ounces of clear serum removed, and half a drachm of the iodo-glycerine solution injected; oozing stopped by collodion. After operation the child was very restless and cried a good deal. The whole of next day she gave convulsive starts at times. 18th.—Tumour tolerably tense; has swollen up a little. 20th.—Child much better and quiet. Tumour has shrunk considerably. 24th.—Tumour very red, and larger. 28th.—Tumour as large as at first, red over surface, and tense; tapped, and three ounces of fluid removed, which was examined and found as follows:—"Fluid alkaline, specific gravity 1009; contains albumen, chlorides, no sugar; slight deposit, flaky, coagulated lymph. Microscope shows pus and lymph cells." The child afterwards became very restless; its eyes twitched at intervals, and its hands and feet got very cold. It would not take any milk on May 31st, and on June 1st it was still in the same state. This morning the tumour gave way at the site of a former puncture, and a little fluid escaped

before it could be stopped; it was of a semi-purulent character. June 2nd.—The child got gradually weaker, and died at twelve noon to-day.

*Post-mortem.*—Permission was given to examine the back. On turning the child over, soon after it died, the tumour burst, and a quantity of purulent matter escaped. Tumour in the lumbo-sacral region, size of a large orange, red, and full of coagulated lymph and purulent fluid. It was removed *en masse*, and the following report is taken from the museum catalogue:—"Spina bifida—lumbo-sacral region; child five weeks old. It was injected with solution of iodine by Dr. Morton, and this has set up acute inflammation and suppuration within the sac, which was lined with pale yellow lymph and full of pus. The sac is shown cleared out, and the nerves of the cauda equina can be seen to cross it. They too were thickly coated in lymph. The aperture into the spinal canal, shown by a bristle passed into it, was occluded in lymph, the whole of which has been cleared out. The inflammation seems to have been limited to the sac. The bodies of the vertebræ have been divided with the knife, to show their relations to the cleft, and it would seem that the last two lumbar and the upper sacral vertebræ are involved."

*Remarks.*—This seemed a promising case for operation, and such was the opinion given by myself, when I first saw it in consultation with Dr. Paterson, of Partick. After operation the early part of its progress was satisfactory, namely, its slightly swelling and then shrinking, but by-and-by, suppuration was suspected, and the worst results were feared. These

fears, however, were rather in the direction of spinal meningitis, ending in convulsions—a termination much more speedy than that by exhaustion; moreover, it was a matter of doubt whether the opening of communication with the spinal canal had been occluded by lymph. Nothing is easier than to be wise after the event, but it is now quite evident that the abscess (for latterly it was such) should have been opened, to lessen irritation and prevent exhaustion. Relatively to the age, size, and strength of the child, it was large and painful, and consequently prostrating. So much importance is justly attached to prevention of the drain of spinal fluid, and so fatal is this drain, that every one fears to do anything to cause it; hence the error, if it was such, in dealing with this patient. In cases where suppuration has occurred, may it not be justifiable to run the risk of the draining away of the spinal fluid by making a free incision into the tumour, and evacuating the abscess which has then formed? Surely it affords one additional chance, though it may not be a great one. Assurance of the closure of the spinal communication, if we could attain it, would be a great help. Upon this point the following case has some bearing.

### Case XXIII.

On January 25th, 1878, the following case was laid before the Clinical Society of London (Mr. Callender, President, in the chair), and I take it from the "Lancet" of February 2nd, 1878:—"Mr. A. Pearce Gould read notes of a case of spina bifida, treated by the injection of iodine. The patient was

born with a tumour the size of a hen's egg, situated over the last lumbar and upper sacral vertebræ ; this slowly increased in size, while the skin over it thinned. When eighteen months old, he was brought to the Hospital for Sick Children. The tumour was then the size of a cricket-ball, sessile, with all the usual characters of spina bifida. An opaque band was seen along the middle line of the lower three-fourths of the tumour. There was no paralysis or other deformity. The head was large ; the fontanelle was widely open, becoming bulged when the tumour was compressed. On September 18th, 1877, the tumour was tapped with a small hydrocele trocar, at the upper part, just to one side of the middle line. Six drachms of fluid were removed, and half a drachm of Morton's iodo-glycerine fluid was injected, the opening being closed with collodion. For the first few days all promised well,—the tumour appeared to be firmer, smaller, and less translucent; but at the end of a fortnight it had returned to its former condition. On October 5th the operation was repeated, one drachm of the solution being injected; but this was attended with a similar result. On November 5th it was injected for the third time, two and a half ounces of fluid being removed, and two drachms of the solution injected. The sac became very tense, red, hot, and tender ; fluctuation persisted for a week, but on the ninth day a maked change was noted: the tumour was smaller, flaccid, elastic, but not fluctuating, and it did not become tense when the child cried. The wall of the sac became gradually firmer and thicker, and the tumour shrank. On December 14th, there being distinct fluctuation in the now thickened cyst, it was again tapped, and emptied

by the removal of six drachms of a yellow, viscid, and highly albuminous fluid; it was evident that the communication with the spinal canal was completely obliterated. One drachm of the iodine solution was injected into the sac, and firstly manipulated, and then allowed to escape. The tumour since then gradually shrank, and now presented a thick pad of skin, quite dense at the lower part, softer above, where there was a small spot which still fluctuated; from this Mr. Gould withdrew about half a drachm of yellow turbid fluid two days ago. There was no paralysis. The fontanelle was closing up. After each operation the temperature rose to 101° to 102·8°, and continued above the normal from two to six days; there was no convulsion or other sign of interference with the nervous system. The after-treatment consisted in thickly smearing the tumour with collodion each morning, and supporting it with wool and a bandage. The tumour evidently communicated very freely with the spinal canal, and most probably contained the spinal cord or nerves. Mr. Gould had examined twenty-three specimens of spina bifida, and found nerves in the sac twenty times, two cases in which this did not occur, and one case in which it was doubtful. The nerves or cord generally occupied the middle line—the position of the opaque band observed in this case. The absence of paralytic symptoms by no means favoured the opposite view. The fluid removed at the first three operations was colourless, becoming slightly turbid on standing, specific gravity 1071, faintly alkaline, containing a trace of albumen, chlorides, and phosphates. With Fehling's copper solution it gave no reaction; but Dr. Dupré analysed it, and, after concen-

tration, was able to get distinct evidence of the presence of sugar. Because sugar could not be detected in spina bifida fluid and that escaping from the skull in cases of fracture, it must not therefore be supposed to be absent, unless the tests be applied to the fluid after evaporation. Dr. Morton's treatment had now been applied several times, and in twelve out of fifteen cases with success. As to the value of the glycerine, Mr. Gould stated that on pouring some of the 'iodo-glycerine' on to some of the cerebro-spinal fluid in a narrow glass it was found to sink to the bottom at once, and not mix with it; and he was of opinion that the same thing occurred in injecting the tumour, for the fluid that oozed from the puncture after the injection was quite unstained with iodine, and the action of the injection had been much more potent at the lower part of the sac. Although the mode of cure resembled that seen in the radical treatment of hydrocele, there was an important difference in the two conditions, the one being a closed sac, the other communicating with a canal full of fluid. As to the fear that inflammatory material would press injuriously on the contained nervous material, it was noted that in none of the published cases had consecutive paralysis been observed; and a specimen of Sir A. Cooper's, in St. Thomas's Hospital Museum, described in his paper in vol. ii. of the Medico-Chirurgical Transactions, showed that the radical cure might take place in this way, when the cord was in the sac, without nervous symptoms. Mr. Gould had considerable difficulty in stopping the oozing of the cerebro-spinal fluid, which was so dangerous if allowed to continue."

A very interesting discussion followed, several

instances of survival to a considerable and even a long age being mentioned, while the question of paralysis, both before and after operation, was dwelt upon by several members, who admitted the difficulties in the way of making sure of this.

I have inserted this case, chiefly because it brings up a point which all operators would wish to be able to diagnose, namely, when is the communication with the spinal canal closed, or, to put it more practically, how can this be ascertained? In this instance Mr. Gould seems to have hit it. It is of the utmost importance in cases of suppurating sac, which should be laid open, as there is little or no chance of these doing well otherwise, and it would be a great relief to the mind of the surgeon if he could trust to such closure to arrest the flow of spinal fluid.

### Case XXIV.

appeared in the "British Medical Journal" of November 30th, 1878, from the pen of Dr. G. W. Thomson, Haywood, Lanark:—"On March 8, 1878, I was called to see a child (male) which had a lump on its back. Examination revealed a spina bifida, situated over the first and second lumbar vertebræ. It would then measure about twelve inches in circumference, with a pedicle about two inches by one inch. It was said to have increased greatly since birth, being then only of the size of a common marble. The child was now ten days old. The tumour was tense, but quite soft, palpation showing that it was filled with fluid contents. The skin covering the upper part was very thin, resembling membrane,

was purple in colour, and ulcerated on its surface. If anything the tumour became more tense on raising the child to the erect position. On looking through the tumour by transmitted light, some strains, which may have been (and resembled) nerve-cords, could be seen running through it. When pressed on, pain was evidently felt, as it caused the child to wince and cry. The child seemed healthy and strong, taking the breast and sleeping well. Both of its feet were slightly clubbed, but it could draw up and push out its legs. The sphincter ani was paralysed, allowing the fæces constantly to trickle away. The natural fold between the hips was wanting, so that the anus appeared as a small dimpled aperture situated on a somewhat rounded surface. On pressing the finger firmly into the root of the tumour, on its upper surface, a gap or opening in the spinal column, large enough to nearly admit the point of the finger, could be felt. This opening was directly over the spot where the usual spinous process should have been, one of which seemed wanting. The father and mother are strong and healthy people, as also the rest of the family; this being the sixth child. The ulceration on the surface of the tumour was dressed daily with oxide of zinc ointment, while a pad of cotton-wool and bandage was kept constantly applied.

"March 20th.—Since last date the ulcerated surface had been repeatedly touched lightly with nitrate of silver, and the ointment applied; still the ulcer was healing very slowly. The child had four slight convulsions yesterday. The tumour was growing rapidly, and had become very tense. Fearing that

it would rupture, I made a tentative puncture with the needle of a hypodermic syringe, and removed two ounces of clear straw-coloured fluid. This quantity did not reduce the tumour above one-third of its size. The opening was immediately closed with collodion, and a cotton pad and firm bandage applied. The child cried a little, but took the breast and seemed none the worse.

"March 22nd.—Yesterday and to-day the child seemed much weaker, although getting half a tea-spoonful of brandy in water every two or three hours. The tumour was rapidly increasing in size again, and was more painful on pressure, and presented a fiery-looking appearance.

"March 25th.—The tumour was as large as formerly. The weakness was now gone, having evidently been due to the withdrawal of so much serum from the spinal column and brain; the sac of the spina bifida was now filled up to its former size. Two ounces of serum were again removed, and without removing the syringe-needle, twenty-five minims of the following solution of iodine, as recommended by Dr. Morton, of Glasgow—namely, iodine grs. x., and iodide of potassium grs. xxx. dissolved in ʒj. of glycerine — were injected. The aperture was sealed as before, and pad applied. The child cried a little, and became within a few minutes afterwards very pale and faintish. It looked as if it were dying—so severely did it suffer from shock. Brandy in three-drachm doses was administered very frequently for some hours, when the child began to recover. Next day the child was well, having slept and taken the breast.

On March 28th the mother said the child had never been more easily handled or in better health, since birth, than now. The tumour had not increased in size since the injection, as it did before it: as yet, however, there was no perceptible decrease; it seemed of firmer consistence, had less fluctuation, and a slight hardness could be felt all along its upper surface, and more especially around the needle puncture. On April 2nd the tumour seemed less in size, measuring about seven inches in circumference. As the firmness was only along the upper part of the tumour, and as fluctuation was quite distinct at the lower two-thirds, four ounces of serum were drawn off, and another twenty-five minims of the iodine solution injected. The child cried, but took the breast immediately afterwards. This time there was no nervous shock.

On April 4th the child was very cross, crying almost continually. This was evidently due to the tumour having become much inflamed after the injection, and even, to appearance, it seemed a little larger. I ordered a powder of calomel and jalap, all pressure to be removed, and oiled lint to be kept applied.

On April 6th all inflammation had gone, and the tumour appeared somewhat smaller and firmer, and could be pressed gently without pain.

On April 9th, as a little fluctuation was still evident, another four ounces of serum were removed, and for the third time 25 minims of iodine solution were injected. The child did well, and this time only a slight degree of inflammation set in, which soon wore away again. On April 29th the tumour

felt quite firm; there was no perceptible fluctuation, and it could be squeezed and kneaded without pain; it continued to contract. The child was getting on very well, was thriving, had a healthy look, and could be handled and carried about without the least sign of discomfort. On September 1st the tumour was simply a mass of corrugated thickened skin, about the size of a small fig, and was perfectly firm. The child has continued to improve, and even the sphincter ani has gained power, as the fæces do not now trickle away.

(Signed) "George W. Thomson.

"Haywood, Lanark."

This case has been very carefully treated, and is well detailed, so that the history clearly shows that a very small quantity of the iodo-glycerine solution is sufficient for even a tolerably large tumour, though three injections were considered requisite. The facility (some may call it impunity) with which the infant imbibed, and seemed to benefit by, what for its age must be regarded as a very large quantity of brandy, is somewhat surprising. Dr. Thomson had reason to feel much gratified by the fortunate result. The recovery of the power of the sphincter ani is well worthy of note.

### Case XXV.

On February 5th, 1879, a child two months old was sent to me by Dr. Wilson, of Dreghorn, Ayrshire, having a lumbar spina bifida. This was situated over the two upper lumbar vertebræ. It was oblong, sessile, and small (about the size of an average date), not very tense, and it was anticipated

that it would be more difficult to manipulate than one of a size somewhat greater. This was found to be the case when it was operated on next day, and the injection was not accomplished in a satisfactory manner. The puncture was readily closed by collodion, but next day the spinal fluid was found to be escaping, and, in spite of repeated applications of collodion, the use of a small needle, silver wire, &c., this escape continued till the child became exhausted, and death took place on February 16.

Permission was given to examine the swelling, which revealed only a large defect in the second lumbar vertebra, but no strands of nerves, or nerve-matter, extending into the swelling.

This death must be ascribed chiefly to failure in injecting properly, chiefly owing to the small size of the tumour, and to the draining away of the cerebro-spinal fluid.

### Case XXVI.

In the presidential address of the Border Counties Branch of the British Medical Association, delivered July 25th, 1879, by Dr. Roderick Maclaren, Surgeon to the Cumberland Infirmary, we find as follows:—

"Spina bifida was a malformation which, in the great majority of cases, meant death to the infant within a very short time of its birth. In most instances the spinal cord, or cauda equina, in passing through the sac is spread out on its inner surface, and any attempt at removal meant its obliteration. In the few cases in which it remained in the canal, excision or ligature occasionally succeeded. But a procedure of beautiful simplicity has resulted in the cure of a large

proportion of those subjected to it. I refer to the injection into the sac of a solution of iodine in glycerine. In one case I had the most convincing proof of its efficacy. Over the lumbar region of a newly-born infant, an ulcer, measuring one inch by one inch and a half, was noticed. It was slightly elevated above the surface, and when touched it could be felt that there was fluid underneath the ulcerated integument, and on pressing deeply an open spinal canal was reached. On the following day the fluid had accumulated so as to raise a tumour which measured two inches across by two inches and a half long. The integument was so thin that in places the white undeveloped laminæ of the vertebræ could be seen shining through. In the evening the injection was done. Four days afterwards the tumour was evidently less tense, and the ulcer beginning to heal. In a fortnight the ulcer was about half its original size, and much of the integument had attached itself to the deep tissues. In a little while longer the ulcer was entirely healed, and no fluid could be detected; the thickened skin closed the spinal canal. So far as the bifida went, nothing could have progressed to recovery more satisfactorily or steadily; but the child was a miserable little object from birth: it never moved its right leg, and the left only very imperfectly; and while the spinal canal closed, hydrocephalus developed, of which it died. Fortunately, this malformation is not always associated with grave defects, as in this case, and accordingly a good result is not marred by profound constitutional impairment."

This case I regard as a success so far as the spina

bifida is concerned; the termination of it is only what might have been expected in the presence of such "*grave defects*," as Dr. Maclaren very properly calls them. With reference to the tumour, Dr. Maclaren, in a note which I had from him, remarks, "It was very astonishing that the thing was cured, considering the extreme tenuity of some parts of the tissue covering the open spine."

### Case XXVII.

On May 21st, 1880, Dr. Kirk, of Partick, caused a child three weeks old to be shown to me on account of a rather small spina bifida tumour on its lumbar region. It had also an ulcerated patch on one side of the swelling. Next day, with the assistance of Dr. Kirk and my hospital assistant Mr. Hughes, it was injected. When seen on the 27th it was going on well, and the tumour seemed to be solidifying. This it continued to do, so that in this instance repetition of the operation was not required, and a few weeks thereafter it was shown to the members of the Glasgow and West of Scotland Branch of the British Medical Association, as a case of cured spina bifida. A considerable time after this, Dr. Kirk informed me that this child had died of measles.

### Case XXVIII.

On December 17th, 1880, Dr. William Findlay, of Duke Street, Glasgow, called my attention to the case of a child, Sangster by name, who had a spina bifida tumour in the upper dorsal region. This was tapped and injected in the usual way on the 21st, and as it did not seem to shrivel in the usual way,

the operation was repeated on January 7th, 1881, and again on February 2nd and 24th, and subsequently in March, April, and May—in all about eight times, as each succeeding injection seemed to produce no effect. In several of the later operations a solution of double the usual strength was injected. At the Whitsunday term of this year the family had to remove to the North, and the following remark, in a letter from the child's mother in July, indicates the occurrence of the desired change. She says, "It is getting smaller than it was, and pretty hard-like about the root."

Afterwards I learned from Dr. Findlay that the tumour had become firm and solid.

### Case XXIX.

*Under the care of Dr. Thomson, of the Dumfries and Galloway Royal Infirmary; communicated by Mr. J. G. Marshall.*

Catherine Martin, one month old, was admitted to this Infirmary on February 10th, 1880. A tumour occupied the site of the upper lumbar vertebræ, about the size of a small orange; the skin over it was red, tense, and glazed, to some extent membranous and transparent, and presented at one point an appearance as if ulceration were coming on; fluid in tumour quite distinct. No paralysis of extremities or sphincters. Child healthy. The tumour was tapped on the 13th by means of the aspirator, the needle being entered not directly into the tumour, but through the sound skin on one side, and then passed subcutaneously into it. About a drachm and a half of serous-looking fluid was removed, and then half a

drachm of Morton's fluid injected through the needle of the aspirator, a little of it escaping. The opening was closed by plaster. The fluid had re-collected to a certain extent in two days, when the removal of part of it by the aspirator, and the subsequent injection with iodine, were repeated. The tumour now began gradually to harden, and when the aspirating was repeated, three or four days after, very little fluid was removed.

The injecting was repeated once or twice again at varying intervals, the tumour continuing to diminish in size and to harden. By the time the child was dismissed from hospital (March 4th) the skin over the tumour had become thick and wrinkled, and it itself felt quite hard; it was about the size of a filbert. No bad symptoms throughout.

### Case XXX.

James Morris, aged six weeks, was admitted into the Glasgow Royal Infirmary on May 25th, 1881, with spina bifida in the lumbar region.

On May 29th the tumour was tapped, about half an ounce of fluid drawn off, and nearly two drachms of the iodo-glycerine fluid injected; no bad symptom observed.

On June 6th the child was taken home (which was in the neighbourhood), the tumour being then more or less solid.

June 28th.—The child was brought to the Infirmary for examination, and the tumour was found to be shrivelled up, and felt quite hard and firm, so that no further treatment was deemed

necessary, except a simple dressing to protect the part.

This boy was shown along with others, on June 30th, 1884, to R. W. Parker, Esq., surgeon, who visited Glasgow for the purpose of investigating the results of this operation. The boy was then in good health, and had perfect power of all his limbs.

### Case XXXI.

Thomas Hamilton, aged six months, from Mearns, near Glasgow, was admitted into the Glasgow Royal Infirmary on June 7th, 1881, with spina bifida extending over several of the lower lumbar vertebræ. The tumour was not much raised, in fact, too flat to be readily punctured and injected, so that at first some pressure was employed round the edges of the swelling. This seems to have had the effect desired, but, unfortunately, the record kept has been very imperfect. The mother, however, informs us that it was three times injected. On July 6th the boy was brought to hospital, when the tumour was found to be diminished in size, more solid, and inclined to pucker up, as well as much less vascular.

This boy was likewise presented to the observation of R. W. Parker, Esq., surgeon, London. He was then in vigorous health, and in full possession of the power of his limbs. So far as known, he still lives a few miles from Glasgow.

### Case XXXII.

John Welsh, aged six weeks, from Pollokshaws, was admitted into the Glasgow Royal Infirmary on

October 25th, 1881, with spina bifida in the lumbar region.

Same day it was tapped, and five drachms of clear fluid withdrawn, and the puncture closed with collodion and lint.

On November 9th it was again tapped, and about a drachm and a half of the iodo-glycerine solution was injected, the wound being closed with collodion. On January 11th, 1882, the child was shown, the tumour much less, and the walls thicker than when last seen; and on the 24th it was tapped, and half an ounce of fluid removed. There is no mention of re-injection. On March 1st, tumour said to be less, and child doing well; and on July 5th, tumour still diminishing in size, and exactly the same colour as the surrounding skin, feels firm, and touching it gives no pain. The child said to be thinner than formerly on account of teething.

### Case XXXIII.

Euphemia Furriss, aged four months, admitted to the Glasgow Royal Infirmary, January 24th, 1882, with spina bifida. Tumour situated in the region of the lumbar vertebræ, about the size of an orange, globular in shape. The skin on its surface is thin for the upper one-third, natural over the remaining two-thirds. There is no paralysis.

January 26th.—Mr. Morton drew off about half of the fluid contents, and injected a drachm of iodo-glycerine solution.

January 30th.—For the first two days inflammatory action was set up in the tumour, but it is now almost

all gone. February 4th.—Tumour less in size, somewhat consolidated; inflammatory action gone.

February 7th.—The tumour became tense and inflamed to-day. Dr. Morton drew off half an ounce of clear fluid.

February 9th.—Child quiet; tumour lax.

February 14th.—Tumour very tense, and child suffering. Two ounces of bloody fluid drawn off, and two drachms of the glycerine of tannic acid (B.P. strength) injected.

February 16th.—Slight fulness of tumour in its posterior part, the rest being quite consolidated. Two drachms of brown fluid drawn off.

February 22nd.—Child died of exhaustion.

### Case XXXIV.

Caroline Johnston, aged two weeks, was admitted to Ward 28 of the Glasgow Royal Infirmary on February 6th, 1882, with spina bifida tumour situated in the middle lumbar region, globular in shape, and about the size of a hen's egg. On the lower part it has a slightly shrunken appearance. The skin over all the surface is thin. There is no paralysis.

February 14th.—Dr. Morton drew off two drachms of clear fluid, and injected a drachm of the iodo-glycerine solution.

[No other notes taken of this case till April 3rd, when it stated—"Tumour quite solidified, and flattened to half its original size. Skin normal in appearance. The child's general health is improved, in fact, quite as if there had been no disease or malformation."]

The child was seen on May 23rd and August 9th of same year, and on both occasions was in good health.

This girl was also shown to Mr. R. W. Parker, on behalf of the London Clinical Society, in perfect health and power of limbs, on June 30th, 1884, in the Glasgow Royal Infirmary.

CASE XXXV.

James Mitchell, aged two months, was admitted to Ward 28 on October 19th, 1882, with a spina bifida tumour in lumbar region, of a size larger than usual.

October 23rd.—Two ounces of clear fluid drawn off with the view of lessening the size of tumour; no injection.

October 28th.—Two ounces again drawn off, and the iodo-glycerine solution injected.

October 29th. — Child had convulsions in the morning, passing off about mid-day.

November 5th.—There was an escape of fluid from the tumour, which could not be arrested by collodion. Sutures of silver wire were introduced.

November 6th.—Sac again becoming tense.

November 8th.—Fluid again making its escape; the old sutures were removed, and new ones introduced.

November 9th.—A ring of redness round tumour. Child very much exhausted; and on the 10th it died.

*Post-mortem.*—Permission was given to open the sac only; and on this being done, the sac was found to contain a considerable portion of the cord, which had become adherent to the sac.

The fatal ending of this case was due manifestly to loss of spinal fluid, which even much very patient labour failed to prevent.

### Case XXXVI.

Matthew Hill, aged six weeks, was admitted into Ward 28 of the Glasgow Royal Infirmary on February 20th, 1882, with a spina bifida situated in the middle lumbar region. Tumour is flat, only slightly raised above the surrounding surface, and about two inches in diameter. There is paralysis of the right leg, which is also slightly wasted compared with the left.

February 22nd.—Dr. Morton tapped the tumour this morning, and drew off about half an ounce of clear fluid, but did not inject.

March 6th.—The tumour looks healthy, and has the appearance of becoming solidified; and on the 17th it is said to be flattened, more on a level with the surrounding skin, quite firm, with no appearance of any re-accumulation of fluid. The paralysed leg much improved, and quite like the other one.

April 12th.—Tumour has a consolidated feel round the edges, but there is an appearance of fluid in the centre. It was punctured, and two drachms of clear fluid drawn off, and half a drachm of iodo-glycerine fluid injected; and on the 19th the tumour and child are reported as looking well.

May 11th.—Tumour quite consolidated, but child becoming hydrocephalic. About a year afterwards this patient succumbed to the disease here indicated.

### Case XXXVII.

*"Liverpool Medico-Chirurgical Journal" for July* 1882, *page* 350.
*Cured Spina Bifida. Patient shown by Dr. Peter Davidson.*

The patient, aged fourteen days, was brought to the out-patient room at the Children's Infirmary, with a spina bifida the size of half a small orange in the lumbar region. Two drachms of fluid were withdrawn, and a pad and pressure applied. In a few days the child was seen again, and the tumour was as bad as ever; so it was tapped again, and a solution of iodine and iodide of potassium in glycerine injected. In a week it was found to be smaller and more solid. The injection was repeated, and the tumour continued to improve. After this no further injection was required. It was painted with collodion, and pressure applied. This treatment was carefully persevered in until five weeks after it was first seen, when the tumour was reduced to a small puckered mass of skin, and the child was now left to its mother, who had instructions to keep up slight pressure with a bandage over the tumour.

### Case XXXVIII.

*Under the care of Dr. Knox.* (*Copy of report in Ward Journal.*)

Annie Halloran, aged three weeks, was admitted to the Western Infirmary, Glasgow, on August 31st, 1883, with a large tumour situated over the lower sacral vertebræ. The tumour was about the size of the child's head, and covered the posterior surface of sacrum, and extended markedly downwards into the perineum, displacing the anus forwards, and so stretching the sphincter as to interfere with its action.

The skin or covering of the tumour presents the usual glistening and transparent characters of a spina bifida over the apex only, while at the side it has the ordinary integumental appearance. The tumour is of a bluish-red colour, fluctuant, very tense, elastic, and translucent. The circumference around its largest part is thirteen inches. At birth, according to the mother, the tumour was about the size of a closed fist, and has gradually increased since. Examined by transmitted light, no appearance of nerves stretched along the walls can be made out. September 1st, Dr. Knox drew off about an ounce of fluid by fine trocar. This fluid was examined by Dr. Steven, Pathological Chemist to the Western Infirmary, a copy of whose report I append.

REPORT ON FLUID FROM SPINA BIFIDA.

"Two drachms received for examination.

"Reaction distinctly alkaline. Colour very pale yellowish, but quite transparent. Sediment, none. Albumen considerable. Sugar present in small but quite distinct and appreciable amount.

"The presence of sugar is one of the characters of cerebro-spinal fluid, and I have obtained sugar once before in fluid from a spina bifida sent to me by Dr. Patterson about a year ago. The fluid now reported on differs from the former in being slightly yellowish, and containing considerable albumen; it agrees with it in being alkaline and containing sugar. Strongly of opinion that it is cerebro-spinal.

(Signed) "J. L. STEVEN.

"September 3rd, 1883."

September 5th.—Dr. Knox tapped the tumour with trocar and canula, and removed fifteen ounces of fluid, almost completely emptying the sac, and then injected about two drachms of Morton's iodo-glycerine solution. This was followed by rapid distension of sac with inflammatory exudation, but without any marked constitutional disturbance. The patient fed and slept well. September 25th.—The tumour is now much smaller; no larger than an orange. Skin lying in folds. One part of the tumour is distinctly lobate, the largest lobe egg-sized, directed forwards to left of anus, and containing fluid in its anterior part. The tense elastic character of the tumour is entirely gone. Anus in position, and completely under control. October 11th.—Tumour much reduced in size, being no larger than a pigeon's egg, but tense and elastic, with feeling of fluctuation. Sacrum and coccyx can be felt distinctly. Skin very lax and wrinkled over the parts. November 1st.—Called to-day to report progress. No signs of any tumour.

April 5th, 1884.—Patient still continues well, and has never suffered any inconvenience.

By the kind permission of Dr. Knox, this girl was seen by Mr. Parker, on behalf of the Clinical Society of London, on June 30th, 1884.

### Case XXXIX.

This case was kindly communicated to me by Dr. W. Marshall, of Greenock, in a letter received from him of date February 13th, 1883, from notes taken at the time.

"Dear Dr. Morton,—The child I operated on for

spina bifida by your method was born on January 3rd, 1880. I operated by tapping once, and injecting immediately your solution, on January 15th. When the child was born the tumour was rather purple in colour, and slightly excoriated on the surface. I operated early, as the coverings of the tumour were very thin, and it seemed to be increasing at such a rate that I dreaded its bursting. The tumour was about the size of a large orange, and occupied the lumbo-sacral region, the centre of the tumour being in a line with the crests of the ilia. For two or three days after the tapping and injection the child was very much exhausted and pale, and had to be fed with the spoon, and had brandy pretty freely administered. The tumour gradually shrivelled, and became harder and more solid; about two months after the operation it was one-third of the original size. The child lived and thrived till it was about fifteen months old, when it died suddenly in convulsions. It had got about four teeth and seemed fairly developed, but had never walked. The convulsions came on suddenly, and cut off the child in about twenty-four or thirty-six hours. I made no dissection of the tumour, and do not know of any one who has made or kept any in this neighbourhood. I have only had in my own practice about three cases of spina bifida since I began practice in 1856. This last is the only one I have operated on.

"I am, yours sincerely,

(Signed) "W. MARSHALL.

"Dr. Morton."

Dr. Marshall may fairly claim to have saved this child from death by spina bifida by his well-timed

operation. It ought to be noted that the child was only twelve days old when the tumour was tapped and injected, and that one injection proved sufficient. No cause for the convulsions is here mentioned, but they are coincident with the period of dentition, and, as practitioners well know, are ascribed to the irritation which infants undergo during its progress.

### Case XL.

On May 14th, 1883, a child near three months old was shown to me by Mr. McCarron, surgeon, Dennistoun, Glasgow, having a spina bifida tumour, about the size of a small peach, in the lumbar region. It was translucent throughout, but no nerve striæ observable. As it was rapidly enlarging and threatening to burst, it was punctured, but not injected, on the 20th. On the 21st it seemed much inflamed, and same day the child died, apparently from acute meningitis. No *post-mortem* was allowed. In the present state of our knowledge of such cases, one feels disposed to be glad that no injection had here been made; for, had it been, it would certainly have been credited with the death. While all will admit that such an inference would have been justifiable, it is, however, just possible that, in place of being harmful, it might have been useful, and might have averted the fatal issue. The wish is probably father to the thought.

### Case XLI.

William Corney, aged seven weeks, was admitted on December 6th, 1883, to Ward 28 of the Glasgow Royal Infirmary, having a spina bifida, situated in

the lumbar region. When the child was born it was about the size of a marble, now it is about the size of a large apple, and is a little columnar in shape, projecting more than usually from its site. The skin round the sides and base is normal in appearance, but that over the end or top is slightly transparent. No paralysis.

December 8th.—Tumour tapped, and some fluid drawn off. One drachm of the iodo-glycerine solution injected.

December 9th.—Child has been fractious. Tumour tense, slightly inflamed. To allay suffering laudanum in half minim doses was given as required, and on the 14th, child was taken home.

December 18th.—Child brought back. Seems quite well. Tumour about the same. Two ounces of fluid drawn off, and a drachm and a half of iodo-glycerine injected. Half minim doses of tincture of opium as before.

January 3rd, 1884.—Child brought back. Slight signs of consolidation in tumour. Tapped, and two drachms of iodo-glycerine injected.

January 19th.—Child brought back. Not much improved. Tumour tapped, and reinjected with a solution of double strength (20 grains of iodine, 60 grains of iodide of potassium to the ounce of glycerine).

January 29th.—Child brought back. Tumour leeting at seat of last puncture. Sealed with collodion.

February 5th.—Tapped and reinjected with double strong solution.

February 12th.—Tapped, some fluid evacuated, and reinjected with double strong solution.

March 22nd.—Child brought back again. Tumour

getting smaller. Tapped and reinjected with doubly strong solution. The trocar used was too thick, and some difficulty was experienced in getting the oozing stopped. The greater part of the injected iodine was returned. A silver wire was passed round puncture, but this did not stop it. It was ultimately stopped with collodion. The tumour continued to shrink, and become firm, so that the child was considered quite safe, and was dismissed. Very lately I learned that this child died of marasmus at the age of twenty months. There was no hydrocephalic condition.

On the 30th June of same year (1884) this child was shown to Mr. Parker, of London, along with others. Tumour was then solid though projecting somewhat; it always had been prominent. The child himself was well, and had power of limbs at that date.

### Case XLII.

*Case of Cervical Spina Bifida, successfully treated by Injection, by John Ward Cousins, M.D. Lond., F.R.C.S., Senior Surgeon to the Royal Portsmouth Hospital, &c., and published by him in the "British Medical Journal" of May 8th*, 1886.

"A male infant, ten weeks old, labouring under spina bifida, came under my care in January, 1886. The tumour was circular in outline, about half the size of a small orange. It occupied the middle cervical region, and was invested with healthy skin, except over a limited area at the summit, from which part a transparent process of the membranous sac protruded. The margin of the skin around this process was well defined. The tumour

was tense, and the base broad and fixed. Immediately below it there was a central depression, marking a considerable deficiency in the neural arches. When the infant cried, a free expiratory impulse occurred in the sac, synchronous with the impulse at the fontanelle. In the prone position, the tension of the tumour subsided, and on pressure the membranous protrusion became quite flaccid.

"The treatment consisted in injecting, near the base of the tumour, half a drachm of Dr. Morton's iodo-glycerine solution. For some days after the operation the infant manifested much fretfulness, and some irregular twitching of the limbs occasionally occurred. The slightest movement of the head appeared to cause considerable distress, and the whole tumour looked swollen and congested. This inflammatory stage was soon followed, however, by a brownish discoloration of the skin, and a gradual shrinking of the sac. At the end of six weeks the tumour was shrivelled to the size of a small marble. The remnant of the subcutaneous portion is now firm and immovable, and the membranous portion is a mere nodule, covered with a thickened cuticle of the same colour as the surrounding skin."

In his remarks upon this case, Dr. Cousins adds :—

"The case is recorded simply as another example of the value of the treatment by injection;" and further on he states that "the infant was well-nourished and otherwise healthy," and adverts to the importance of "a favourable state of the system in estimating the probable result of surgical interference."

My reason for giving it so fully here is, that it is a most interesting and well described case of spina

bifida in the cervical region, of which we have but few compared to those in other parts of the spinal column, and of these few, still fewer have been subjected to this mode of treatment.

### Cases XLIII., XLIV.

The two following cases, which appeared in the "British Medical Journal" of March 27th, 1886, were treated by Mr. F. A. Southam, in the Manchester Clinical Hospital for Women and Children, and are worthy of insertion here.

"In the valuable report on spina bifida recently issued by the Clinical Society of London, injection with Dr. Morton's iodo-glycerine solution (the method adopted in the following cases) is strongly recommended as the best and most successful plan of treatment.

Case 1.—A male child, four weeks old, was admitted on March 5th, 1885, suffering from spina bifida over the upper part of the sacrum. The tumour was of the size of an orange and extremely tense, presenting all the symptoms characteristic of this affection. The skin covering it was very thin, almost translucent, and commencing to ulcerate. The child itself was somewhat marasmic, and slightly hydrocephalic; there was a tendency to talipes calcaneus, but no paralysis of the lower limbs.

March 18th.—As the tumour was very tense it was tapped, under the carbolic spray, with a small trocar, and a little fluid having been drawn off, one drachm of iodo-glycerine solution was injected. The operation was followed by no symptoms, nor by any change in the condition of the tumour.

April 1st.—The operation was repeated. In the course of a few days the tumour began to show evidences of consolidation and contraction, and these processes have continued ever since, until at the present time (eleven months after injection) all that remains is a mass of thickened puckered skin, and dense fibrous tissue. The subsequent treatment has consisted in occasionally painting the tumour with collodion, and applying gentle pressure by means of a pad and elastic bandage. For some months after the operation, as the tumour continued to contract, the tendency to hydrocephalus increased; but this is now disappearing as the child grows older, and is only present to a very slight extent. The child is bright and well, its intellectual faculties are in no way affected, and the tendency to clubfoot is hardly perceptible. The case may therefore be regarded as completely cured.

Case II.—A male child, eight weeks old, was admitted October 27th, 1885, on account of spina bifida in the lumbo-sacral region. The symptoms were almost identical with those present in the preceding case, except that the coverings of the sac were free from ulceration. (Nothing is said of the size, which may thus be assumed to be similar.)

October 30th.—The tumour was tapped and injected as in Case I.

November 2nd.—The temperature was 100·8° Fahr. The coverings of the tumour had become red and inflamed.

November 4th.—The temperature was 101·4° Fahr. The child was troubled with sickness, and from time to time was slightly convulsed. The coverings

of the tumour,—which were so tense that it appeared to be on the point of rupture,—were acutely inflamed and commencing to ulcerate; there was very slight oozing of fluid from the seat of puncture. The tumour was tapped with a fine trocar, and, about one ounce of fluid having been allowed to escape, the puncture was closed with collodion. The child was taking small doses of bromide of potassium, and counter-irritation was applied over the spine.

November 6th.—The temperature was 103° Fahr. Attacks of convulsions, with twitchings of limbs, recurred from time to time. The tumour was soft and flaccid; the coverings were less inflamed; the slight discharge of fluid still continued.

November 8th.—The temperature was 104·6° Fahr. There was no change in the condition of the tumour. Death took place after an attack of convulsions. As permission could not be obtained for a *post-mortem* examination, it was only possible to examine the tumour. This was soft and flaccid, and contained a quantity of semi-purulent fluid; its inner lining was extremely inflamed, and coated with a layer of lymph. The spinal cord and nerves of the cauda equina, which were contained within the sac, running across its interior, were intensely injected, being of a vivid red colour. The opening into the spinal canal was just large enough to admit the tip of the finger."

Passing over some remarks by Mr. Southam on points which are elsewhere referred to in this volume, and also showing that both cases were treated in a most careful and skilful manner, we add the following, as it refers to matters of fact, and completes the description of the second case. "In Case II.," he

says, "there was an entire absence of any signs by which the presence of the spinal cord or nerve-trunks within the sac could be detected before operation. There was no furrow nor depression over the summit of the tumour, sometimes observed under those circumstances. The swelling had previously been examined by transmitted light in a dark room, but appeared uniformly translucent throughout. The disposition of the cord and nerves within the sac was such that excision of the tumour, according to the plan recently recommended by Mr. Mayo Robson, would have been quite impracticable."

I have no doubt it must have occurred to Mr. Southam himself, that only the divisions of the cauda equina could be present in a tumour situated so far down as that in Case II.

### Case XLV.

In March, 1884, Dr. J. Martin, of Kirkintilloch, called upon me regarding a case of spina bifida in a child a few days old, situated over the lower lumbar vertebræ.

The tumour seemed to have burst during parturition, and was discharging, and very properly Dr. Martin applied collodion over the opening, and succeeded in checking the loss of fluid. The tumour then began to refill, and when I saw the case with Dr. Martin on the 5th March, it was considered desirable to operate at once, and so avoid the risk of another bursting. This was done in the usual way, about half a drachm of the iodo-glycerine fluid being injected, and the puncture readily closed by collodion,

which was also freely applied over the tumour. I ought to say that the tumour was not large, about the size of a flat dried fig.

This injection had the desired effect, and when I saw it again on the 26th of same month, it was so consolidated that I considered it safe, and it has remained so.

This case was seen by Mr. W. Parker at my house on June 30th of same year, and it was noted then that the power of limbs remained perfect, and in the end of November last (1885) I saw the child, and then it was, as the phrase is, the picture of health.

### Case XLVI.

*Reported by Dr. James Hamilton, Glasgow.*

Alexander Kelly, aged eleven days, was brought to my consulting room on March 7th, 1885, on account of a tumour, situated on the lumbar region of the spine, existing since birth. The tumour measured about 7 inches in circumference, 3 inches in length, and $2\frac{3}{4}$ inches in width at greatest convexities. It was soft, fluctuant, bluish in colour, and had a very thin membranous covering, the centre of which presented an ulcerated surface about the size of a florin. It diminished slightly on pressure. Besides this deformity there was talipes calcaneo valgus of right foot, and slight talipes varus of left foot. The right leg was paralysed, and there was incontinence of fæces. The child was otherwise healthy, and had been able to suck vigorously since birth, but was almost continuously moaning, which was only silenced when he was permitted to lie on his face. There was nothing abnormal noticed in the

size of the head at that time, but no measurements were taken.

As the tumour had rapidly increased in size since birth, it was decided to operate at once, so on March 12th, 1885 (the child being then sixteen days old), with the kind assistance of Drs. McMillan and Brown, I (Dr. Hamilton) inserted a No. 2 trocar and canula into the upper and left side of the tumour, and, after allowing about two drachms of the fluid to escape, injected 30 minims of Dr. Morton's iodo-glycerine fluid into the sac. Painting the puncture with collodion, and the application of a pad and firm bandage, completed the operation. The child did not seem any the worse for the interference, the only difference noted throughout that day and the next being slight startings when he wakened from sleep.

This seemed so far successful, because in the course of ten days the lower half of the tumour had shrivelled considerably, was quite hard and firm, and the ulceration on the surface almost completely healed. The upper portion, however, did not appear to have been much affected by the injection, so on March 24th (twelve days after first injection) the operation was repeated, this time inserting the trocar high up on the right side into the remaining soft part of the tumour, and after allowing all the fluid that was in it to escape—about thirty drops in all—forty-five minims of the iodo-glycerine fluid was injected, the child again not apparently any the worse of the operation. This completed the hardness of the tumour in the course of a few days, and from that time normal skin gradually developed over almost the whole surface, and the child seemed altogether stronger.

By-and-by, however, the head was noticed to enlarge disproportionately—so much so, that when the little fellow was six weeks old, the head measured fully 17 inches in circumference; and measurements taken at various intervals afterwards showed a marked and rapid increase, so that when eleven weeks old the measurements were $18\frac{3}{8}$ inches in circumference and $12\frac{3}{8}$ inches across from one meatus auditorius to the other, and when nine months old the same measurements were, respectively, $19\frac{1}{2}$ and 13 inches. But in spite of this the child throve remarkably well, and as far as the back was concerned no better result could have been desired. Vaccination was postponed owing to the condition of the head.

Early in December of the same year he became attacked with catarrhal bronchitis, and the hydrocephalus taking on an acute form (meningitis?) he died on the 10th of the same month, his age being forty-one weeks.

(Signed) JAMES HAMILTON.

January, 1886.

*Dr. Hamilton's Case.*—Report on specimen of cured spina bifida, sent by Dr. Morton for dissection: "Received from Dr. Morton portion of a young child, consisting of five lumbar vertebræ and first sacral, with integuments corresponding. The integument presented marks of an emptied spina bifida (more than an inch in length, and less than an inch broad). The integuments had been partially dissected up, so as to show imperfection of laminæ of three lower lumbar vertebræ, and connection of the coverings of the cord with the skin. I removed the bodies of the lumbar

vertebræ, and showed the five lumbar nerves with their ganglia, apparently normal, and the lower part of the sheath of the dura mater in no way enlarged. On slitting open the dura mater a large amount of new tissue was seen, by which the dura mater was completely adherent to the deeper parts. By tearing separate the thickened tissues, the different textures could be determined. The motor and sensory roots of the first and second lumbar nerves of the left side were traced back through the dura mater, and the attachment of the ligamentum dentatum between them was found quite distinct and much thickened. The anterior and posterior roots of these nerves, and apparently of all the lumbar nerves, were directed to the lower end of the lumbar region, those of the first lumbar passing in front and behind the succeeding process of the ligamentum dentatum. I mention this to show that this was the part of the course of the nerve roots superficial to that ligament.

"The outline of the sheath formed by the pia mater was next made out, and shown to narrow to a thread just below the lower border of the second lumbar vertebra. Inside the pia mater there is a spongy felted tissue, which is certainly not spinal cord.

"I apprehend that in this case there has been obviously dropsy of the lower end of the central canal; that the injection has caused the throwing out of new tissue, to the obliteration of the sac of the dropsy, and the arachnoid and subarachnoid spaces; and that by the subsequent contraction of the new tissue the roots of the lumbar nerves have been dragged downwards."

(Signed) "JOHN CLELAND."

This preparation remains in the hands of Professor Cleland. It would seem that during the process of a gradual cure, such as this, the parts have a tendency to assume their natural position, or at least to approach it, where the actual attainment of it is not possible.

### Case XLVII.

*Treated by Dr. Alexander Patterson, Surgeon to the Western Infirmary, Glasgow.*

James C——, aged one month, has a tumour—congenital, translucent, and fluctuant—hanging from lower end of sacrum. Size constant since birth; purplish colour, globular shape, smooth outline, wide attachment from the anus to the middle of the sacrum, and in the middle line. The size, that of a man's fist. Admitted May 19th, 1881, and on May 25th tumour was tapped, and part of the contents withdrawn (quantity not stated), and the iodo-glycerine solution injected, and on May 28th he was dismissed, to return.

June 30th.—Since dismissal has returned once a week for examination. Tumour gradually decreased, and now almost gone.

The injecting of the tumour had no appreciable effect on the health of the child, and when seen on August 22nd, there was no tendency whatever to a return of the tumour, and the child was in good health.

### Case XLVIII.

*Treated by Dr. Alexander Patterson, Surgeon to the Western Infirmary, Glasgow.*

John P——, aged five months, was admitted into Ward 12 of the Western Infirmary on November 2nd, 1882. Has a tumour present since birth, and of

constant size; occupying the middle line over the lower lumbar vertebræ, of a flattened globular shape, to a certain extent pedunculated, but with a broad basal attachment. Covering thin and of a bluish-red appearance, while over the most prominent part is an elongated area, which is thinner than the general covering, and running down it is a faint streak of a white colour, probably some nervous filaments. The covering is somewhat translucent and of a cicatricial appearance. The skin of the surrounding parts terminates at the neck of the tumour, so that the covering is either thinned and altered skin, or the rachidian membranes forming a hernia. The tumour is fluctuant. Fontanelles not unusually full or open. Same day tumour was tapped at the upper and outer region, and part of the contents drawn off. The fluid is perfectly clear and limpid, and, according to Dr. Steven's report, containing albumen and a slight trace of sugar. Half a drachm of Dr. Morton's iodo-glycerine solution was injected, and the opening closed by cotton wool and collodion, while a broad bandage of flannel was applied. The child did not manifest any serious symptoms at or after the operation. Patient's mother states that it did not at any time move its legs about, while it moved its arms quite freely (paraplegia).

November 3rd.—Child somewhat restless during the night, but quieter to-day.

November 5th.—General condition of patient considerably improved. Sleeps and takes food well.

November 6th.—Dressing removed. Opening was found closed, and no leakage had taken place; child continues well.

November 7th.—Dismissed improved.

November 23rd.—Patient returned, and it was found that the walls of the tumour were much more firm and fleshy, while the covering approximates more to the character of normal skin. Tumour as a whole much more firm and fleshy, and the thinner part over the most prominent region of the tumour is now less thin and diminished in size. Tumour again tapped on the left side, and about a third of a wine-glassful of fluid, somewhat resembling thin pus, drawn off. After withdrawing the fluid the walls did not collapse, but did so when compressed, and the greater thickness of the wall is now more manifest. No serious symptoms developed during or after operation, and patient was dismissed two hours after, the part being dressed with collodion and cotton wool. The fluid withdrawn was examined microscopically and chemically, and found to correspond to pus. In regard to this case Dr. Patterson himself says:—"In the case where the pus came at second tapping, apparently the tumour cavity was closed off from the spinal canal, and the pus continued to be discharged and the tumour gradually shrank."

### Case XLIX.

Dr. Patterson mentions to me that he had another case in his private practice, where the tumour was situated high up, about the second dorsal vertebra, which failed after the third tapping, the patient dying apparently of meningitis. I have not been furnished with any further details of this patient.

The same surgeon, to whose kindness we are indebted for these three cases of spina bifida, some

years ago published with etchings, in the "Glasgow Medical Journal," a case of meningocele, into which he repeatedly injected the iodo-glycerine solution without any harm resulting. On one occasion I saw the case with him, and can testify that the size of the swelling was so great, and the state of marasmus of the infant so extreme, that the hope of benefit from anything was indeed forlorn.

### Cases L., LI., LII., LIII.

Dr. G. H. B. Macleod, Professor of Surgery in the University of Glasgow, has kindly favoured me with a short account of four cases which were treated on this method.

In a letter addressed to me he says, "I can in the short time at my disposal only find notes of four cases of spina bifida treated by injection. I can recall two other cases, but I have no notes of them.

"1. A male child, three and a half months old, with a congenital tumour, about one-fourth the size of a small orange, in the lower dorsal region, was operated on by me in June, 1879. It was a round, tense, semi-transparent tumour with a broad base, and increased when the child cried. Pressure on it seemed slowly to diminish it, but the child did not suffer when this was done; however, I did not continue the pressure for any time. I thought I could detect the dark lines of the nerves within the tumour by transmitted light. There were no complications—no clubfoot, hydrocephalus, &c. It had been treated by pressure before I saw it. I distinctly felt a small indentation or aperture in the bone below it as the fluid was running off. It was

injected twice, at an interval of three weeks. I was told that the child had had a slight convulsion some hours after the first injection, but I did not see it. No harm was apparent when it was injected except that on both occasions the child got pale. Consolidation followed, and when I saw it three months after the last injection, the tumour was firm and about half its former size.

"2. A healthy, well-developed male child, five and a half months old. Tumour at union of dorsal and lumbar vertebræ. A broad-based, fluctuant, round, congenital cyst. The skin was thin, and scarred like an old cicatrix. It was not perceptibly increased when the child cried, nor was it affected in dimensions by pressure, but the child was evidently pained when the pressure was applied. I could discover no hole in the bone below. There was slight talipes equino-varus in the right foot. One injection consolidated the tumour; and it diminished rapidly within the following two months. After this I lost sight of it, and could not discover the parents at their former address. This child's limbs, though not paralysed before the operation, were very weak, but afterwards (whether in consequence or not I cannot say) their strength much improved.

"3. A strong large boy of five months, healthy and well in all respects, except that his mother said he did not kick like her other children. The tumour was as large as the closed fist, and was in the lumbar region. It measured three inches across. The skin was strong, but a little puckered and cicatrix-looking. No bad symptoms followed the injection, and sixteen days after, when I punctured it with the intention

of injecting it again, I found it solid and fleshy, so that no fluid could be introduced into it, and only a very small amount of serous fluid came out. This case was operated on in May, 1882, and the growth is slowly but decidedly diminishing.

"4.—A female child, aged two and a half months. The tumour was central and small. It was in the lumbar region. It became distinctly tenser and more turgid when the child cried. There was no other congenital defect. One injection was alone used, and in fourteen days it was so firm that the child was allowed to return to the country. The tumour was not then quite consolidated, but it was somewhat firm, and was not affected by the child's crying. The mother was to return with it, if the tumour failed to diminish, but she did not come again. It was in December, 1881, it was injected.

"In none of these cases could I hear of any other child in the family or any relative having a like formation; but in the second case an elder brother had double talipes.

"I am sorry that I have not time to trace the other cases. I may say I have been very much pleased with the effects of the iodo-glycerine injection, and have not in any case seen any harm arise from its use.

"I am, &c.,

(Signed) "G. H. B. Macleod."

The third case here given from Dr. Macleod's list (No. L.) affords an example of what may happen to any operator—namely, that on puncturing a second time with a view to re-injection he, the operator, finds that the previous operation has done more than he was aware of; in fact, that the cure

was already accomplished, or nearly so. This has occurred to myself, and in one sense it becomes a pleasant surprise.

The following two cases were under the care of Dr. George Buchanan, Professor of Clinical Surgery in the University of Glasgow, and one of the Surgeons to the Western Infirmary in Glasgow. The reports I have been able to obtain are rather meagre.

CASE LIV.

"David Dalling, aged five months, was admitted on August 3rd, 1876, and operated upon on August 4th. Tapped and injected with iodized-glycerine. Dismissed August 11th. *Result.*—Doing well; parts a little thickened. To return in eight days. No further record."

CASE LV.

"Andrew Struthers, aged two months, was admitted on February 10th, 1881, and operated upon on February 28th. Tapped and injected with iodine solution.

"March 5th. Dismissed. Tumour had become somewhat solid in some parts."

It is added, "I (the assistant in the wards) understand that this case died some time after dismissal." Cause of death is not given, probably not known.

It is apparent that in these cases, the time between the date of operation and that of dismissal was quite insufficient to allow any considerable amount of shrivelling of the tumours, though what is here stated justifies the conclusion that the process of consolidation had commenced.

CASE LVI.

In the "British Medical Journal" for May 2nd, 1885, a case is published by Dr. Robert Sinclair, of Dundee, which he treated in 1878, "the record of which," he says, "has lain undisturbed in my note-book ever since;" and he gives as a reason for the delay that he would have preferred to have narrated a group of cases, but since then he had seen no other such case.

April 9th, 1878.—Mary Ann C——, aged twenty-five days, had a spina bifida over the sacrum. It was tapped, and three ounces of clear fluid were drawn off. The fluid was clear, neutral, albuminous, and contained abundant chlorides. Half a drachm of Morton's iodo-glycerine solution was injected. The opening was sealed with flexible collodion. On April 10th the child had been restless all night, but had slept during the forenoon. There was no constitutional disturbance. The tumour was as large as before the operation. On April 17th the tumour was contracted to about half the size it had been before tapping. On May 12th it was much smaller, but there was still some fluid. Half an ounce was drawn off, of the same characters as before. Half a drachm of Morton's iodo-glycerine solution was injected. Flexible collodion was applied to the wound. On June 1st the part was quite firm and contracted. The child was well, and had no bad symptoms. Dr. Sinclair does not state the size of the protrusion; but this may be inferred approximately from the quantity of fluid withdrawn by the first tapping (three ounces). At my request Dr.

Sinclair most kindly made inquiry regarding the history of the child subsequent to the dates named above, and ascertained that it had died from measles about three years thereafter, which fact he communicated to the profession in another number of the "British Medical Journal."

### Case LVII.

*Published in "Lancet" of January 20th, 1883, by E. M. Little, Esq., M.R.C.S. Eng., Out-Patient Surgeon to the National Orthopædic Hospital.*

"M. E., aged three weeks, was brought to the hospital last May, suffering from spina bifida. The child was well nourished, but somewhat pale. There was a large sac in the lumbar region, the bone deficiency extending from the second lumbar to about the second sacral vertebra, the tumour being three inches in diameter, nearly circular, and standing out fully one inch from the body. It rather overlapped the edges of the fissure, and was very tense. Its walls were very thin, membranous, and transparent, and on its summit was an ulcerated surface as large as a halfpenny. The tumour appeared in no way affected by the child's crying or inspiring. Both lower extremities were affected with talipes varus of the usual pronounced congenital type. The mother stated that the tumour was increasing, and that the child moved its lower limbs very little. She readily consented to an operation, as affording a chance of cure. The patient was admitted on June 1st, and by the courtesy of my colleague, Mr. F. R. Fisher, I retained the care of the case.

"June 1st.—The sac was aspirated, and six drachms of clear fluid removed; remains about three-fourths full. No ill effects followed.

"June 3rd.—The sac refilled; it was again aspirated, and one ounce and a half of fluid removed.

"June 6th.—The patient is very unwell. Starts at slight stimuli. Does not sleep, but cries continually.

"June 14th.—Is again in usual health; is again aspirated, and six drachms removed. No ill effects.

"June 21st.—Sac refilled. Half emptied, and twenty minims of Morton's iodo-glycerine solution injected.

"June 22nd.—No bad symptoms.

"June 23rd.—To be out-patient.

"June 27th.—Sac much smaller, its walls thicker and redder. The sore has healed.

"June 28th.—Tumour has not shrunk for the last day or two; half a drachm of solution injected, and collodion freely applied.

From this date the tumour rapidly shrank, until the skin over the fissure was level with the rest of the back. The treatment of the talipes has since been proceeded with, and the necessary tenotomies, &c., have produced no bad effects. Simple evacuation of the fluid was first tried, as recommended by Dr. Morton. It would perhaps have been as well to have proceeded to inject at first."

With the knowledge we now have I quite concur in the opinion here stated, and in this very case, as appears in this report, the child was placed in very great danger by the too frequent tappings, and the withdrawing so much of the spinal fluid. A longer interval between the aspirations is advisable,

and also between the injections. It is probable that Mr. Little would now concur with me in this.

### Case LVIII.

*Reported by A. Milroy, Esq., Surgeon, Kilwinning.*

On Sunday, May 8th, 1881, I was called upon to attend Mrs. McLauchlan, The Green, Kilwinning, who was in labour. When I arrived at the house I found that the child had been born, and the subject of spina bifida. There was no tumour, but an ugly dark-red broken surface, about the size of a penny. The child was very weak, which I considered was due to the tumour having been ruptured during parturition. The infant was hurriedly washed and wrapped up, but nothing was used to protect the sore except a small piece of cotton cloth. I told the attendants before leaving that the infant would not live long. On my next visit the child was all right, but three or four days elapsed before I again examined the sore, when I found a very distinct tumour, the walls of which were as thin as paper, of a bluish colour, and abraded at the centre. I now caused it to be protected, thinking it might be a case for Dr. Morton to operate upon. About a fortnight afterwards, when I stated the *pros* and *cons* of the case, I found that the parents were unwilling to remove their child to Glasgow, and that if an operation was to be performed I must do it myself. This I had little hesitation in doing, as I had already seen Dr. Morton perform a similar operation on one of my patients.

On May 23rd, when the child was fifteen days old, and the tumour about the size of a small orange, and seemingly ready to burst, I operated as I had seen

Dr. Morton do, and as he has so often described elsewhere, with this exception—the trocar entered the sac, but the canula, as I found afterwards, was a little ruffled around the edge, and did not. I saw at once that if I used force I would tear the sac. Merely holding the canula against the hole made by the trocar, I tried to inject a little of the iodine preparation, but it did not seem to enter. On making the puncture little or no fluid came out, so I am convinced none went in, and more so because the child was perfectly well in a few minutes, and never showed any of the symptoms which generally follow injection. The parents fortunately saw no mistake, but I was exceedingly annoyed at the bungle, as it can be called nothing else, so I got a new trocar and canula, and three days afterwards I performed the same operation properly, injecting, I should think, from half a drachm to one drachm of the fluid. I let off first a little of the contents of the tumour, I should say from one to two drachms. A few moments after the operation the child grew dreadfully pale, and looked as if it was dying. I had previously warned the mother that such a collapse might take place, still it was more than I anticipated, and much more sudden. I really thought that I had killed the child, but still hoping that it would survive the shock, I returned in two hours, when I found the infant somewhat better. I now resolved, and so did the parents, that the same operation should not again be performed. The child remained very unwell for three days. About that time I looked at the tumour, and found it contracted to almost nothing. The centre, where the surface was abraded, was now quite like

true skin. After this I occasionally looked at the tumour, and painted it with collodion. At the end of less than a fortnight it was quite gone, and the finger could be easily put into the defect in the spine, which is about one inch in diameter, and feels as if surrounded with bone. On Tuesday, June 21st, twenty-six days after the operation, I sent the child to be examined by Dr. Morton, when he wrote me saying that "it was one of the best cures he had seen, so smooth and such an absence of puckering. The sac must have been thin, and is still so. It will be prudent to keep a soft protector over it for some considerable time."

*Remarks by Mr. Milroy.*—Any remarks on this case other than those made by Dr. Morton would be superfluous, except that I was quite astonished at the rapid cure. The reason I cannot give. It might be, I gave a formidable injection, or it may be some of the fluid entered during the first operation, and both within so short a space of each other may have had an effect in working the cure. The effect of the operation was such that I gave up all hope of the child, now it can draw up both legs a little, but one in particular, and seems to have complete power over the sphincters.

(This case I have given almost in full, because the graphic description truthfully illustrates what practitioners may meet with in similar attempts.)

### Case LIX.

Some years ago, the date I have omitted to note, Dr. William Berry, of Wigan, kindly favoured me with the particulars of the following case:—On March

3rd last, Dr. Berry was present at the birth "of a female child, apparently healthy and strong, but having a spina bifida, the size of an orange, in the lower dorsal region, covered with an imperfect membranous material. At this time nothing was done, with the exception of a roll of cotton wool being placed as a pad around the tumour underneath the binder.

"On May 26th, the child being nearly three months old, I examined it carefully, and found it, instead of being healthy, sickly and puny, with a large hydrocephalic head. The tumour has increased very much in size, being now the size of a large orange, the covering is thin and shining, looks as if it would burst; when the child cries it distends very much. At this time I drew off, by means of a medium-sized trocar, about six ounces of cerebro-spinal fluid. I did this as a tentative procedure, to see what disturbance would follow; the child was a little restive afterwards, but nothing alarming took place. The opening was covered with lint and flexible collodion. On the 27th (next day), I found the tumour as tense as ever, having refilled.

"May 31st.—I drew off one and a half ounces of fluid, and injected half a drachm of Morton's iodo-glycerine solution, then covered the opening with collodion, lint soaked with collodion, and strips of adhesive plaster. The child cried lustily during the operation, but the effects soon passed off.

"June 1st.—The child had been pretty quiet during the night, and had taken food well. The tumour is very tense, and has discharged freely. Readjusted

the coverings, and placed cotton wool over the whole.

"June 4th.—Tumour semi-solid, still oozing. The child appears very feeble.

"June 8th.—Child not well; hydrocephalus more marked; the tumour somewhat less in size, but a portion appears to be suppurating, as, through the thin membrane, purulent looking fluid can be seen.

"June 15th.—I now took off the dressing and found the tumour much smaller; one half, from above downwards, is solid, and the other half suppurating, the skin broken. The child still keeps very feeble, and the hydrocephalus increases; there is a constant discharge of semi-purulent fluid from the ulcerated portion of the tumour. The child gradually wasted, and died on June 24th. No examination was allowed.

"*Remarks.*—This case was unfavourable for operation. At the date of operation we had a weakly hydrocephalic child, with large tumour having a membranous covering. The following lesson was learned:—In a similar case—1st. Operate early, before hydrocephalus appears. 2nd. No tentative tapping. 3rd. Prevent, as far as possible, any escape of cerebro-spinal fluid. 4th. Make a good and definite injection, and hermetically seal the orifice made by the trocar, and allow time for absorption before making a second injection.

"A portion of this tumour becoming solid, and closing a portion of the canal, proved to me more than ever the usefulness of this plan of treatment. I had to deal with a hopeless case from the first, and the alteration of the character of the tumour was such

that I cannot describe it; it was beyond my expectation, and it is extremely probable that if I had operated when the child was a few days old, I should have had a complete cure, and consequently might have saved the child."

### Cases LX., LXI., LXII.

*Communicated to me by Dr. Hector C. Cameron, Surgeon to the Western Infirmary, Glasgow.*

David Simpson, aged three months, was admitted to Ward 17 on May 26th, 1882, with spina bifida tumour immediately above sacral region, painful when manipulated.

May 30th.—Twenty-five minims of Morton's solution injected.

May 31st.—Child restless during night.

June 1st.—Dismissed. Tumour not much changed.

June 20th.—Re-admitted. Mother says child is rather weak as regards the use of the lower limbs, but there is no distinct paralysis to be observed. Tumour harder to the touch than formerly.

June 22nd.—Tumour injected with twenty minims of Morton's solution.

June 27th.—Dismissed. Tumour not diminished in size, but feels rather firmer.

August 4th.—Re-admitted. Tumour more solid.

August 5th.—Tumour injected, but only part of the solution got in, on account of the syringe getting out of order.

August 7th.—Dismissed, and asked to return in about five or six weeks, but there is no note of this having been done. Dr. Cameron regarded this case as successful in regard to the tumour; and adds that

the child succumbed to an attack of measles some months thereafter.

*From Dr. Cameron's private practice.*—"June 8th, 1886.—About three years ago I saw a child about three or four months old with Dr. A. Sloan, with a spina bifida, about the size of a Tangerine orange, in the lower dorsal region. It was twice injected with Morton's solution, and ultimately appeared to be radically cured. Soon, however, the head began to enlarge, and the child succumbed after the hydrocephalus had attained a very large size, which was about six months after the operation and cure of the tumour on the back.

"Shortly afterwards I saw a child, more than two years old, with a tumour in a similar situation, along with Dr. W. Forrest. It had two days previously given way at one point, and was collapsed and wrinkled, but by no means empty. The late Dr. David Foulis had seen the boy shortly after birth, and had recommended operation, but the parents could not be got to consent to the proposal. On the present occasion the child was ill. He was restless and moaning, had an elevated temperature, and had been sick. His pulse was quick, and there was considerable thirst. The loss of fluid had been stanched by the application of collodion to the little burst spot of the tumour. Morton's solution was injected in the usual way, and with the best possible result. After a few days of continued illness he began to recover, and ultimately a satisfactory radical cure took place. Once before the sac had given way but healed again; on that occasion also the accident was followed by a feverish illness. This case illus-

trates one danger of delaying the operation; but the question may fairly be asked whether the danger of subsequent hydrocephalus is not lessened in such a case by the fact that the sutures and fontanelles of the skull are firmly united and ossified.

"I once saw a case in which a spina bifida in the lumbar region had burst during parturition. The medical man in attendance had some difficulty in recognizing what the exact state of affairs was; but rightly concluding that he had to do with the ruptured sac of a spina bifida, he sewed up the rent (some inches long). Next day, when I saw it, it was fully distended. We injected it with the solution, but no union taking place in the rent (the edges of which became sloughy) the stitches gave way, fluid drained off in large quantity, and the infant sank and died.

(Signed) "H. C. C."

In this last case, though it was quite proper to inject the iodo-glycerine solution, it is manifest that the operation had very little chance of doing any good, in the presence of such a rent in the tumour. The other three given by Dr. Cameron may fairly be regarded as successful.

The same surgeon has furnished me with a short notice of an occipital meningocele, into which this solution was injected, which will be referred to in an Appendix.

### Case LXIII.

On March 14th, 1880, Dr. John Wilson, of London Road, Bridgeton, Glasgow, showed to me a child a few days old, having a large spina bifida tumour in

the lumbar region, of the usual globular shape, and having a sloughy-looking ulcer on one side. It was agreed to defend tumour and attempt to heal the ulcer, which course was pursued for some days; but the increasing size of the swelling and risk of speedy bursting induced me to tap and inject in the ordinary way on March 28th. This was followed by the usual appearances of inflammatory fulness, but unfortunately, and probably from want of care in nursing, a slough formed on the ulcerated part and separated on April 1st, producing draining of spinal fluid, which could not be arrested. The child died on April 7th, the death being attended by slight convulsions.

In this case, as hinted, I had no confidence in the persons in charge of the child; they did not seem to give it the judicious care requisite for the management of such protrusions.

### Case LXIV.

On March 9th, 1884, I had occasion to meet in consultation a local practitioner in one of the suburban burghs near Glasgow, who desired me also to see with him a child about four and a half months old, having a large spina bifida tumour over the lumbar vertebræ. It was alleged to have been about the size of a small tomato at birth, but had grown to near the size of an infant's head, only flatter in shape. To inject such a swelling there and then did not appear to me a safe or warrantable proceeding, because of the large proportion it bore to the body of the child. To attempt to lessen its size by puncture was thought to be the least dangerous proceeding, which was done, and nearly a breakfast cupful of clear fluid was drawn off, and the

puncture closed by collodion. I afterwards learned that this child died some days subsequently from exhaustion. I regard this as a case of death from delay in seeking treatment. I believe the medical attendant faithfully explained to the parents the dangers of the malformation, and also put before them the possibility of cure by operation. The parents felt much reluctance towards any operative procedure, which led them to put it off too long, until it attained the alarming proportions already mentioned, thus rendering it formidable from its relative size. I should have stated that it had thin membranous and translucent coverings.

### Case LXV.

About the end of January of this year (1886) a child nearly three weeks old, was shown to me, having a lumbar spina bifida, rather small in size, about that of a full-sized plum somewhat flattened. Its coverings were thin and translucent, except at two points on the upper part of the tumour where natural skin appears, of which the larger part is towards the right side of the child. Assisted by Dr. A. T. Thomson, the usual operation by puncture and injection of the iodoglycerine solution was performed on February 12th. As the swelling was so small, no fluid was drawn off except a few drops unavoidably, per canula, as the syringe was introduced, and only a small quantity of the solution was injected, less than half a drachm. In operating on so small a tumour I accidentally wounded the opposite side of it, but both punctures were closed readily by the collodion, and gave no further trouble. The child was shown to me on the

26th, when the tumour seemed to have shrivelled up, and when again seen on March 23rd, it was quite flat, presenting a slightly raised oval patch of thickened and wrinkled skin. Child thriving.

This case was recommended to me by Dr. McKechnie, of Paisley.

### Case LXVI.

On March 13th of the present year (1886), Alexander Porter, Esq., surgeon, Glasgow, called upon me regarding a child two weeks old, which had a spina bifida tumour, which, on visiting, I found to be sacral. It was irregularly circular, nearly heart-shaped, the coverings red and vascular, except at the upper part, where it was like the normal skin. It appeared to be increasing rapidly, aud therefore it was thought best to operate without loss of time. Accordingly this was done in the usual way on March 16th: the puncture was readily closed by collodion. It may be noted that as it was still a small tumour, not more of the spinal fluid was allowed to escape than what unavoidably follows the withdrawing of the trocar. Perhaps too little of the iodo-glycerine solution was injected; at all events, it soon became evident that repetition was requisite. This was done on the 30th with the same result, so that the operation was again repeated on April 16th, and more of the solution injected. In a few days it became evident that this had proved effectual, and the tumour is now solid and gradually lessening and becoming flat. At no time were there any symptoms to cause uneasiness, and up to the present date the child continues well and thrives.

CASE LXVII.

On June 9th, 1866, a Mrs. M——n brought to me a female child, concerning whom she had been recommended to consult me by Dr. Wm. Young, of Glasgow. This child had a lumbar spina bifida, the size of a large hen's egg, with a large part of its covering membranous and semi-translucent, though at the sides there was some normal skin. There was a considerable part of the surface abraded and ulcerated, and on one part a small slough. On the 10th I injected nearly a drachm of the usual solution, and sealed the puncture by collodion. During this time no unusual symptom appeared, but the mother had been allowed to hold the child, and after it was turned to the nipple, a state of shock with slight appearance of approaching convulsion followed, which soon passed off. This alarmed both Dr. Young and myself, and induces me to say that I will not again allow a mother who is suckling her infant to hold it during such an operation.

June 12th.—Child well, tumour smaller.

June 22nd.—Child seen; quite well, and tumour lessening.

July 1st.—Tumour contracting and child now quite safe; surface nearly whole.

This state of matters continued till near the end of the month, when, so far as I can learn, some gastric disorder occurred, and the child sank under it on July 28th. So far as the tumour was concerned, no injection could have done better. Infantile life is fragile.

CASE LXVIII.

*Was communicated to me in the following letter from a Glasgow student, now a practitioner in Brazil.*

"Rio de Janeiro, Brazil.
"June 10th, 1886.

"JAMES MORTON, Esq., M.D.

"DEAR SIR,—In the 'Lancet' of May 8th, I note your letter with reference to the cure of spina bifidæ by means of the iodo-glycerine fluid.

"I beg to place at your disposal the following notes of a successful case I had, which was treated solely by your method.

"Henrique M., born March 4th, 1885, with a lumbar spina bifida, about the size of a half orange. A strong, well-made child, with no other deformity. On March 12th, tumour *in statu quo.* I tapped it with a fine trocar and canula, and drew off about two drachms of fluid, and then injected about half a drachm of the fluid, containing ten grains of iodine, and thirty grains of iodide of potass to one ounce of glycerine. On withdrawing the canula, I sealed up the puncture with collodion. No injurious effect followed. One week after the operation was repeated, and likewise a third time.

"After each operation the coverings became more thickened and corrugated, until, a fortnight after the third tapping, no trace of fluid was present, and the tumour was reduced to a flattened, fleshy, wrinkled mass. After a lapse of fifteen months, it is still further diminished in size, and the child is as plump and lively as possible, showing no sign of weakness anywhere.

"I regret that my experience of such cases is limited to this case only, but observing your letter above mentioned, and especially the quotation from the 'Dublin Medical Journal,' I consider it my duty to inform you of this, another case in which your method was eminently successful.

"Believe me, Dear Sir,

"Yours very sincerely,

(Signed) "W. Loudon Strain, M.B. (Glasgow),

"*Late Resident Assistant, Glasgow Western Infirmary.*"

It is pleasant to read a record like this, and my best thanks are due to Dr. Strain for forwarding it. For a first case, it has been admirably treated. As noted elsewhere, a little longer time between the operations may be allowed, when it may be found that repetition could perhaps be dispensed with.

### Case LXIX.

On July 8th last (1886), at the request of Professor James Dunlop, M.D., one of the surgeons to the Glasgow Royal Infirmary, I operated on a female child, which on the 5th of that month had been admitted into Ward 23 of that Institution. This child was just a month old, and had a large spina bifida tumour over the upper lumbar vertebræ, but was in good health, and free from any other deformity. The tumour was ovoid in shape, its long diameter being about four inches, and in depth about two inches; in size and shape like a large hen's egg somewhat flattened. A semi-transparent membranous area covered nearly the whole of its surface, but at the sides this was met by true skin, one part of which near the upper end was selected for

the seat of puncture. It was sessile, being attached by a broad base. When punctured, about an ounce of limpid fluid was withdrawn, and fully a drachm of the iodo-glycerine solution injected, the puncture being sealed as usual by collodion. The fluid was found to be in specific gravity 1·005, faintly alkaline, giving a trace of albumen and chlorides; no sugar. The result of the operation was that the swelling was reduced slightly in size, but it soon resumed its original size and tension.

On July 30th it was again punctured, one ounce of fluid removed, and nearly two drachms of the iodo-glycerine fluid injected. No constitutional disturbance after each operation. After this second operation a somewhat more solid feel was perceptible in the tumour, but it remained as full and large as at first. During my absence on holiday, Mr. Fisher, assistant to Dr. Dunlop, considered it proper to puncture it with a hypodermic injection needle on 6th, 9th, and 14th August, and drew off on each occasion from three to four drachms of the fluid contents. After the first two tappings no appreciable difference was observed, except at the time, but after the third tapping the sac remained smaller, and did not revert to its original size. About this time it was seen that a small slough was forming at the lower part of the swelling, about the size of a sixpence, and in the process of separation some fluid oozed away now and again, the child then becoming fretful and not taking the breast so well. Slough dressed with iodoform vaseline on lint. On August 26th, it was noticed that there has been no oozing for the last two or three days, the lint

covering tumour being quite dry. The walls have fallen in, are much thickened, and it looks as if most, if not all, of the fluid had gone, and child is well.

I am indebted to Mr. Fisher for the chief part of the notes of this case as now given.

### Case LXX.

On January 10th, 1884, a female child, about two months old, was sent to me from Forfarshire, with a spina bifida tumour in the sacral region. The tumour was large, about twice the size of an ordinary sized orange, lying considerably to the right side, covering and involving great part of right buttock. It was semi-translucent, and presented a small nodule on the side next to the mesial line of the body. I thought this tumour formidable from its size, and in a note to the family medical attendant recommended tapping, so as, if possible, to reduce the size previous to injecting, and thus lessen the amount of shock which such a proceeding necessarily causes. This seems to have been done at rather too long intervals, and had not the desired result in the reduction of size, so that after the lapse of eighteen months, the child being then twenty months old, when it was again shown to me, I found the tumour had become very large and heavy; it was quite a load to the child, and about the size of its own head. The patient was in all other respects quite well and active in limbs. On July 25th, 1885, the tumour was tapped, and about thirty ounces of bloody serous fluid withdrawn, and the puncture closed by collodion. When thus rendered flaccid, several solid portions were felt under the loose skin,

apparently about the size of ordinary walnuts. Two days were allowed to pass, when it was again tapped, about two ounces of the same kind of fluid were withdrawn, and two drachms of the iodo-glycerine solution injected. The child was then taken home. From communications received from the local practitioner, I learn that since the above dates the tumour has been frequently tapped, and I suppose injected; but at present I am not fully informed regarding such proceedings, nor as to the present condition of the girl.

In reply to an inquiry of mine, Dr. Paton, of Carnoustie, writes thus:—

"This case may fairly and honestly be classed as a cure. I have punctured and injected the tumour nine times, and have injected each of the last four times ℥ij of your solution. Nothing had been done for the three months prior to my last communication to you, as one of the parents, seeing no apparent good result, objected. Suppuration took place, and the tumour partially opened of itself on July 24th (1886). On the 25th I laid it open, Dr. Murray, of Forfar, the child's uncle, being present, and evacuated a large collection of fluid of a muco-purulent nature, together with some pretty large lumps of curdy-scrofulous matter. I explored the interior of the tumour, as far as I thought safe, with my finger, and could detect no opening; the internal lining of the tumour to the touch felt more like a serous than a mucous membrane. The cavity was washed out with Condy's fluid diluted, a drainage tube inserted, and put up with compresses; but from the position of the tumour, neither the drainage tube

nor the compresses were of any service, as they could not be retained in position. I washed out the tumour daily with Condy's fluid diluted for about ten days, after that every two or three days, till at last there was a very considerable hæmorrhage during night after the injection of the morning. Since then nothing has been done. There is still, now and again, a little discharge, but the tumour is shrunk and consolidated very much. Externally and internally it is nodulated; some of the nodules are large. The tumour has a semi-cartilaginous feel. The child is running about again and quite healthy."

### Case LXXI.

*Spina Bifida cured by Tincture of Iodine and Glycerine. By Dr. P. Campbell McNiven.*

A few days ago (I write on November 17th, 1886), Dr. J. B. Russell, of Glasgow, directed my attention to the "Indian Medical Gazette" for September, 1886, where I found, under the heading, "A Mirror of Hospital Practice," the following case:—

"A child nine months old, of Dhangar parents, was brought to me on July 2nd. The mother stated that he was suffering much from fever, and that he had had a swelling on his back since birth. On examination he presented an elastic tumour, the size of a hen's egg, over the upper lumbar vertebræ. There was no mistake about the diagnosis, as it was a typical case. I questioned the mother as to what she had done to it. She said that she had three times put a needle into it; water issued from the puncture, the tumour got less, but filled up again to its ordinary size in an hour or so.

"I treated it in the ordinary way—cotton-wool and bandages. This I continued for ten days without any apparent effect, or any likelihood that it would effect a cure. I hesitated to try Dr. J. Morton of Glasgow's treatment, seeing that the parents were very much interested in their child, and that I might excite fatal inflammation. I therefore dismissed the case. The parents then took the child to a native doctor, who diagnosed it to be a wart, and advised them to have it cut off. Fearing the knife, they brought the child to me again, urging me to do something for him. I then resorted to Dr. Morton's views (whose lectures I had the pleasure of hearing).

"On July 16th I injected, by the means of hypodermic syringe, 2 mm. of tincture of iodine to 3 mm. of glycerine into the sac. On the following morning there was no change further than a slight coloration of the thin glazed skin over the top of the tumour. I used the iodine and glycerine again this time, using 3 mm. of the tincture to 5 mm. of glycerine, having previously drawn 15 mm. of the cerebro-spinal fluid by means of a second syringe and dressed it with cotton-wool as before. I was called away that evening, and did not again see the case till the third day, when there was a decided change in the tumour. The walls were much thickened and elongated, with a small opening on the free end, through which a fibrous cord of a greyish colour protruded, and on pulling it gently it caused extreme pain. The child took to the breast well; there was no fever or other disturbance, so the operation gave no anxiety. I dressed it with carbolic oil for a day or two, and how to get rid of this appendage was the question now. I could not use

the knife with safety, as there was a nævus round its base, which might give rise to troublesome bleeding. To strangulate it was in my mind the best line of treatment, which I did by means of prepared horse-hair tied tightly round the base of the tumour. This had the desired effect; the tumour sloughed off in two days, and left behind it an ordinary sore which healed in a few days, leaving no bad effect save a little thickening of the tissues.

"From this case I am led to believe that there is no immediate danger of exciting inflammation of the cord, and its coverings, by the injection of tincture of iodine, if done with care. I would have no hesitation in treating a similar case in the same way. I am of the opinion that the sac or tumour should not be completely tapped, as this might lead to a serious inflammation, the iodine getting in a concentrated state to the covering of the cord, which might be avoided by leaving the tumour half full of its fluid. This may be of some practical use to some medical gentlemen, as it holds out the hope of a speedy cure. Equable pressure and bandages are very unsatisfactory. They worry the patient and disgust the surgeon. Whereas recovery is probable to result from the former, protracted pain and unsatisfactory results follow the latter."

In this case a modification of the method which I follow has been successful. The tincture of iodine was used instead of the mixture of iodine with the potassium iodide, with the same solvent, glycerine.

In all probability this case presented an instance of closure of the spinal opening as a consequence of the injection, like several of the cases already narrated,

thus protecting the infant from the danger of loss of spinal fluid, and rendering the subsequent procedure in some degree safe. The phrase, "a nævus round its base," I take to mean the turgid appearance of the smaller vessels in the skin around the membranous area, which is frequently present. I have previously alluded to the probable utility of a combination of the method of injection with that of excision, or removal, as in this case, by ligature; that is, after all risk of continuous oozing of spinal fluid has passed away.

### Cases to which this Operation is Adapted.

Premising that this mode of treatment may be employed in all cases, where death is to be feared from rupture of the protrusion and its consequences, still, in regard to probability of benefit, these may be divided into three classes.

1. Cases in all other respects healthy, and in which a complete and permanent cure may be reasonably expected. Apart from the presence of the tumour which constitutes a spina bifida, the child ought to be sound, and, if possible, thriving. Should anything be amiss, a few days' careful treatment may be necessary before an operation is proceeded with.

2. Cases in which various deformities or defects may be present, but not of so serious a character as to render survival unlikely or impossible. The child may have talipes, either slight or aggravated, or there may be paralysis of sphincters or of limbs. For that of the anal sphincter I fear we have no remedy except a pad, but it is not a fatal complica-

tion; the sphincter vesicæ sometimes acquires more power if the child lives and thrives. Paralysis of the lower limbs must be admitted to be a very serious complication, though it does not entirely exclude hope of benefit from operation. The prospect of prolonged survival is slender, unless the family circumstances are such that every care and appliance can be commanded.

In cases of spina bifida where only slight indications of a hydrocephalic tendency can be observed, it would seem to be proper to give the child the chance of benefit from the operation. At all events, I cannot think it right to withhold this chance. In several of the cases here detailed under different observers, symptoms of impending or threatened hydrocephalus have been noted, which did not recur after the treatment of the tumour. I am fully aware that it may be prudent to avoid coming to any hasty conclusion on this point, yet the balance in favour of health and life may thus be turned, as it has been by even smaller matters.

3. Cases in such a state of collapse as to render any operation unjustifiable, such as those in which advanced hydrocephalus is present, or a state of extreme marasmus from any cause. Under this head it seems almost unnecessary to allude to acephalous and other extreme monstrosities. A marasmic condition has not been frequent in those which I have seen—in fact, it has been rare.

### Time for Operating.

In regard to this point the surgeon has not in every case a choice, and his duty then is, to make the best

selection in his power. Patients may not be presented to him till the most favourable time has elapsed; and even then, parents and others may interpose injurious delays. What, then, is the most favourable time? My experience has led me to the conclusion that within a month, or about a month, after birth is the safest time, and where all other conditions are favourable, no further delay should be recommended.

A reference to those cases which have been under my own care will show that from the first I have acted upon the principle of early treatment, when that was in my power; and in the former edition of this book we find this—"As soon after birth as may seem prudent, the operation should be performed; when the child is well, a fortnight may be allowed to elapse, but an earlier day may be chosen if circumstances demand it."

When the child is two or three weeks old, it is fairly past what are called the accidents of birth, and, if thriving, is in as good a condition for the operation as it can be; the tumour has not had time to reach any great size, though usually it is growing more rapidly than the child's body, in some instances very rapidly.

I am aware that in this matter I differ from the opinion given by the Committee of the London Clinical Society in their report, and repeated in their conclusions, which recommends two months. When this part of their report was first noticed in the medical prints, I took exception to it in the pages of the "Medical Times and Gazette." The report says: "The best result is to be hoped for in children who have reached the age of two months, in whom there

is no paralysis or hydrocephalus, and when the sac is covered by healthy skin." That delays are dangerous is a proverb in common use, and I think it applies here. Infants having spina bifida tumours are always in danger from bursting of the sac, which may occur at any time from over-distension, or from accident, as by rough handling, or undue pressure on the part. I regard also the size of the tumour as an important element in the prognosis of any case, especially its relative proportion to the size of the child, and lay so much stress upon this that I would give the following as a general rule—the smaller the tumour, if injectable at all, the less is the danger of the operation.

Doubtless to this, as to all rules, there are exceptions. Very small tumours are not easily injected, and thus there may be cases where it would be right to wait two months, or even longer; on the other hand, when a tumour grows rapidly and threatens to burst, it may be important to operate much within the month. Surgeons will readily perceive that children having large tumours of this kind have much more to contend with, in the process necessary to their cure, than those with small or moderate-sized protrusions. The surface upon which the injected solution must act is so great, and the irritation and inflammatory condition and suffering so much increased, that deaths from exhaustion are to be feared. Nor must we forget that the danger from shock must also be augmented.

When a tumour has burst, if the aperture has been closed, it may be requisite to operate speedily, so as to avoid another bursting, and the consequent loss of

spinal fluid. In one of the cases narrated (No. XLV.) this course was followed with advantage.

### Mode of Operating.

Assuming that a preliminary puncture is not to be made, my own mode of operating is the following:— The child is laid across the nurse's knees, face downwards, with the side slightly raised on which I intend to make the puncture with the trocar; and I select that side which is uppermost when the child is in the nurse's arms. Thus it may be either the right or the left side, according as the nurse is in the habit of using the right or left arm in supporting the weight of the child. Most nurses use the left arm, and then it is the child's left side that is uppermost. I make the puncture through a part of the covering of the tumour where the skin is normal, if that can be found in the upper part of the side of the tumour indicated. Then withdrawing some fluid, if that be necessary, the injection of the iodo-glycerine solution is made slowly through the canula, and when sufficient has been injected the syringe and canula are withdrawn at same time, while with the thumb and index finger of the left hand I grasp the sac at the punctured aperture, and hold the sides of it together, so that an assistant may apply the collodion there, and when that has been successfully done about a square inch of lint. saturated with collodion, is placed over the point of puncture. To hasten the drying of the collodion, by accelerating the evaporation of the ethereal solvents, we were in the habit of using a fan, when operating in the Royal Infirmary, for which, when not at hand, it is easy to devise some substitute. When the

collodion is completely dried and no oozing perceived, generally a piece of lint is laid over the tumour, and some finely carded cotton wool around it, while the bandage usually worn by infants is so placed as to keep the protective dressings in position, care being taken not to make the bandage too tight.

The articles which I consider it necessary to have ready to hand are—

1. A trocar and canula of medium size.
2. Syringe with glass body and vulcanite fittings and point to fit canula.
3. Bottle containing two ounces of iodo-glycerine solution.
4. Bottle of collodion.
5. Camel's hair pencil or brush.
6. Common probe (silver).
7. Lint and cotton wool.
8. One clean soft sponge.
9. Fan, or substitute for one.
10. Surgeon's pocket case, containing small needles, fine silk thread, and fine silver wire.

In managing a private case it is well to leave the collodion, the camel's hair brush, and the lint and cotton wool in the house where the patient resides, to be readily accessible in event of any escape of the spinal fluid, from displacement of dressings or any other cause.

## Puncture.

It may have been observed that in my early cases a tentative puncture was made, and for the following reasons :—Believing then, what we now know, with much more assured certainty, that the cord itself, or

parts of it, and nerves were present in such protrusions, like others I regarded interference as extremely hazardous in itself, and I was not then certain of being able to close the punctures with collodion, while an idea also prevailed that death from shock or convulsions might be an immediate consequence. Happily these fears were not realized except in very rare instances, and experience having thus proved that tentative tappings were not requisite, we now, in favourable cases, proceed at once to pierce with trocar and canula and inject.

The seat of puncture, already indicated, is to the side of the middle line, at the upper part of the tumour, and in normal skin if possible. The middle line is shunned so as to avoid the cord, or any part of it, if present, for when so it usually occupies a central position. For a similar reason we avoid a part showing a dimple or umbilication, which may indicate the attachment of a nerve.

Neither should the puncture be made in the thinnest part of the sac, which we find surgeons naming the membranous portion, and for the strongest of reasons, that such a wound would not be easily closed—would, in fact, be very difficult to handle in any way. It has been found also that an aperture in the upper part of such a tumour is more easily closed, and less likely to reopen and give occasion to oozing, than one made in the depending portion of such a sac.

The description of Brainard's method, already quoted, states that "a small-sized hydrocele trocar was carried into the tumour at its base"; and some other surgeons have thought of, and practised, a similar proceeding

at the base, or in the skin of the back close to the base.

I have not in any case tried this plan, and rather regard it as rendering the operation more formidable, which in such young infants is undesirable. It has been alleged that an aperture so placed is more easily closed than one on the body of the tumour.

### Means of Closing Puncture.

As we have seen, after injecting, collodion is applied for this purpose, and either common collodion, or collodion flexile, may be employed. If carefully and patiently used this generally succeeds, though in one or two operations I have been tempted to use a fine silver wire, yet I do not like the expedient, and for a long time have not felt the need for such assistance in effecting closure, in which it is so important that we should succeed.

### Dressings.

Of late, in all cases, whether the coverings of the tumour be sound or ulcerated, I have been in the habit of smearing the surface well with collodion, and giving it a few seconds to dry, applying a piece of dry lint large enough to cover the swelling, and over that a little carded cotton wool, which is retained in position by the flannel bandage of the child so commonly employed. The layer of collodion may separate from the ulcerated patch in a few days, and require re-application, but healing takes place rapidly under it, and the part becomes sound.

### The Fluid Injected.

This is now known as the "iodo-glycerine solution," from its composition; consisting, as it does, of ten grains of iodine and thirty grains of iodide of potassium dissolved in an ounce of glycerine. In the histories of the earlier cases, especially the two first, the composition of this fluid, as here stated, is given, and the reasons for its adoption in preference to solutions of iodine in a thinner menstruum. Its somewhat colloidal character, giving almost an assurance that it would be less rapidly diffusible than a spirituous or even a watery solution, induced me to employ it, in the expectation also that it might act very much in the way which the tincture of iodine is found to do in the tunica vaginalis in effecting the radical cure of hydrocele. In both these respects it has fully answered expectation. It will be noticed that in a few instances I have found it advisable to double the strength of this solution, making it twenty grains of iodine and sixty grains of the potash iodide to the ounce of the solvent, yet the original solution has been found quite efficient in the great majority of the cases, whether in my own hands or those of others.

The quantity used at each injection has varied from a few minims to a couple of drachms or more. This ought to bear some proportion to the size of the sac to be operated on, and must be regulated by the judgment of the operator. If sufficient be injected to cause effusion of fibrinous material, so as to fill up the sac, obliterate the communication between it and

the spinal canal, and afterwards contract, the desired result will have been attained, and thus the patient will be saved from one mode of death.

I suspect that some have attached too much importance to the solution and its injection, to the neglect of the other steps of the operation, especially the complete closure of the opening made by the trocar. I have been informed on very good authority that some, who had not taken pains to inform themselves sufficiently, have proceeded to operate, trusting to the injection alone, without precautions, and have, of course, met with disappointment. I had this very forcibly brought before me in a letter sent to me from the centre of England in 1881, by one who had previously acted as clinical assistant in my wards in the Glasgow Royal Infirmary. He says, "A friend of mine who lives near————told me the other day that he had treated three cases of spina bifida with your solution, but they all died. On inquiry I found he had indeed used your solution, but not your method. He stated that there was no tendency to harden after injection, and that the fluid from the tumour continued to ooze till death ensued. He pulled a very long face when I told him how important it was to arrest oozing by collodion. He had not read your book on the subject, but got his information second hand." Thus we see how important it is that every practitioner should remember that the cerebro-spinal fluid is essential to the integrity of both brain and spinal cord. It must never be forgotten that the injection *per se* is only a part of the proceedings requisite to the careful and safe management of the treatment of spina bifida under the method which I have recommended. The

other parts of the operation ought to be rigidly adhered to.

### The Instruments Employed.

In order to suit the consistence of this iodo-glycerine solution, the size and form of the trocar and canula require a remark. While it is desirable to avoid making a large opening in the sac, it is requisite that the trocar and canula should be of such a calibre as to admit of the solution passing easily, though slowly, through the latter. The nozzle of the syringe should fit into the canula, and should correspond closely with it in calibre. For this operation I have had a trocar made, having less shoulder than those used for other purposes, so that it makes a smaller puncture than others of similar size; and the slit in the canula should be short, extending only about one-fourth of an inch into its length. With such instruments, the trocar being rather under what may be called a medium size, the injection is securely made, and the aperture is not large, and usually easily closed by the collodion. Such instruments can be obtained from Messrs. W. B. Hilliard and Sons, 65, Renfield Street, Glasgow. In the absence of instruments specially made for the purpose, the operation can be, and has been, performed with an ordinary medium-sized trocar and canula. In the latest edition of his work on Surgery, Mr. Erichsen says, "It is best done by means of a screw syringe fitted with a fine platinum needle." I have not employed such a syringe, and thus have no experience of it. The syringe I use is made of glass fitted with a tapering vulcanite nozzle. It

holds about two drachms of the solution, and it is easy to estimate by the eye the quantity injected, which, as a rule, varies from half a drachm to a drachm.

### Time for Re-injection, when required.

About three weeks after the first injection is the average time to wait, if nothing is going wrong. By that time it becomes evident whether the first injection has been sufficiently effective, and it allows time for the shrinking of the tumour to become apparent. When failure, however, either complete or partial, becomes evident, a second operation may be undertaken, and a third or fourth. It is seldom that a greater number than three is necessary.

### Dangers of Interference.

We have seen that this malformation, when untreated, leads, and that speedily, to a fatal termination in all but exceptional cases. How small the minority is that survives, it is at present impossible to say with any approach to accuracy; some of them are carefully concealed. Such a condition of matters led me at first not only to devise a solution which might suit for injecting safely, but also led me to use preliminary punctures to ascertain whether such interference would be tolerated. It has been seen that in one instance (Case XL.) such a proceeding was rapidly followed by a fatal termination, though no injection was made. It is a fair surmise that, had such a result followed the tentative

puncture in my first case, a stop might thereby have been put to any further attempts on my part in the same direction. Even now I never proceed to operate without warning parents or guardians that they must be prepared for the worst, that the patient may die in a few seconds, from shock, as happened in Case XIX. The critical nature of the proceeding, therefore, should be patent to the minds of both surgeons and relatives. It follows, also, that surgeons would not operate at all, were they not able to offer to themselves and others a hope, founded on experience, that favourable results are not only possible, but probable.

Besides shock we may have acute meningitis, which probably was the cause of death in Case XL., and which speedily kills by convulsive seizure. We may also occasionally meet with suppurative meningitis, which is not less fatal, though it kills more slowly, and usually does so by exhaustion. The same condition—exhaustion—is one result of loss of the spinal fluid, which is so important that its prevention has been emphasized under the section on *closure* of the *puncture*.

A fear has been expressed lest the operation, and still more the subsequent contraction of the sac, from its effect upon the nerves might produce paralysis. The best answer to this is, that it has not been found to do so, which the histories of the cases abundantly prove.

It has also been feared that the acknowledged tendency to hydrocephalus might be increased by the closing of the sac. Of this there is no evidence of a reliable kind. In some cases the opposite has

been alleged, that with the cure of the spina bifida the symptoms of hydrocephalus have disappeared. Meantime it may be well to admit our ignorance on this point, and, rather than dogmatize, leave it *sub judice*, if not with a mark of interrogation.

Among the conclusions given in the report of the London Clinical Society, under No. 4, we find—

"In cases in which the operation may nevertheless be legitimately performed, we should consider the following as unfavourable circumstances :—

($\alpha$) Distinct evidence of the cord being in the sac, as shown by umbilication or a longitudinal furrow.

($\beta$) A very thin membranous or ulcerated sac.

($\gamma$) Previous rupture of the sac.

($\delta$) The occurrence of a distinct impulse between the tumour and the anterior fontanelle; or a sac, the contents of which are easily returned into the spinal canal.

($\epsilon$). A very early age of the patient."

We find also that conclusion No. 5 says—"The best result is to be hoped for in children, who have reached the age of two months, in whom there is no paralysis or hydrocephalus, and when the sac is covered by healthy skin."

Now, I fully appreciate the great merits of this laborious report, yet, with all due respect for its framers, I may be pardoned for remarking that I cannot concur in the conclusions quoted, except in reference to ($\beta$) and that clause in No. 5 which speaks of paralysis and hydrocephalus. I agree that a very thin membranous sac greatly increases the difficulties of manipulation, and consequently the dangers of

interference, but I take exception to the other points. An ulcerated condition of the surface of the sac is so commonly met with, that I have ceased to regard it as increasing the risks during treatment, though it entails more care and trouble in dressing.

Before I attempted to grapple with this malformation in the way of remedy, I had made up my mind to the presence of the cord, or parts of the cord or nerves, in the majority of such protrusions. Research (anatomical and pathological) has proved this to be correct; but neither pathological research nor experience has yet shown that the presence of nerve-tissue of any kind has increased the risks in dealing with them. I do not, therefore, consider the presence of the umbilication or furrow as at all indicating a condition of increased danger. These marks or depressions are often absent—my own observation leads me to say that absence is the rule—so that their presence becomes the exception, and it is certain that both umbilication and furrow have been found to be absent in cases where it was found that the cord, or part of it, was in the sac.

In regard to previous rupture of the sac, if the aperture has been closed, and kept so, I do not regard the condition as unfavourable to treatment. In Case XLV. such rupture had occurred, and it was afterwards successfully managed. No doubt reopening of the ruptured spot might occur, but is likely to be prevented by the proceedings necessary towards a cure. Granting that fatal oozing has not already occurred, I regard such cases as manageable.

In books, and still more in periodicals, I have seen not unfrequent allusion to the conditions referred to

by the Committee under section (δ), and therefore I wish to avoid being dogmatic in regard to these, but I may be forgiven for being somewhat sceptical as to the certainty of their existence. The presence of a distinct impulse between the sac of a spina bifida and the anterior fontanelle cannot easily be demonstrated. I do not question the *bona fides* of those who persuade themselves that they have seen such, but suspect they may have deceived themselves. I have not been able to satisfy myself that I have seen such; and certainly I have never tried to return the contents of even a small spina bifida sac into the spinal canal, though I can imagine a condition of parts which might admit of it. I cannot, however, consider either of these conditions as increasing in any appreciable degree the dangers of the operation. If we suppose that such cases do occur, there would probably be a greater likelihood of other subsequent mischief, such as hydrocephalus, and no operator surely would be rash enough to affirm that hydrocephalus would not follow in any given case.

Under the section upon the time to operate I have strongly advocated early operation, so that "a very early age of the patient" is not, in my opinion, a circumstance unfavourable to operation; and certainly two months is much too long to wait, and exposes the infant to one of the most fatal risks attending spina bifida, the bursting of the sac. After birth, if the sac be unbroken, it is well to allow the child a week or two to become accustomed to its new surroundings, but then, if the child be well and the tumour itself in a favourable condition, no further delay should be allowed. Certainly two months is much too long to

wait. I should say, rather operate within the month, or as near that as possible. Reference to the cases will show that I have always preferred to operate early when I had the opportunity.

### Statistics of this Method.

What are the results of this method as shown by figures? The London Clinical Society's report contains a table of seventy-one cases said to be treated on this method, and of these thirty-five recovered, twenty-seven died, five were unrelieved, and four relieved: the proportion of cures is thus about 55 per cent.

Taking the cases recorded in this volume, we find one case of spontaneous cure, two cases of death after puncture without injection, fifty-five successes by puncture with injection, with ten deaths, making in all fifty-four cures out of sixty-seven cases, and (still leaving the spontaneous cure out of view) this is exactly a percentage of 83·3 of recoveries, against 16·7 deaths—a very encouraging result. It may be at once admitted that this is a very favourable estimate; the tendency to report favourable, rather than unfavourable, cases is so well known, and so manifest in the history even of nations. In my own hands the percentage of success has been slightly lower than the above: six deaths out of twenty-nine cases gives a mortality of 20·7 per cent. nearly, which leaves the percentage of success at 79·3. As in other operations, runs of success have been experienced; for example, my first five cases were all successful, and during the present year (1886) I have seen and treated four with equal good fortune; and there has been no

choosing of cases, this number including all that have been presented to me.*

But I may be asked, nay, I have been asked, what does this treatment profess to effect? It professes to save infants who are the subjects of spina bifida from death by the bursting of the sac and its consequences. Even cranial meningoceles are not beyond its influence. It does not pretend to prevent hydrocephalus, to which such infants may be more than usually predisposed, nor to restore power to paralysed limbs, nor to sweep away other concomitant deformities.

Laying aside the question whether we are able to cure over 80 per cent. of the cases or not, or whatever may be the precise percentage, it remains as an accepted fact that the great majority of cases of this malformation may now be saved; and if even one-half become cured, the saving of infant life is great, and may soon amount to many thousands. Is it too much to hope that, like other surgical procedures, such as ovariotomy, for example, the operation may become more and more safe and effectual, and that the prognosis in regard to cases of spina bifida may be immensely improved, so that in this respect the infants so afflicted may be placed nearly on the same level with the average of other children.

* Since the above was written other two lumbar cases have been treated by me. One in a child eight months old, formidable from its size alone, which succumbed about thirty hours after injection—the operation ought to have been performed seven months earlier; the other with paralysis of both legs, operated on when sixteen days old, has been perfectly successful after one injection. Thus, in 1886, six cases in all, five succeeded and one failed, due to delay.

## List of Spina Bifida Preparations

*As noted in the Catalogue of Anatomical Preparations in the Hunterian Museum in Glasgow College, under the heading "Brain."*

No. 47 *s.* Spina bifida in a child at birth, unopened; tumour size of an orange.

No. 48 *s.* Ditto, very young; external integuments removed; the spinal process of last lumbar and first sacral vertebræ wanting, forming an oval of an inch long and half an inch broad.

No. 49 *s.* Ditto, older, dissected; dura-matral coat likewise wanting, and the nerves pushed out, forming right angles nearly with medulla spinalis, and adhering to the sides of the sac.

No. 49 *a. s.* A spina bifida from a child; the nerves not pushed out as usual, but in their natural situation.

No. 49 *b. s.* Ditto.

No. 50 *s.* Ditto, a little older.

No. 51 *s.* Ditto, half injected.

No. 52 *s.* Ditto, injected.

No. 53 *s.* Other half ditto, ditto.

No. 54 *s.* Ditto, uninjected.

No. 55 *s.* A very elegant dissection of ditto; the nerves of cauda equina seen forming right angles with the vertebral canal, passing through the middle of the sac one inch and a half in length.

No. 56 *s.* Ditto, ditto, very large, as one's fist nearly; the outward part of the sac beginning to ulcerate; the bag would have burst and killed the patient soon.

At the end of a paper in the 17th volume of the "Journal of Anatomy and Physiology," entitled "Contribution to the Study of Spina Bifida, Encephalocele, and Anencephalus," Professor Cleland, of Glasgow, writes regarding these specimens—"Since writing these pages, Dr. Morton, of this city, whose successful treatment of spina bifida is justly a subject of interest to the profession, has attracted my attention to the question of the position of the nerves in cases coming before the surgeon, and, with him, I have looked at the specimens in William Hunter's collection in the University of Glasgow."

Of preparations from ten different cases, only two have the tumour completely covered with true skin. One of these (49 *a*.) is a tumour three-quarters of an inch in diameter. In it the cavity shows on the deep side a slight linear depression, as if communicating with the cord, which is situated in front; and on one side the deep wall is dissected away, showing the sacral nerves lying normally, and coming from a level above the linear depression. The other skin-covered specimen (47) is large. It was unopened, but, with the kind permission of Professor Young, the Curator of the Hunterian Museum, I have opened into it, and find, as I expected, the cord in this instance also on the deep side of the dropsical cavity. This I expected, because I judged that such a tumour must be the result of delayed closure of the cord, or reopening of its canal behind at an early date. In the bottom of the cavity there is a depression, in connection with which the cord seems to end; at the same time there is a communication with the arachnoid space.

Without entering into detailed description of the other specimens, it may be stated that they all of them present membrane of a non-cutaneous kind on part of their surface. In some of them the cord seems to end distinctly in connection with the superficial membrane. Some show the nerves of opposite sides, coming off from the membranous surface, crowded together in the middle line, there being evidently dropsy of the anterior sac of the arachnoid to such an extent as to lead to obliteration of the posterior sac. In others the nerves arise from the covering of the tumour in two series, which may be marked on the surface by punctiform depressions at their attachments, or which may spring from the lines of junction between a central membranous part of the tumour and two lateral skin-covered parts.

"For practical purposes, spina bifida may be described as divisible into two kinds, the skin-covered and the membranous. The skin-covered are posterior to the spinal nerves; the membranous are traversed by nerves which arise from the membrane. But it ought to be understood that these nerves proceed to the intervertebral foramina, and have no connection with developed spinal cord."

# APPENDIX.

In relation to the cases previously given, the following remarks of others on certain cases of greater deformity than usual are possessed of some interest, while the case of the child Wilhelmina George presents features of its own, which render its publication instructive, and consequently desirable. The same may be said of a case of cranial meningocele which is now appended to it.

## Manser's Case.

In the "British Medical Journal" of March 20th, 1875, Dr. Morton, referring to Mr. J. E. Burton's case of spina bifida, reported in the "Journal" of the 13th March, says: "It belongs to a class of cases all but absolutely hopeless, in which the lower limbs and lower part of the trunk of the body are paralysed, and the infants usually die in a few days. Instances of longer survival are rare indeed, and I am not aware that there are any on record in which the paralysis was so very extreme as in Mr. Burton's case."

I have at the present time under my care a case precisely similar to the one described by Mr. Burton,

and the child is now eleven weeks old. It was born on December 7th, 1874, and was a healthy-looking and well-made female child down to the seat of the cleft in the spine.

Over the upper two lumbar vertebræ was a fluctuating tumour about six inches in circumference, having a well-marked pedicle. The tumour had two small superficial ulcerations, from which a thin ichorous discharge exuded; the remainder of its surface was covered by a somewhat dense, opaque-looking integument. There was talipes varus of both feet, the plantar surfaces being accurately apposed to one another, and quite flat and smooth, as if they had been kept in perfect apposition during the period of gestation.

Both legs were flexed upon the abdomen, and had an arched appearance, with the concavity towards the abdomen. There was no appearance of the natural fold of the buttocks or of the popliteal space. The whole length of the legs, from the tuberosities of the ischia to the heels of the feet, presented a smooth, unbroken, convex surface. There was paralysis of the sphincter ani. This state of things continues. I did not consider the case at all fitted for operative interference, and in this my partner, Mr. Marsack, concurred. At the present time the tumour and the lower limbs are much in the condition I have here described. There has been no increase in the size of the tumour,—rather a diminution.

The child for the first month appeared to thrive; since then it has gradually wasted, until now it is quite a skeleton. There have been no convulsions, but it has suffered severely from eczema of the

head, face, and trunk. The surface of the tumour has continued to give forth a thin and sometimes offensive discharge. This case appears to be in all respects similar to Mr. Burton's, except that my patient has no rotation outwards of the legs. I could not see any object in attempting to cure the spina bifida, as there appeared to be no prospect of relieving the distorted and paralysed lower limbs; and I felt, as did also the parents, that the sooner the poor little deformed creature quitted this world the better.

Probably the injection of iodine, as in Mr. Burton's case, would have expedited matters, but possibly it might have prolonged the child's life, which was not an issue to be desired.

FRED. MANSER, M.R.C.S.E.

Tunbridge Wells.

### LISBON CASE.

At the meeting of the Lisbon Society of Medical Sciences, on February 17th, 1872, Dr. Camara Cabral communicated a case of congenital spina bifida which he had successfully treated. The patient was a child aged twenty-five days, which was brought into the St. Joseph Hospital on November 21st. It had in the lumbo-sacral region a swelling 40 centimetres in circumference, 17 in vertical and 10 in transverse diameter, and 6 in depth. It fluctuated, was transparent like a hydrocele, and appeared to contain not only fluid, but some solid body. Pressure on it did not produce any convulsions, nor were there any paralysis or other symptoms denoting lesion of the

spinal cord. It was therefore concluded that the tumour consisted exclusively of a hernia of the meninges, filled with fluid. On the 29th it was tapped with a Dieulafoy's trocar, and 400 grammes of a transparent yellow fluid, containing an abundance of albumen, were removed.

Compression was applied by means of adhesive plaster. No symptoms followed the operation, beyond some vomiting and loss of appetite. Some days later, the tumour having again enlarged, 250 grammes of liquid were removed; and on December 14th, 425 grammes. The defect, which was found to be in the situation of the fourth and fifth lumbar vertebræ, was gradually diminishing. On a fourth and a fifth occasion, puncture was performed at intervals of some days, the quantities evacuated being respectively 175 and 125 grammes, and the fluid being more highly albuminous than before.

After the last two operations there was some meningitis, which yielded to ordinary remedies. The child made a good recovery, and was exhibited at the meeting at which the case was described.

O Correio Medico de Lisboa.

March 1st, 1872.

## Case of Spina Bifida.

Wilhelmina George, aged eight weeks, was admitted on November 15th, 1874, into Ward 28 of the Glasgow Royal Infirmary. At the upper part of the posterior cervical region, and near the occiput, a tumour is situated, which at birth was loose and

flaccid, and contained little or no fluid, but in the course of a few weeks the fluid gradually increased in quantity, until now the tumour, which is of a globular form, measures nine inches in circumference, and is apparently capable of containing from six to eight ounces of fluid. It possesses a peduncle, the circumference of which measures about four inches. The skin over the tumour is healthy-looking, and has no appearance of impending ulceration. As the child is suffering from cough, it is considered prudent to delay operation for a few days.

November 25th.—The tumour was punctured to-day, and about two ounces of fluid drawn off.

December 1st.—Tumour was again punctured, and about the same quantity of fluid drawn off as on the previous occasion, and a little of the following solution was then injected:—

℞ Iodi. grs. x.; Potas. Iodidi grs. xxx.; Glycerine ℥j.

December 7th.—Child doing well; tumour measures eight and a half inches in circumference.

December 15th.—Tumour tapped, and one and a half ounces of fluid withdrawn, then injected with a little of the above solution.

December 17th.—Child pretty well; tumour a little swollen and tender to the touch.

December 29th.—Tumour was punctured to-day, and five drachms of a reddish fluid removed, and a portion of the iodo-glycerine solution then injected. Dr. Morton, being dissatisfied with the quantity of the solution injected through the canula, withdrew it, and, inserting the nozzle of the syringe, injected

freely into the tumour, which has been getting solid and less tender to the touch.

December 31st.—Allowed to go home; to come back in a week.

January 6th.—Tumour more solid, looking well, still a little translucent.

February 15th.—Domestic affairs having required the presence of the mother at home, the tumour has not been seen till now since January 20th, when it was looking well. It has increased in size, being now ten inches in circumference, and round the peduncle five and a half inches. The child has been thriving well, and its general health has been unaffected by each operation. This morning the tumour was punctured for the fifth and injected for the fourth time; about three ounces of fluid were removed, and two drachms of the iodo-glycerine solution injected.

February 16th.—Child doing well; sucked vigorously, and rested well during the night. The tumour is considerably inflamed, and tender to the touch; left the hospital to-day for home, its mother promising to bring it back on the 23rd.

February 23rd.—To-day the tumour is very much inflamed. Dr. Morton punctured it and drew off six ounces of fluid, and then injected two and a half drachms of the iodo-glycerine solution.

March 1st.—Tumour still translucent; to-day three ounces of fluid were drawn off, and three drachms of a solution exactly double the strength of that previously used was then injected. The fluid drawn off was tested for sugar in the following manner:—A quantity of Fehling's solution was boiled in an

ordinary test-tube for the purpose of ascertaining whether it was reliable or not; the result being satisfactory, a few drops of the fluid were then added, and the whole boiled, when the characteristic reaction indicating the presence of sugar was obtained. This was afterwards confirmed by Professor Ferguson, of the University of Glasgow.

March 10th.—The tumour was tapped to-day, and more than three ounces of fluid removed; a seton medicated with the iodo-glycerine solution was then introduced. The patient apparently suffered little, and was sucking vigorously ten minutes after the operation, and remained so well that on March 13th the child was allowed to be taken home.

March 14th.—On awakening this morning at 8.30 the mother found the clothes of her child literally soaked with fluid that had escaped from the tumour. She brought the child to the Infirmary at 10.30 a.m. Collodion and resin plaster were applied, but failed to control the escape of the fluid, which ceased for a while after applying lint soaked with collodion. Child much exhausted, and had a convulsive fit.

March 15th.—Child calmer than yesterday, but extremely weak, and continuing to sink, died at 1 p.m.

*Remarks.*—Every justifiable effort was made to procure a *post-mortem* examination, but in vain, as the mother persistently refused. This is much to be regretted, as by this alone could it be ascertained whether the sac communicated with the spinal canal or with the cranial cavity; if the latter, then it would be called an encephalocele. The large quantity of fluid withdrawn is worthy of remark; it could

not be less than twenty-five or twenty-six ounces. Upwards of twenty-one ounces were actually measured, and at every operation there was an escape of a portion uncaught and unmeasured, so that twenty-five or twenty-six ounces may certainly be considered within the mark.*

Four times was it injected with iodo-glycerine solution of the strength usually employed, and once with a solution of double the usual strength, and none of these injections seemed to cause any injury, not even a disagreeable symptom, yet none of them seemed effectual in causing shrinking of the cyst or tumour. So many failures naturally produced a little impatience, and strengthened my desire to succeed, and as such free handling had done no harm, I was tempted to think of a seton, and used it. This I now regard as an error, and it is named chiefly to counsel its avoidance in future. Still, even the seton did not, as such, do any mischief; it was the drain of cerebro-spinal fluid that prostrated and killed the child, thus furnishing another proof, if that be wanted, of its baneful consequence. Had this child been retained under such surveillance as we find in an hospital, it might have been saved.

### Case of Cranial Meningocele.

Margaret Turnbull, aged six weeks, from Aikenhead Road, Govanhill, was admitted into Ward 28

* It will be observed, however, that this was a gradual abstraction; it is probable that even half this quantity drained off at once would have proved fatal.

of the Glasgow Royal Infirmary on November 16th, 1880, with meningocele. (My assistant of that time has not favoured us with any description of the tumour at this stage.) It was situated on the occiput over the lambdoidal suture.

November 17th.—It was tapped with a small trocar and canula, and about two ounces of fluid let out, which was clear, colourless, slightly alkaline, specific gravity 1005 ; gives a precipitate on boiling, especially if a drop or two of acetic acid is added previously ; also a precipitate on adding nitric acid. Minute residue of soda salts on evaporation, but no sugar present.

November 21st.—A few drops of the iodo-glycerine solution injected, with no apparent effect.

December 4th.—About two ounces of fluid drawn off, and two drachms of solution injected.

December 13th.—Two ounces of fluid drawn, and two drachms of solution injected.

December 24th.—An ounce and a half of fluid drawn, and two drachms of iodo-glycerine fluid injected.

January 4th.—Three and a half ounces drawn off, and three drachms of usual solution injected.

January 15th.—Three ounces drawn, and two drachms injected.

January 16th.—Child doing well. Tumour is tense and tender to the touch.

February 3rd.—Tumour measures eleven inches in circumference, and six and a half inches round pedicle, which is about double the size it was when admitted.

February 4th.—Tumour tapped, and two and

a half ounces of fluid drawn; four drachms of iodo-glycerine solution injected, and closed as before.

February 5th.—Child in its usual health; slept well during night; tumour tender to the touch and inflamed.

February 22nd.—Tumour tapped, five ounces of fluid drawn, half an ounce of doubly-strong iodo-glycerine solution injected, and collodion applied. Tumour measured twelve inches in circumference.

March 8th.—Circumference of tumour nine and a quarter inches; feels more solid. About an ounce of fluid drawn off, but it did not come freely, and two and a half drachms of iodo-glycerine solution (double strength) injected.

About this time the child was taken home, and was visited there, and on July 9th this report was given:—"Looks rather emaciated, and has had several convulsions; it has a vacant stare about the eyes, and the head seems heavy. Tumour is tense and solid in feel, measures nine and a quarter inches in circumference (the same as on March 8th), and six and three-quarter inches round the pedicle."

These symptoms indicated the onset of hydrocephalus, from which the child died about a year afterwards. I regret that the opportunity of obtaining a *post-mortem* was lost by the indifference of my then assistant. It would have been interesting to ascertain the precise condition of the parts. That the tumour was solidified is certain; apart from its solid feel, the measurements almost establish this, as it remained of the same size from March 8th

onwards. Even if this case had no other value, it proves with what impunity such injections may be performed.

Not one of these numerous punctures and injections produced any immediate bad effect whatever, not even shock. It will be noticed that in dealing with this meningocele I cautiously felt my way, and we may reckon this at least prudent. Still the question suggests itself whether a bolder course might not have had a better result. Probably it would have led to an earlier consolidation, and thus diminished the number of operations.

On the whole I think the history of this meningocele justifies the supposition that there may be instances in which a more complete, and even a permanent, success may be attained.

In the work published in 1885 under the title "Operative Surgery in the Calcutta Medical College Hospital," by Dr. Kenneth McLeod, we find this at page 299 :—

*Spina Bifida Tapped and Injected.*—Mahometan male, one year old. Large fluid tumour over sacrum, size of a fœtal head, twelve inches in circumference; tapped with a hypodermic syringe, and half a drachm of Morton's iodo-glycerine solution injected. Refilled in a week. This was repeated eight times at intervals of seven to ten days, from five to six ounces being evacuated on each occasion. Fever followed the first two operations. It was intended to increase the amount of fluid injected, but the parents grew impatient, and withdrew the child after sixty-four days' residence in hospital. The treatment did no good whatever. A large aperture could be

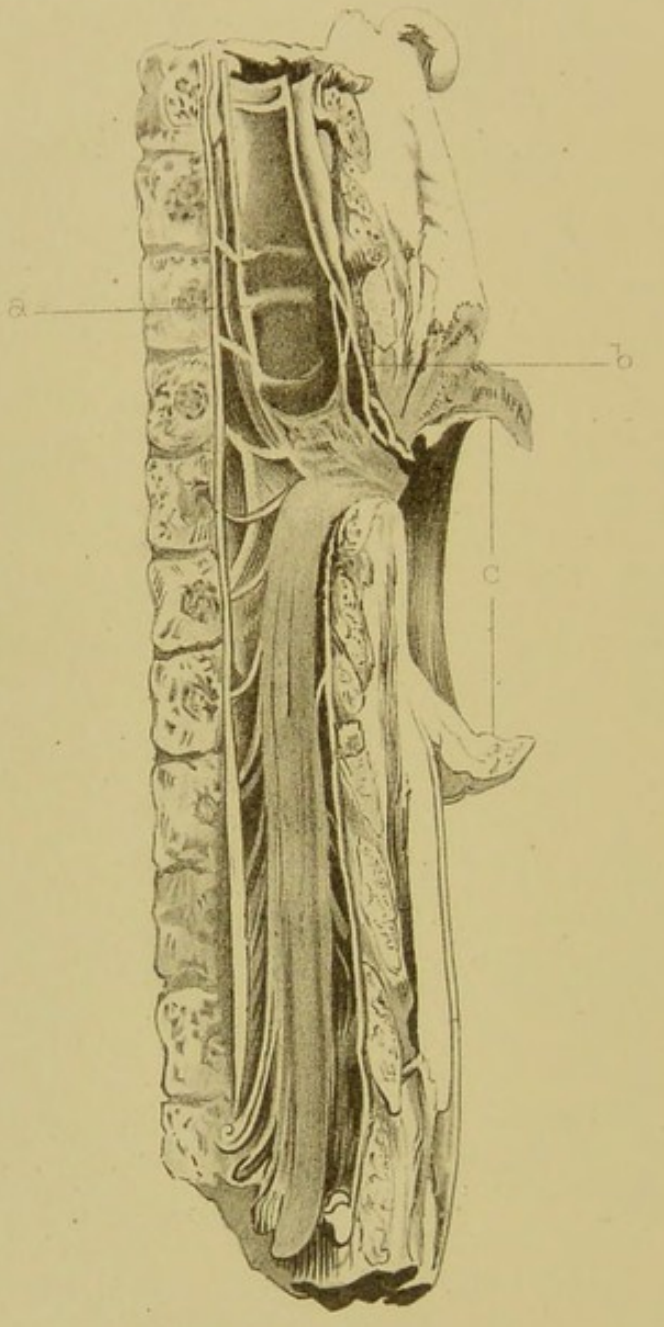
discovered in the back of the sacrum when the tumour was emptied."

I quote this chiefly to show that the treatment was inadequate to the case; more of the solution was required, and a larger syringe. With a hypodermic syringe probably very little passed in; more of the fluid or a stronger solution was indicated. The repetition of the operation was too frequent, causing too great drain of spinal fluid, if it was such. Failure was nearly certain, but Dr. Macleod was on right lines when he thought of injecting more.

*(Plates and descriptions to follow.*

*London: Pardon and Sons, Printers, Wine Office Court, Fleet Street, E.C*

Plate 1




Stephen Miller (Glasgow) del

Danielsson & Co. lith.

## DESCRIPTION OF PLATE 1.

Vertical section of the parts concerned in a spina bifida of the mid-dorsal region; the chief part of sac has been removed.

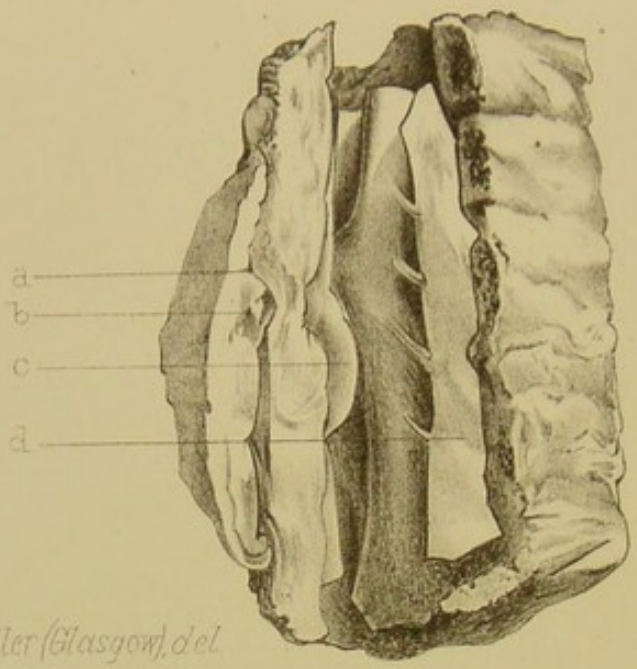
*a*.—Dilated central canal in the portion of spinal cord above the protrusion.

*b*.—Incomplete septa crossing the dilated canal.

*c*.—Remains of sac-wall.

There is a slight prolapse of the cord into the mouth of the sac.

Plate 2.




Steph. Miller (Glasgow) del.

Fig. 1.

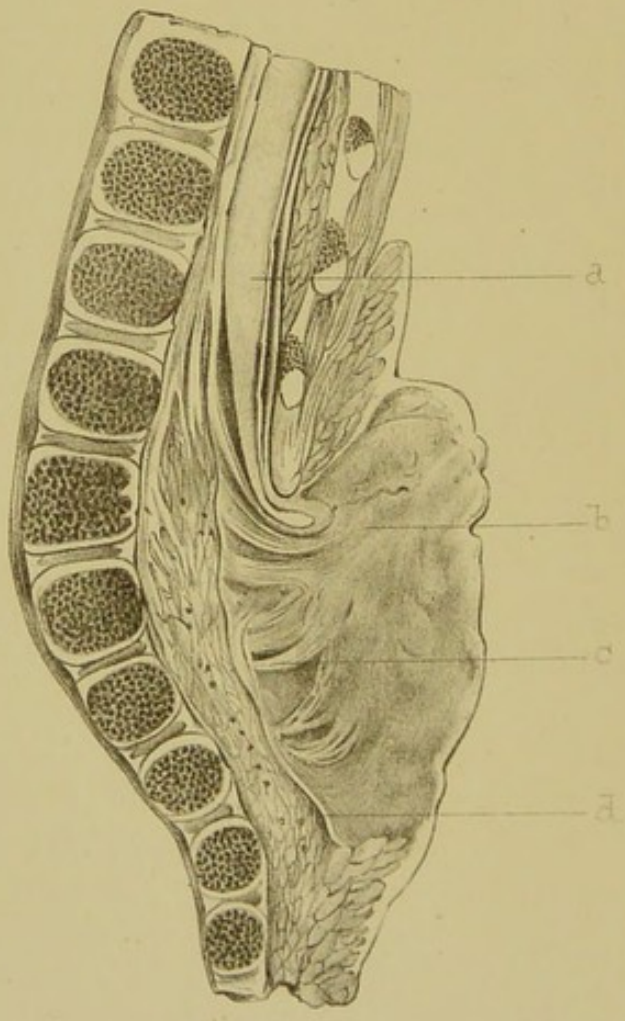



Fig. 2.

S. G. Shattock del.

Danielsson & Co. lith.

## DESCRIPTION OF PLATE 2.

Fig. 1.—Portion of spinal column from the dorsal region; the laminæ of the right side have been removed to show the spinal cord.

*a.*—Outer margin of the aperture in the neural arch through which the protrusion has occurred.
*b.*—Neck of the consolidated protrusion.
*c*, *d.*—Reflected portions of the dura mater.

The line of origin of the nerve-roots is quite normal. There is slight prolapse of the cord into the mouth of the sac, as in the preceding specimen.

Fig. 2.—Vertical section of lower part of the spinal column after the cure of a spina bifida by the injection of Dr. Morton's iodo-glycerine solution.

*a.*—Lower portion of the spinal cord above the sac.
*b.*—Young connective tissue produced after the injection and filling the sac; into this the spinal cord is traceable for a short distance.
*c.*—Nerve-roots lying in the new connective tissue, and passing forwards to the intervertebral foramina.
*d.*—Anterior divided edge of the dura mater.

Plate 3

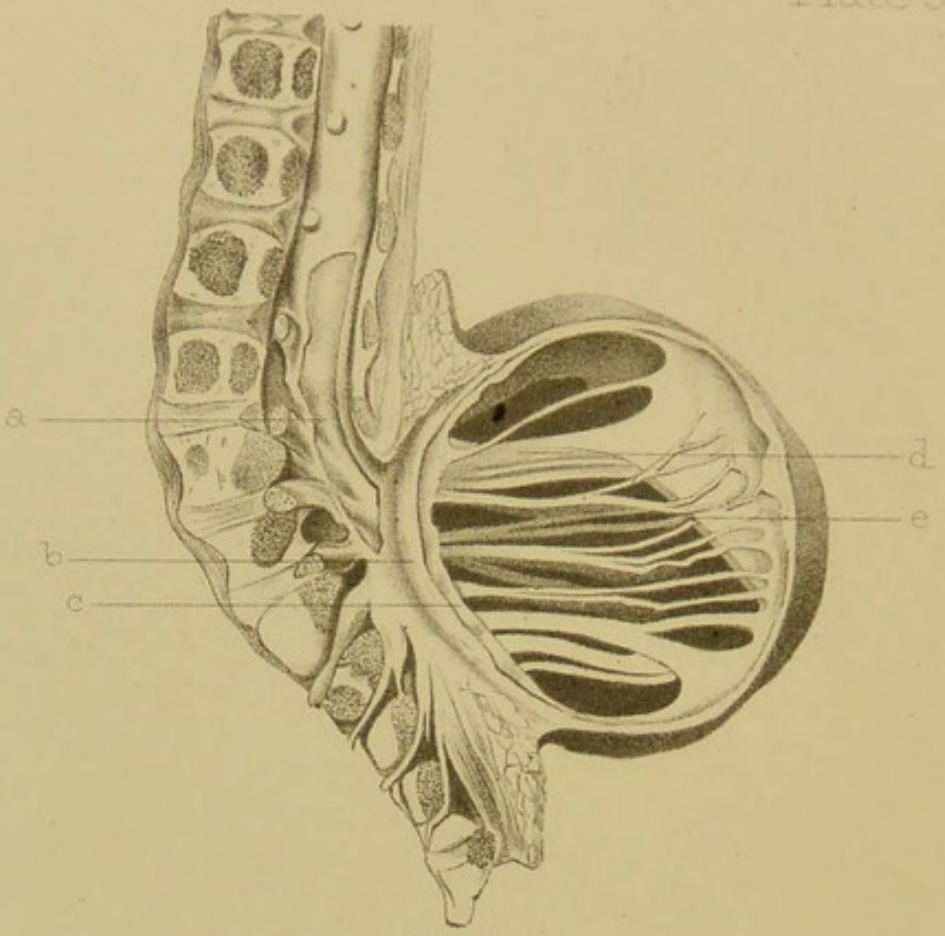



Fig 1.

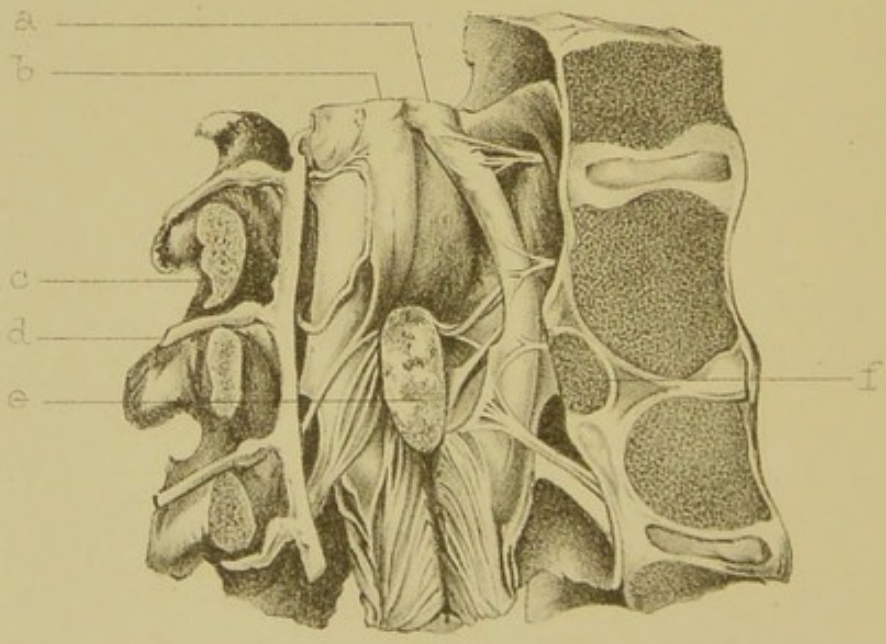



Fig 2.

S.G. Shattock, del. Danielsson & Co. lith.

## DESCRIPTION OF PLATE 3.

### Fig. 1.

Dissection of the parts concerned in a lumbo-sacral spina bifida, showing *the typical anatomical disposition* in cases of meningo-myelocele. A portion of the sac-wall has been cut away to show the interior.

*a.*—Surface of cord, covered with arachnoid, exposed by the removal of portion of dura mater.

*b.*—Dura mater entering into the formation of the sac-wall.

*c.*—Arachnoid lining the sac.

*d.*—Lower portion of the spinal cord crossing the interior of sac; some of the nerve-roots pass forwards upon it, towards the intervertebral foramina. The other nerve-roots arise from the posterior wall of the sac in a vertical series and traverse the space horizontally.

*e.*—Falciform process continuous with the pia mater, separating the anterior and posterior roots of the nerves of the left side; there is a corresponding process on the right side.

### Fig. 2.

The last two dorsal with the upper two lumbar vertebræ. The bodies of the vertebræ have been divided vertically, as well as the pedicles of the arches on its right side; the right halves of the bodies have been entirely removed, so as to expose the spinal cord; the cord has been more fully exposed by turning back the laminæ of the right side. The cord is perforated by a bony process which crosses the canal.

*a.*—The left division of the cord above the perforation, consisting in its upper part chiefly of the anterior median column; in its lower part it is almost of the same size as the right.

*b.*—The right division of the cord.

*c.*—Sheath of dura mater.

*d.*—The last dorsal nerve.

*e.*—Divided surface of the osseo-cartilaginous process (by which the cord is perforated) turned forwards.

*f.*—Anterior portion of the same process connected with the bodies of the vertebræ.

Plate 4.

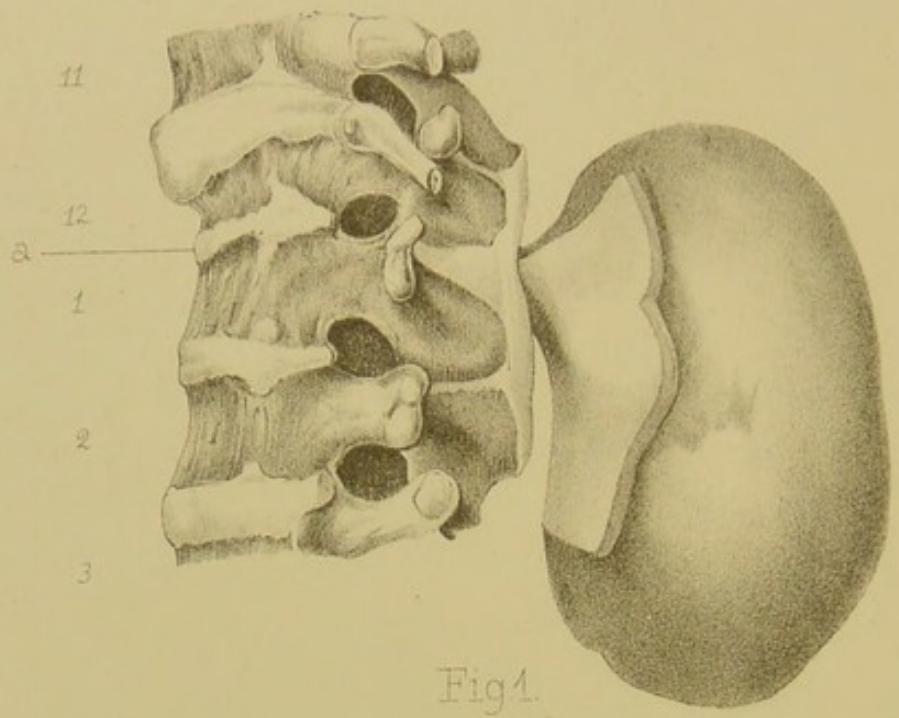



Fig 1.

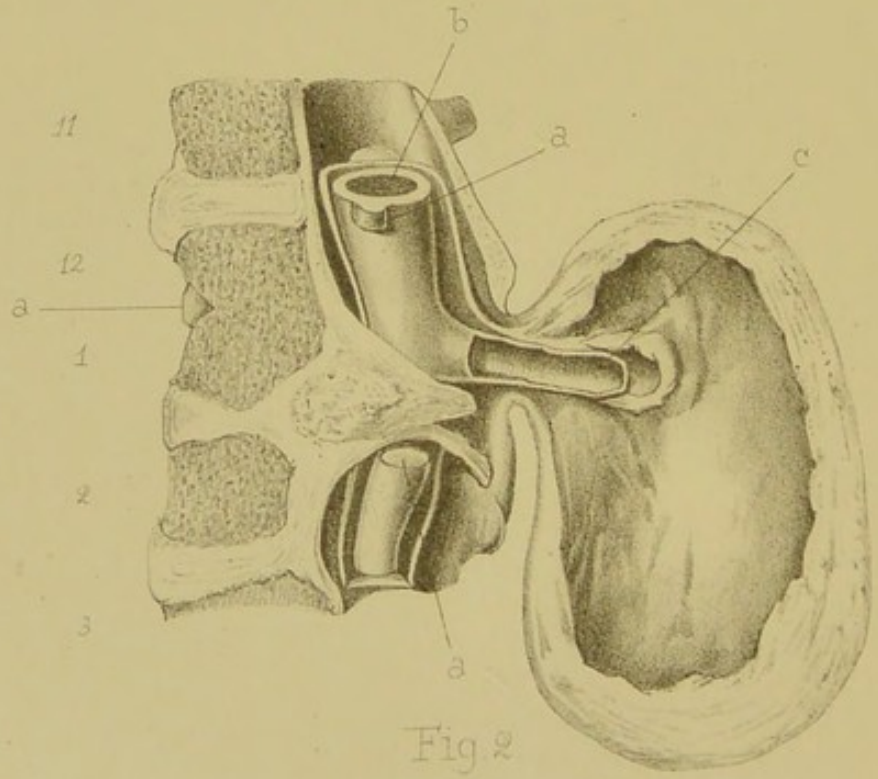



Fig. 2.

Danielsson & Co. lith.

## DESCRIPTION OF PLATE IV.

Fig. 1. External view of specimen in College of Surgeons.

Fig. 2. Sectional view. 11, 12, 1, 2, 3, the bodies of the lowest two dorsal and the upper three lumbar vertebræ ; *a*, the band of cartilaginous intervertebral substance encircling the fused bodies of the 12th dorsal and 1st lumbar vertebræ. The bony process is seen projecting backwards from between the 1st and 2nd lumbar bodies, its hollowed posterior part presenting in section a bifid appearance ; *b*, central canal of spinal cord ; *c*, tubular prolongation of it between the arches of the 12th dorsal and 1st lumbar vertebræ, covered by an extension of the dura mater ; *d*, upper and lower cut ends of the smaller division of the cord, which passed on the left side of the osseous process.

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—— Outlines of Infectious Diseases, 7
Allingham on Diseases of the Rectum, 14
Anatomical Remembrancer, 3
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———— Outlines of Medical Treatment, 8
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—— on Principles and Practice of Medicine, 7
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Granville on Gout, 9
———— on Nerve Vibration and Excitation, 9
Guy's Hospital Formulæ, 2
———— Reports, 2
Habershon's Diseases of the Abdomen, 9
———— Liver, 9
———— Stomach, 9
———— Pneumogastric Nerve, 9
Hambleton's What is Consumption? 8
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