was recommended. My advice was not complied with. Vigorous antisyphilitic treatment was adopted, and, no benefit accruing, was given up.

Four years afterwards I made the following notes as to her condition: Headaches were no longer constant, but the sight has always been worse after an attack. Her features are not acromegalic; her gloves are still of the same size; her boots a size larger. Is much stouter than she was; she looks bright. Amenorrhoea still present. Smell, taste, and hearing are normal.

R. V. $\frac{2-3 \text{ metres}}{\text{Fingers}}$ (on the nasal side).

L.V. No perception of light.

R. Hemianopic pupillary reaction.

Ophthalmoscopy: Right and left discs—consecutive optic atrophy.

When seen a month ago, R.V. $\frac{1 \text{ metre}}{\text{Fingers}}$.

Headaches no longer trouble her.

Prognosis and Treatment.

1. If there be only symptoms of hyposecretion, as in Madelung's case, in which the syndrome developed after a gunshot wound of the base of the skull involving the sella turcica, symptomatic treatment should be adopted and an encouraging prognosis given as to duration of life.

2. If the tumour syndrome be also present at least a decompression operation is indicated.

Before concluding this address I would strongly urge the advantages of a suboccipital decompression operation as a palliative measure in all diseases, irrespective of their etiology, in which such symptoms as headache, optic neuritis, and vomiting are aggressive features; though in less severe conditions—milder cases of Bright's disease for example—treatment by lumbar puncture might suffice. I believe, with others, that the dura mater, stretched like the sclerotic in glaucoma, is the predominating factor in the production of headache; and that the optic neuritis, and frequently the vomiting, is almost invariably due to an obstruction to the escape of cerebro-spinal fluid. This, again, is parallel to the locking of the filtration angle in glaucoma.

Time will not permit me to dilate upon the presence of optic atrophy in hyperpituitarism and that of optic neuritis in hypopituitarism, so I will conclude by thanking my colleagues of the Royal Halifax Infirmary for their valuable assistance on many occasions; and Dr. Pollard, our late Senior House-Surgeon, for much help in the collection of the material for this address; and Mr. Wrathall, of the same infirmary, for the photographs and radiograms. I am greatly indebted to Professor Hochenegg and to Dr. Exner for kindly adding details of some of Professor Hochenegg's unrecorded cases when sending me the reprint of Dr. Stumme's paper. Professor Halstead's paper on the Operative Treatment of Tumours of the Hypophysis has been of the greatest assistance to me, and no less so have been other brilliant communications of our American confrères on the Pathology and Surgical Treatment of Diseases of the Hypophysis.

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A Fourth Report

ON

EXPERIENCES WITH SPINAL ANALGESIA IN REFERENCE TO 2,354 CASES.

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SOME years ago I published in this JOURNAL¹ all the cases, without exception, in which spinal analgesia had been employed in my own hospital work, with a view to a study of its merits or demerits. Every one was carefully noted by officers specially appointed for the purpose in tables recording all those points upon which information was then considered to be particularly needed. Since then the procedure has been adopted in a large number of cases, and more and more frequently by all the surgeons of our hospital, some more and some less. One of our junior anaesthetists, after due study and observance of the details which had been found needful, has lately qualified himself to undertake this branch of anaesthetics, and all our operators, who for one reason or another do not wish in any particular case to carry out the procedure themselves, can now have it well done for them. Every effort has been made to secure uniformity of method in following the principles and details suggested in the papers referred to, and in recording the cases. All this has resulted in the accumulation of a further series dealt with in precisely the same way. Taken with those already published from the same institution, they offer an opportunity for further study of the procedure. But besides, I am permitted to refer to the experiences of several surgical friends who have adopted the same principles and closely followed our ritual in large numbers of cases in their own hospitals, and have kept their records scrupulously on the same plan. Digests of these they have kindly furnished me with.

The figures to be now reviewed embrace the following: (1) Cases at University College Hospital, including my own first 300 and 475 since done by myself and Dr. Felix Rood, our Junior Anaesthetist, who has lately relieved me of a good deal of the labour in my own cases, and has used the procedure largely for our other surgeons as well. (2) Those of the Military Hospital at Millbank, at the hands first of Majors C. Spencer, J. H. Houghton, and O'Shea, R.A.M.C., and later of Major Pilcher, D.S.O. (3) Those at the Cambridge Hospital, Aldershot, done independently by Major J. H. Houghton. (4) Those at the Military Hospital, York, by Major C. Spencer himself. (5) The cases at the Dreadnought Hospital under the care of Mr. L. McGavin and his assistants. To all these gentlemen I owe the most cordial thanks for kindly supplying me with a digest of their tables and allowing me to make the present use of them; also to Dr. Rood for an abstract of our joint records. To Mr. McGavin I am particularly indebted. The figures he has kindly supplied to me are abstracted from a paper by him now in the hands of the editor of the *Practitioner* for early publication, for whose courtesy in sanctioning their present use I am very grateful. Mr. McGavin's paper is sure to be most interesting and valuable, giving many details of his cases as it will do, and also his independent opinions, though working on exactly the same lines. It embodies his own work and that done under his supervision by his assistants, Mr. O'Leary and Mr. Gwynn Williams, previously my own House-Surgeon before going to the Dreadnought Hospital, and now returned to us as Surgical Registrar.

Since August, 1908, I have not thought it desirable to publish my own further experiences in this field, for two reasons, though strongly urged to do so. In the first place, further relatively small series would prove nothing that is not already known. In the second, it seemed more to the point to give time for a number of serious individual workers to complete substantial groups of cases dealt with on exactly the same lines, which might be fairly combined into a large homogeneous collection from which conclusions could more safely be drawn as to mortality and other drawbacks than from each separately. Such a homogeneous record is now offered (for as much as it is

worth), for all those who have furnished their experiences have worked together, first, at our own hospital, and then independently, though on precisely the same plan and with the identical instruments and solutions at their own.

Moreover, all our collaborators have done their work in public institutions before colleagues, residents, students and visitors, subject to criticism—adverse and favourable—with every conceivable check on undue enthusiasm or carelessness.

Again, the series now combined are from the practice of surgeons who employ all kinds of anaesthetics, general, local, and spinal, and, in our own case, that most recent innovation, the intravenous ether narcosis, first devised by Professor Burkhardt, of Würzburg, and put in practice very successfully for us by Dr. Rood; and are, therefore, qualified to contrast them one with the other. I venture to think that all the questions as to the relative values of the different anaesthetics can only be safely threshed out in public hospitals dealing with large numbers of patients, in which competent observers employ them all under every form of scientific control and the wholesome check of publicity; and that the less we hear of private unchecked excursions into this domain, with statements about small numbers, not published, the better. In my own work, not one-third of my patients are operated on so far under spinal analgesia. In many, local and regional analgesia are employed, and in the rest one or other form of general anaesthesia.

The method employed for all these cases of spinal analgesia followed the general plan formulated by Professor Bier, its talented inventor, but modified in some, as I believe, important particulars.

The solution for injection was devised by myself at the outset under the conviction, supported by many experiments (see Reports I and II, *BRITISH MEDICAL JOURNAL*, 1907 and 1908), that the specific gravity of the fluid suspending the drug played an important part in its localization within the dural canal. This conviction is now shared by all who have worked with me, and is borne out by their own experience since. This injection fluid consists of stovaine 5 parts, glucose 5 parts, and distilled water 90 parts, all by weight. It is as nearly as possible isotonic with the blood, and has a specific gravity of 1023, as against that of the cerebro-spinal fluid, which is 1007. Injected slowly through the hollow cannula into the dural sac it remains, being heavy and slightly viscid, to a large extent unmixed with the cerebro-spinal fluid, and seeks in a thin stream the lowest level it can find, where it pools and continues for a long time undiffused, as proved by experiment. By adjusting the patient in the lateral position, with the head and shoulders well raised on a properly designed bolster, it is possible to bring this or that vertebra to the lowest part of the curve between the head and the pelvis, estimated from the horizontal. The nerve roots of the dependent side at the bottom of the curve will then be immersed in the heavy analgesic fluid as well as those caudal to them, over which the injected compound has run. If the patient continue to lie on the side without movement the roots on the upper side continue to be for a long time unaffected. This is proved by the fact that I have been able on a man preserving the lateral position to amputate the leg next the table without any pain, while sensation and motion remained intact (as tested by skilled observers) in the other uppermost limb. But if a patient injected in the lateral position be subsequently turned over on the back the heavy fluid finds its way between the *ligamenta denticulata* across to the opposite roots, and a double-sided anaesthesia results, which, however, remains to the end more profound and more extensive on the side which has been dependent while the injection was taking place. That this is not a complete "cut-off" of a segment of the cord itself (at all events at first), but only an effect upon the uncovered roots after they leave the cord, is evident from the above and from other observations.

When the injection is made in the sitting position the heavy compound runs into the sacral part of the dural sac and the analgesia is limited to the parts supplied by the sacral nerves, the lumbar plexus being usually unaffected, and we employ this position for perineal and anal operations. A fluid of less specific gravity than that of the cerebro-spinal (1007) would, of course, rise and possibly spread into the cranial cavity. This was proved long ago by Klapp in his experiment on dogs shown at the

Congress of German Surgeons in Berlin, with cocaine dissolved in a light oil injected into the lumbar sac. At that time I saw one of these dogs quite happy and able to walk, but anaesthetic from the tip of his ears to the tip of his tail, only the sensory roots (the uppermost in this case) being affected by the light fluid, as it spread from the lumbar to the cervical region. It is curious that in Bier's clinic, where these experiments were done, it has since been denied that gravity can play a useful part in the procedure, as I and my friends believe has been proved by the experiments referred to in my second paper and in actual practice.

The average dose of stovaine in the cases now grouped was 5 centigrams—that is, 1 cubic centimetre of the 5 per cent. solution. Very rarely was this raised to 6 centigrams, often it was reduced to 4 or even 3. Abroad some very much larger doses of stovaine have been employed, up to 7.5 cg. and more, quite unnecessarily, and often with bad effects. In only one or two of our earliest cases were any of the adrenal derivatives or their synthetic equivalents made use of. I soon became confident that they are unnecessary, and that if they do produce ischaemia of the roots or cord, which is claimed, they are dangerous. Biberfeld's experiments on animals support this view. Even some surgeons abroad who formerly employed them in the belief that they prolonged the analgesia, which is very doubtful, appear now to regard them as useless, and probably injurious, in spinal, though of undoubted value in local analgesia.²

Except for perineal and rectal cases, the lateral position has been the rule, and great care was taken in regulating the curve of the spine, with the head raised on a small hard bolster made for the purpose of a definite height. In the case of men with broad shoulders and narrow pelvis, the latter was also raised from the horizontal table about 1 in. by means of a padded board. In women with narrow shoulders and broad hips this was not found to be necessary in most cases, but in all the head was carefully raised. Too much stress cannot be laid upon these points, and they are not so easily learnt.

In every case the same pattern of instruments was used, and they were kept apart for spinal analgesia and for it alone, and specially sterilized before and after use in each case. They were the 2 c.cm. "Record" syringe fitted with Bier's hollow needle which I have had made in hard, pure nickel. This metal is nearly as hard as mild steel, and does not corrode in boiling. It takes a good sharp point, and though it may bend with rough handling, is too tough to snap. My own fine nickel cannula open to its point and blunt to go through the lumen of the needle completes the outfit, which is stocked in metal boxes by Kröhne and Sesemann. The hollowed-out point of the injection needle must be always kept sharp, otherwise it will not penetrate the dura, which is not tense when the patient is lying down. The sharpening of the needle should be done on a smooth emery wheel of the diameter of 1 cm. This gives its opening the correct concavity and obliquity without making it too long. If the needle, moreover, is blunt, it may first press the posterior wall of the dural canal against the anterior, and then penetrate both walls at once as they rest upon the vertebrae. In such a case the injected fluid will only partially enter the dural canal or be discharged beyond it. This is almost certainly the cause of failure in some cases of which we hear. Another reason of ill success is that the oblique opening of the hollow injection needle may penetrate for half its length through the dura, causing only a crescentic puncture. Part of the lumen of the needle, especially if the point be too long, will then lie outside of the dura and part within, a small flap of dura half filling the opening in the needle. This can be well seen if one of these trocar needles be pushed so that only half its point penetrates a sheet of notepaper. If the needle has thus only half penetrated the dura the cerebro-spinal fluid may run out in drops, but if any liquid is injected it will impinge against the little flap and run out of that part of the needle opening outside the dura and not into the dural sac, failure being the result. For this reason when only a few drops of fluid escape by the needle it should always be turned round on its axis once or twice without pushing it further in. This will have the effect of turning the little flap aside and the slight pressure of the fluid within the canal will force the dura outwards on the needle until the

whole of its opening is within the canal. To further ensure the delivery of the fluid within the dural sac I have devised the little central cannula which is fitted on the nozzle of the syringe before the stovaine-glucose solution is sucked up through it from the ampoule. This is pushed through the lumen of the needle from which the cerebro-spinal fluid is flowing and when "home" its open end is exactly long enough to project just a millimetre beyond the hollow needle point. This will push the little flap aside and deliver the fluid beyond the point of the needle.* But though we employ this cannula, the hollow trocar needle should in all cases be turned on its axis after it has punctured the dura in order to turn the little flap aside, otherwise there is a danger of the cannula impinging on the flap and pushing the dura off the end of the needle and delivering the injection outside the canal. But with these precautions taken the failures to get the injection into the dural canal have been in our cases in the last few hundreds under 0.5 per cent. (vide Table). In my own first 50 cases before I had adopted them they were 6 per cent.

The syringe is filled from the ampoule through the slender cannula to the extent of circa $1\frac{1}{2}$ c.cm. It is then turned point upwards, and all bubbles are driven out with the excess of fluid until only the exact dose (= 1 c.cm.) is left. There has evidently been an impression current that each ampoule holds exactly the required dose. This is absolutely wrong, and has, I know, led to dangerous overdoses. Each ampoule holds nearly double the required amount, to allow of loss in filling the syringe and subsequently dislodging of air bubbles. *The exact dose must always be measured in the syringe, and no other way.* The five divisions with which each cubic centimetre of this particular 2 c.cm. "Record" syringe is marked correspond each to 1 centigram of stovaine in our 5 per cent. solution of the drug, so that 1 c.cm. of the solution contains the average dose = 5 centigrams.

In introducing the hollow needle the aim of the operator should be in every case to strike the dural sac *exactly in the middle line*. Moreover, the needle in entering the sac should always have its opening turned towards the patient's head. (This opening corresponds to a slot in the collar of the lift.) If the point enter in this way with its greatest breadth transverse to the cauda equina it will simply push aside any of its strands if they are touched at all. If entered with the opening turned to either side, the fine point might possibly penetrate a nerve bundle if this happened to be tense. But the chance of pricking a nerve floating loose in fluid is small indeed, and where it has occurred the strand has probably been touched not in the middle line of the sac but at its lateral aspect, where it is more or less anchored; moreover, the aperture of the needle has probably been turned sideways. Another reason why the opening of the needle should be directed upwards is that no loose nerve strand can be floated into it by the escaping cerebro-spinal fluid in that position and so block the outflow. Be this as it may, it is usually noticed that when the first few drops of fluid come away slowly the turning of the needle is followed by a rapid stream.

There is much to be said in favour of only using glucose-stovaine solutions which have been quite recently prepared. It is conceivable that even in a sterilized form in sealed Jena glass ampoules the compound may in time undergo some mutations or transformations rendering it more or less inert or even harmful.[†] With this possibility in view I have long avoided keeping any large numbers of filled ampoules in stock, and have insisted on having the compound freshly made and stored in sealed Jena glass ampoules only in such numbers as will ensure their being used up in a couple of weeks or so. In hospital where they are in daily use this is easy, for they are prepared every week or so by our pharmacist. But, as a matter of fact, any one can obtain by post from him for private work a few freshly prepared at a trifle over cost price.

Working with these fresh preparations we have

* I have lately seen one of these little cannulae, purporting to be mine, made with a closed end and a lateral opening short of the point which could only discharge the solution outside the dura in many cases. It was hopelessly wrong; it should be open to its end.

† This paper had been long written and ready for press when I saw in Mr. Owen Richards's admirable paper that "a number of insufficient anaesthetics were certainly due to decomposition of the solutions" used in his series of cases, for which changes he gives very satisfactory reasons.

obtained more constant, safe, and in every way more satisfactory results than formerly when filled ampoules were obtained in large numbers from other sources and stocked for long periods.

The method which I devised a couple of years ago for preparing the stovaine-glucose solution with accuracy as to strength and transferring it sterile into sterilized Jena glass ampoules has since been carried out for our use by Mr. R. Bennett, the pharmacist to the hospital, and has proved simple, speedy, and satisfactory. All that is required is an accurate balance, pure drugs, fresh distilled water, and two small Jena glass beakers $2\frac{1}{2}$ in. in diameter, which, when about half full, hold 100 c.cm. The oblong Jena glass ampoules (2 c.cm.) are made and stocked by the firm Ulbrich of Jena, and cost only 2s. 6d. per 100.

If two dozen, say, are to be charged at one time they are put in one of the Jena glass beakers with *distilled* water, their open ends down, their sealed ends upwards, and are boiled for a quarter of an hour, the beaker being placed in a special boiler made on my own design by Kröhne and Sesemann. This is then allowed to cool, when the ampoules will be found full of water. In the meanwhile 45 grams of distilled water are weighed into another similar beaker and 2.5 grams of Merck's pure glucose are added and boiled for ten minutes, and then cooled to the original temperature (15° C.) and again weighed. The weight lost by ebullition is replaced by boiled distilled water. Then the stovaine (2.5 grams) is added and the beaker is placed in the central hole of the sterilizer.

The ampoules are now picked up with sterile forceps and arranged with their open ends downward in holes in the plate which supports the beaker in which the solution has been prepared. The sterilizer should have an inch deep of distilled water at the bottom. It is now covered and boiled for ten minutes or a quarter of an hour. When the cover is removed the ampoules will be found empty, as the water within them is driven out of their unsealed lower ends by the boiling, and the solution of stovaine and glucose in the beaker will be at boiling point. The ampoules are then lifted with sterile forceps and quickly inserted into the solution in the beaker, open end downwards. The cover is again put on, and the sterilizer is kept boiling for a few minutes longer and then allowed to cool. When the cover is now removed the ampoules will be found to be full of the stovaine glucose solution, and their open ends are then sealed in a spirit lamp. If this simple procedure is accurately carried out the strength of the solution is secured with certainty, and the compound is transferred absolutely sterile into the ampoules automatically within the sterilizer. N.B. See that the sterilizer does not boil away all its water.

The principles and details of technique for carrying out spinal analgesia alluded to above are now well understood by those whose results are here grouped together for study. And we are all agreed that the more experience the administrator has accumulated the easier and more certain the procedure becomes for patient and operator and the less is heard of subsequent headache and sickness. When a patient has had two or three attempts at puncturing instead of one and has, to use a common phrase, "been fussed," he or she, especially if neurotic, is likely to have some headache a day or two after operation, more rarely after an interval of some days. Those who have had only the necessary preparation and have been quietly and skilfully dealt with probably will not. And the same may be said of sickness and nausea. Another important factor in their after-comfort is gentle lifting off the operating table without jolting or disturbing the level of the spine and its relation to the head. Too much stress cannot be laid upon this point. At all events, unpleasant sequelae are less and less seen as we gain in experience and that confidence which here as elsewhere communicates itself to our patients. When placed quietly in bed the patient's head and shoulders are slightly raised for the first day. In a few cases the drugs used in the same way were tropacocaine and novocain, but they appeared to offer no advantages over stovaine, and were given up.

That spinal analgesia is not suitable for every part of the body is admitted by all who have used it most freely. And this notwithstanding the work of Professor Jonnesco, who claims that he can operate on any part with its aid. From the experience of the 2,354 cases recorded here it

seems to be suitable in practised hands for most conditions seated below the diaphragm, and to them to offer many marked advantages, both for patient and surgeon during and after operation, especially complete muscular relaxation and quietude. Personally, from what has been seen, I am inclined to except from its use cases of extreme asthenia due to carcinoma, and of advanced toxæmia depending upon septic peritonitis or obstruction, especially in later life. (In all cases of obstruction the stomach should, of course, be washed out and emptied before operation.) With experienced administration general anaesthetics probably do not involve at any rate more *immediate* risks for the patient, though perhaps they are followed subsequently by greater dangers from their after-effects on internal organs already damaged by toxæmia. But this is not the universal opinion abroad among those of large experience. Indeed, some say that they regard the conditions referred to as peculiarly claiming the spinal procedure. One thing is clear at all events, that is, that these conditions of extreme toxæmia and asthenia are intrinsically very dangerous under any form of anaesthesia, and will always add to the mortality of any particular procedure employed, be it general, spinal, or other.

It is clear that a much more extended study based upon homogeneous records is demanded, and to that end this present limited contribution, which has at least the merit of uniformity of procedure and principle, is now offered. The whole question for or against spinal analgesia requires to be treated, in my opinion, in a non-polemical way. It is not ripe for any other treatment. It has gone far enough to justify an extended trial by those, and only those, qualified to test its possibilities after painstaking study, but its place in our surgical armamentarium is as yet by no means fully and finally established. We may look forward in the wonderful evolution of synthetic chemistry to the discovery of some new drug which shall act on the naked nerve roots without producing any unpleasant general effects. So far no drug has been found to be free from risk, however introduced into the system. But if those more recently discovered have shown a great advance in this respect over cocaine we are justified in hoping that our present agents may be replaced by others less open to objection, and that our methods of employing them may be improved. It is obvious that the whole subject of anaesthetics is still in a state of evolutionary flux in spite of many decades of most conscientious research, and no one can foretell its ultimate position. One thing is clear: that is, that chloroform and ether—those magnificent gifts to humanity—are having their former paramount position, as hitherto employed, challenged on all sides. They have been replaced to the extent of at least 20 per cent. of all operations by the perfectly innocuous local infiltration analgesia of Schleich and Braun applied to nerve endings. This again has led on to the equally harmless and often more convenient application of drugs by injection into and around nerve trunks in regional analgesia, and this by a process of natural evolution to the application of the same drugs to the naked nerve roots further back within the dural sac by Bier's ingenious, if not wholly innocuous, method of spinal analgesia. Moreover, the inhalation methods of administering volatile anaesthetics are on their trial, and infusion of various anaesthetics through the veins is challenging their place with more or less encouraging results. Their supremacy is also being invaded by the *general* narcotics introduced hypodermically, such as scopolamine and morphine. The number of anaesthetic drugs is increasing rapidly almost every day, and the most diverse modes of employing them alone or combined are being devised. Who shall say what direction all this strenuous effort will ultimately take? For an end to it let us hope, in the interests of patient and surgeon, there will never be. Those of us who have upon us the heavy responsibility of many surgical operations will do well to encourage this praiseworthy endeavour by all means in our power, lending what experience we may have to elucidate the many points in a very complex problem which still remain dubious.

Of Braun's modifications of Schleich's local infiltration and regional analgesia I will only say here that they are certain to be more and more widely employed as years pass. My own experience of these methods for more than twelve years has steadily increased my confidence in them,

and, I am glad to say, this confidence has communicated itself to many assistants, so that we now have numbers of the younger men quite familiar with their principles and details, and practised in their uses. Spinal analgesia—which doubtless has its risks—may have to be restricted, but these harmless methods are certain to be extended even to some of the larger operations. If it is possible to make use of them for such serious conditions as thyroid tumours, many of which I have removed under local infiltration analgesia most comfortably for the patients and myself, it must be possible to extend the method very widely indeed. And this is being done in our hospital and in others too. Knowledge, practice, great care, and some skill are required to do the thing well, but these are worth acquiring at some expense of time and patience. The risks, immediate and remote, of some of our older forms of anaesthesia are well known, and can be avoided by employing local and regional analgesia, which are harmless in trained hands; surely, then, they ought on every principle to be avoided.

The first point to be noticed in regard to our combined figures refers naturally to mortality immediate or delayed. Of our 2,354 cases, 3 have died soon after the dural injection in a way to throw suspicion on the procedure. Two were in my own personal experience, and have been already reported in the *BRITISH MEDICAL JOURNAL*, August 22nd, 1908. Each was in a desperate condition to begin with, and occurred at a time when the limitations of spinal analgesia were far less understood than at present, and they suggested restrictions which have since been adopted. Neither would now be submitted to spinal analgesia, and very probably they would have succumbed under any form of anaesthesia. The first case was that of an old and very decrepit man, suffering from extensive carcinoma of the stomach and its lymphatic glands, and, as it turned out, with large secondary deposits in the liver besides. My exploratory operation, which involved a good deal of manipulation, was followed by severe shock, and he died soon after removal to the ward. The second was that of a middle-aged woman, with extreme distension of the intestines, and toxæmia from prolonged obstruction due to carcinoma of the sigmoid flexure. She died five hours after the completion of a short circuit, during which much handling and dragging of the intestines was necessary. In these two cases I believe the anaesthetic, at all events, contributed to the fatal issue. One other death took place soon after injection by Dr. Rood for one of our other surgeons. It was one of acute obstruction, with stercoraceous vomiting. Soon after analgesia was induced the patient vomited, and the larynx was flooded, producing fatal asphyxia. It is open to question whether this case should be included in our mortality figures at all. Except these, there are no deaths in the whole series of 2,354 cases which could be in any way put down to the spinal method of anaesthesia. It appears, then, that the only mishaps have occurred among the most serious abdominal operations. There have been none of those distressing cases familiar to all surgeons of any experience, in which the anaesthetic has been given for some comparatively trifling condition, and death has followed in no way connected with the ailment or even before any operation had been begun. But decrepitude, advanced carcinoma, and toxæmia from obstruction, alone or combined, will always be formidable factors to face with any kind of anaesthesia. Among the other abdominal operations, which amount to more than half of all, there have been no serious mishaps; and this, notwithstanding that there were many grave cases among them, such as gastro-enterostomies, perforated gastric ulcers, excision of large tracts of intestine, and quite a large number of acute cases of appendicitis, for which our method appears to be peculiarly suitable. But for the class of extremely bad cases referred to above, and especially for conditions high up in the abdomen, I have personally for the last couple of years avoided spinal analgesia. I have felt that it is easy to bring discredit upon a new procedure, possibly of great value, by forcing its use at the outset too far, and that if a sufferer has to face grave risks under an anaesthetic it is better for him, when a doubt exists as to which is best, to take the more or less well-known dangers of general inhalation anaesthesia. Otherwise the propor-

tion of abdominal cases to others has not fallen; it remains just over 50 per cent. The method is seen at its best when used for conditions below the umbilicus, especially in pelvic and perineal cases. For advanced strangulated hernia with great debility and prostration, especially in old people, I am still strongly of the opinion, expressed long ago, that local infiltration analgesias should be employed in preference to other forms of anaesthesia, and it is satisfactory to note that this view is more and more gaining ground in our hospital among those who are competent to induce local analgesia. It is peculiarly suited to such cases if correctly done, and, as it is without danger, it ought with them at least to be the rule, and the more dangerous methods of preventing pain should be abjured as a matter of course.

Of permanent nerve lesions we have seen nothing in our whole collection of cases, even when followed up for long periods.

Transient diplopia was complained of in three cases. In one it was so slight and fleeting that it could only be substantiated by our ophthalmic surgeon. The other two were somewhat more marked, but were soon quite well.

Faintness, or more rarely retching, on the operating table, and headache and vomiting in the wards, were noted in a considerable number of cases. These were mostly very transient. Many of the headaches were quite slight, and would not have been noted in the clinical records had not special inquiry been made. In a few cases they were severe—about 2.5 per cent. (*vide* table)—but never permanent. It is hard to express their frequency in exact figures; but headaches in all degrees from the slightest to the worst were noted in those long series accurately kept in about 20 per cent. Nausea or vomiting on the operating table was noticed in 10 per cent. and in the wards in 6.3 per cent. Subjective phenomena are proverbially difficult to test by any known standard. One man has a headache and says nothing about it, another has perhaps a very trifling one and makes as much of it as he can, though when not under direct observation it may appear to make but little difference in his enjoyment of life. I venture to think that in future records we ought to give up special inquiries on this point, and only ask generally "How are you?" only noting obviously severe and troublesome pains in the head or back.

In conclusion, it must be insisted again that none of

these "Reports" are put forward in strong advocacy of the method, which I venture to think would be premature. They are nothing more than an attempt to elucidate a difficult subject seriously and dispassionately, and to furnish data for further inquiry, if such be considered desirable. My own attitude towards spinal analgesia now is very much the same as that of Professor Müller of Rostock, stated in a full debate on the subject at the congress of German surgeons, some 800 being present, in Berlin at Easter, 1910.² His view was that having employed it in over 2,000 cases he would be sorry to dispense with it; that it obviously had its defects probably owing to lack of uniformity of procedure. This last view is particularly my own. It appears to have been employed by too many in a somewhat haphazard manner; often as though the puncture was the only difficulty and the quality and the quantity of the drug and the position of the patient only a secondary consideration. For this reason I have only recorded the experiences of surgeons permeated by the same ideas and who have mutually agreed to record their cases on the same plan. It may be noted that Müller, like ourselves, has always used stovaine. It is also worth while adding that in the discussion referred to several of the ill-effects are attributed to the employment of the adrenal compounds so widely popular as an adjunct in these cases in Germany. It is incomprehensible to me why they are ever used at all in spinal analgesia, though, of course, they are invaluable in the local and regional method. It is doubtful if the effects of spinal analgesia are in any way prolonged by the addition of adrenal compounds. At any rate it is possible to operate on the abdomen for two hours in many cases without them.

POSTSCRIPT.

Since the above record was written, and while waiting for the last few cases to be added up to the end of 1911, a paper has appeared by Mr. Owen Richards in the *BRITISH MEDICAL JOURNAL* of December 23rd, 1911, invaluable for its straightforward analysis of 500 consecutive cases of spinal analgesia. These were done in one hospital in Cairo at the hands of many, apparently, not specially trained men, on different lines and with varying drugs and solutions. His experiences are, therefore, of special value and well worthy of study. My object in this report has had a different aim from his, as can be seen. It has been rather to show what results would be obtained were the

Table showing the Results at Five Hospitals working on exactly the same Principles and Technique, and with the same Instruments and Solutions carefully prepared. In the last Column the Cairo Results are given. Here the Principles, Technique, and Solutions were not always the same; some of the Solutions were decomposed.

	Barker at Univ. Coll. Hosp. Published B. M. J., Aug. 22, 1908.		Majors Spencer, Houghton, Shea, Pilcher, at Millbank Military Hosp.		Major Spencer later at York Military Hosp.		Major Houghton, later on Gold Coast, and at Aldershot Military Hospital.		McGavin, Williams, O'Leary, at Dreadnought Seamen's Hospital.		Barker and Rood, Univ. Coll. Hosp., Aug., 1908, to Dec. 31, 1911.		Totals and Percentages of Our Combined Tables.		Richards, at Cairo, Egypt, B. M. J., Dec. 23, 1911.	
Abdominal operations..	148		189		26		140		418		267		1,188		185	
Other operations ...	152		196		24		160		426		208		1,166		315	
Total ...	300		385		50		300		844		475		2,354		500	
Failure to enter dural sac...	5	1.6	2	0.6	0		0		3	0.35	3	0.6	0.5		12	2.4
Injection with no analgesia following	6*	2.0	Not entered†		0		0		0		0		0.3		38	7.6
Injection with too short an analgesia	12	4.0			0		8		13	1.5	2	0.4	1.7		18	3.6
Chloroform used to complete the operation for all the above causes	23	7.6	17	4.4	2	4.0	8	2.6	34	4.28	16	3.3	4.2		68	13.6
Fatalities ...	2	0.6	0		0		0		0		1	0.2	0.1		3	0.6
After-Effects:																
Severe headache ...	Not sufficiently accurate		Not sufficiently accurate		2	4.0	1.3	5	0.59	19	4.0	2.5	§		16.0	
Slight headache...					21	42.0	39.0	69	8.17	85	17.8	26.7			40.0	
Nausea on table...					9	18.0	19.0	22	2.6	3	0.6	10.0				
Vomit in ward ...					6	12.0	10.0	7	0.8	12	2.5	6.0			?	

* 4 in first 100; 2 in second 100, none since.

† As these two points are not entered in the Millbank tables, I have calculated the final percentages without the Millbank figures on the remaining 1,967.

‡ 121 were abdominal.

§ Calculated from the percentages given, excluding the first two earlier columns, which were not full enough.

mode of procedure, the drugs and solutions, the same in a long series of cases conducted by surgeons seeing eye to eye. Assuming, as we are bound to do, that his and all the other records involved have been kept in good faith and with equal care, they offer an opportunity for contrast which may be availed of without any wish to make too much of the differences between them.

On the question of the gross mortality or first risk from spinal analgesia, both series are not conclusive. Mr. Owen Richards has frankly recorded three deaths (0.6 per cent.) soon after the procedure. But when the nature of these cases is examined no fair critic could assert that the results were certainly and altogether due to the anaesthetic. The same might be said of my own two fatalities, and almost positively of Dr. Rood's. All were in a desperate condition to begin with. Still they are there, and every surgeon must form his own opinion as to whether they would have survived after any method of anaesthesia. All of them but the last occurred in the early days of a method whose limitations were as yet imperfectly known. In the work of our collaborators, which commenced later when some experience had been obtained and the plan of recording the cases was better developed, it will be seen that there were no fatalities, nor were there in our own after 1908 if we exclude the case of stercoral flooding of the larynx and suffocation in Dr. Rood's experience, as I think may safely be done.

In classifying the technical drawbacks to spinal analgesia as he found them (see table), Mr. Richards places inability to enter the dural canal first with 12 in 500 cases, or 2.4 per cent. The reasons given appear perfectly adequate—that is, faulty needles and wrong direction of puncture. He next mentions that in 38 cases (7.6 per cent.), after reaching the dura and obtaining a flow of cerebro-spinal fluid, the injection was followed by absolutely no effect. The explanation for this is, I suggest, sound and not far to seek (see above). Then there were 18 cases (3.6 per cent.) in which after injection the analgesia was so imperfect that chloroform had to be given. According, then, to his figures, the technical drawbacks to analgesia in his 500 cases, including the 12 failures to enter the dura, were 68, or 13.6 per cent.

In arranging our own collection of 2,354 cases in the same way (*vide table*), it will be seen that there were 13=0.5 per cent. failures to enter the dura in 2,354 cases, of which 3 belong to my own first 100 cases; there were 6=0.2 per cent. of absence of any analgesia on injection, of which 4 occurred in my own first 100 cases, 2 in the next 200, none since. Then there were 100 cases in which after injection the analgesia was insufficient for the completion of the operation=4.2 per cent. So that the technical drawbacks in our 2,354 cases which required the administration of a general anaesthetic (often only a drachm or two), and including failures to enter the dural sac, were in the gross 100=4.2 per cent. Of these, 14 occurred in my own first 50 cases.

The differences on all these points may be said to be small, but as far as they go they seem to support the view that a definite ritual with the same heavy solution, carried out by men who have worked first cordially together and then independently, is more likely to give uniform and better results than where there have been less uniformity of technique and different solutions, instruments, etc.

If any concrete proof of this were necessary, it is offered to us in the accompanying table, which shows Major Houghton's series to be the best of all those given, probably because he had more opportunity of studying the methods in the work of others before employing it himself. He was, with other officers of the Royal Army Medical Corps who followed him, appointed by the War Office specially to assist me at University College Hospital in recording these cases at a time when, in the second hundred, I had more or less got over the first difficulties and failures, and had devised the solutions since used. Then at the Military Hospital, Millbank, he assisted Major Spencer, who had also been much with us. Subsequently, on the Gold Coast and at Aldershot, he worked independently with accumulated experience, with the results shown in the table. It is interesting to note that on the Gold Coast he was obliged to make his own solution fresh, and fresh on account of the climate, and with the best results. Our own results since 1908, when we might

be said to have passed the "tyro" stage, point to the same conclusion.

Mr. Richards's paper, if I may be allowed to say so, appears to me most useful and admirable. He does not yet, to be sure, endorse the opinion expressed above, and held by all those whose results are here tabulated—that the specific gravity of the compound injected plays an important part in the success of spinal analgesia; but perhaps that is to come. But he furnishes strong evidence of the necessity of freshly and carefully prepared solutions, for which I have long contended and provided.

REFERENCES.

¹ BRITISH MEDICAL JOURNAL, March, 1907; February, 1908; August, 1908. ² Debate at Congress of German Surgeons held in Berlin, 1910.

SUBDURAL ABSCESS, THROMBOSIS OF THE LATERAL SINUS, AND DIFFUSE OSTEO- MYELITIS OF THE SKULL BONES TREATED WITH VACCINES: RECOVERY.

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THE following case, which was under my care while I had charge of the Aural Department of the Coventry Hospital, presents features of such unusual interest that I have no hesitation in recording it.

T. W., a male aged 25, came up on February 8th, 1909, complaining that he felt very ill, and had a severe headache. His condition was so serious that he was at once admitted.

History.

He has had a foul-smelling otorrhoea on the right side as long as he can remember, which he has completely neglected. Three days ago he vomited once. Violent earache and much headache came on at the same time. He has felt more ill every day, and "hardly knows how he got to the hospital." No history of rigors.

Present Condition.

The patient is obviously very ill; temperature 100°, pulse 100. He has otorrhoea on the right side, which is very offensive. The right meatus is full of pus and is blocked by polypi. There is tenderness at the tip of the mastoid, but none over the antrum or the emissary vein. The left ear shows no sign of present inflammation, but the drum is thickened and retracted from old chronic disease. The patient is moderately deaf in both ears. No tenderness in the neck over the course of either jugular vein.

In the absence of any very definite signs it was decided to watch the patient for a few hours before opening up the mastoid, but chloroform was given and all the polypi and granulation tissue was removed from the ear with snare and curette.

February 9th. The ear has ceased to discharge and is sweet. The patient vomited twice (9 and 9.30 p.m.). Temperature 100°, pulse 90. There are no signs of cerebral irritation; the patient is quite lucid in his mind; headache bad at intervals. No squint, pupils normal in size and reaction and equal in size. V.R. = § partly, V.L. = § all. There is no optic neuritis.

February 10th. The patient's temperature ran up to 104° in the night, with a rigor; vomited once. Headache better.

February 11th. There is a little stiffness in the muscles at the nape of the neck. Seems very ill indeed. Diagnosis made of subdural abscess, with possible thrombosis of the lateral sinus. Ear now sweet, no otorrhoea.

First Operation.

The radical mastoid operation was performed by Zaufel's method. The bone was so hard that two gouges were broken before the small, deeply-seated antrum was exposed. The tegmen of the antrum was found as a loose sequestrum blocking the aditus. The antrum and subdural space contained about two drachms of thick pus. The dura was freely exposed, the bridge cut down and the middle ear curetted. A meatal flap was turned back above and below, and a large rubber tube placed in the antrum and brought out by the retro-audicular incision. As pus had been found the lateral sinus was not exposed. The patient stood the operation, which lasted about an hour, well.

After-History.

The result of the operation was disappointing. The patient felt better, but his pulse-rate increased to 120, and his temperature became pyæmic in character, ranging from 97° to 103°. The headache ceased, but there was pain and tenderness about 2 in. behind the tip of the left mastoid and at times in the left posterior triangle of the neck. This tenderness on the opposite side introduced an element of doubt into the diagnosis. Was