TREATMENT OF A CASE OF DEPRESSED FRACTURE OF THE SKULL CAUSED DURING BIRTH.

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I was called on January 25th to see Mrs. F., aged 28, in her sixth confinement. At her first confinement and her third she had chloroform, and her children were born alive and uninjured, but she does not know whether instruments were used on these occasions. Her second labour was tedious; the child was born dead, but its head was injured; no instruments were used. Her fourth labour was only a little prolonged, and a healthy female child was born uninjured. Her fifth labour, twelve months before, was a case of placenta praevia, delivered by version, between the seventh and eighth months. On the present occasion labour had been going on for fourteen hours, and the nurse in attendance reported that progress had ceased. The os was fully dilated. The head was presenting in the left occipito-anterior position, and seemed fairly well fixed in the brim. Flexion was well marked. I delivered with axis-traction forceps. There was considerable resistance to traction at first, then something seemed suddenly to give way, after which the head and trunk were easily delivered. The diagonal conjugate of the pelvis was roughly estimated to be 4 in.

On the child's head there was a deep almost circular depression, measuring 2 in. antero-posteriorly and $1\frac{1}{2}$ in. across, in the left frontal bone; its posterior and internal margins were at the corresponding borders of the bone, the angle of the latter at the anterior fontanelle being slightly tilted up. The anterior margin of the depression lay $\frac{1}{2}$ in. from the supraorbital ridge. I endeavoured to raise the depression by Dr. J. Munro Kerr's method, placing the child's head between my knees, and with one hand on its right frontal bone and the other on its left parietal posteriorly, making strong compression in the diameter of the head at right angles to that in which the depression lay, but this produced no change. The child did not appear to be suffering in any way from the effects of the injury.

On February 17th, twenty days after birth, as there was no spontaneous improvement visible, the child, who was showing no symptoms, was operated on in the Glasgow Maternity Hospital. I made an incision 1 in. long through the scalp, beginning just external to the anterior fontanelle and running parallel to, and $\frac{1}{2}$ in. in front of, the left coronal suture, and then cut through the bone in the same position by a lateral rocking movement with a sharp scalpel. An angled periosteum elevator was now inserted and passed forward between the bone and the dura mater; injury to the latter was avoided by making the incision in the bone $\frac{1}{2}$ in. away from the suture to which it is adherent, as recommended by Dr. Jardine. The point of the elevator was brought under the centre of the depression, and by tilting it upwards the inner portion of the bone was raised without difficulty, a sound and sensation being produced as if a dent in a celluloid ball were being pushed out. The outer part of the depression, however, had not come up, and when the point of the elevator was moved out to get under it, it was felt to slip out from under the bone and to lie immediately below the scalp. There was then recognized to be a fracture of the bone running antero-posteriorly and situated rather in the outer half of the depression. The point of the elevator was got under the outer fragment which was also raised, but not so completely as the inner fragment, as the position and size of the incision in the bone prevented a proper manipulation of the instrument. Had the incision been begun a little further out along the coronal suture doubtless this difficulty would not have been experienced. There was very little bleeding, and the scalp wound was closed with two stitches. The area where the depression had been was now flat. Four days later the scalp wound had healed well, and the area of former depression had risen spontaneously and become convex to such an extent that although the head was shaved hardly any difference was noticeable in comparison with the right side, except a slight ridge which was visible where the outer margin of the depression had been. The child was seen a week later, quite well, but no further change in the skull had taken place, and the small difference between the two sides remained.

The operation was practically a subcutaneous one, and could easily be done immediately after birth, without fear of infec-

tion from the skin, in cases where the depression could not be raised by other means, and where it was giving rise to respiratory or other symptoms. The failure of compressing the head immediately after birth in this case to raise the depression might, I think, have been taken as strong presumptive evidence of the presence of a fracture, although it was not otherwise detected, because Dr. Munro Kerr has found that in ordinary depressions his method is almost invariably successful; and, as the late Dr. Milne Murray suggested when the method was first described, in cases of fracture the lateral pressure is more likely to drive the angle in the bone at the line of fracture inwards than to force it out.

THE GLYCOGEN REACTION IN BLOOD:

ITS PATHOLOGICAL AND DIAGNOSTIC IMPORT.

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NATURE OF THE REACTION.

The reaction which I wish to describe is one which has been known for a good many years. Ehrlich described it in pus in 1883, and Gabritschewski studied it in numerous blood conditions in 1891. It fell out of sight, however, and it is only within the last two or three years that it has again been made use of to any extent. This has been due mainly to Kammer, Czerny, and Weiss on the Continent, and to Dunham, Locke, and Cabot in America. In this country little attention has been paid to it. It is to Locke that the credit is due of having most exhaustively studied it and placed its application on a firm basis. Since his paper appeared I have applied it to all the cases whose blood I have examined, and to many earlier cases of which I had preserved films, and I have found his conclusions hold good on almost every point.

The method is extremely simple. The solution employed, which serves for fixing, staining, and mounting, is composed of

Iodine, 1 gram; iodide of potash, 3 grams; distilled water, 100 c.cm., with enough gum acacia or gum arabic added to make the fluid of a syrupy consistence.

The bottle must be kept tightly corked as the iodine evaporates and the staining is weakened. A rather large drop of this solution is placed on a clean slide, and an ordinary air-dried blood film on a cover-glass lowered on to it, allowed to remain undisturbed for half a minute to allow of complete staining, and then displaced towards one end of the slide in order that the thick layer of fluid may not cut off too much light in examination; or the surplus fluid may be removed with filter paper. The gum soon sets and the preparation will keep for weeks, or sometimes longer, though it slowly fades. The film of blood should be thin, as the reaction is much more easily studied if the leucocytes are flattened out.

The specimen is at once ready for examination, and this must be done with an oil-immersion lens and a good light—daylight for choice—but if that is not available, with the whitest light obtainable. The light from an incandescent gas burner is satisfactory. An ordinary high power will usually allow one to make out well-marked reactions, but not fainter ones, and should therefore not be used. Other methods have been devised both of staining and mounting, but after a careful trial of them all I have returned to the original method as most satisfactory.

In a film of normal blood treated in this way the red corpuscles are stained yellow on a white or faintly yellow background, the white corpuscles of a much fainter lemon-yellow tint. The lymphocytes, indeed, can hardly be distinguished from the background, except by the slight difference in the refractive index of their nuclei. Eosinophiles can at once be recognized by the high refractive index of their granules, and the polymorphonuclear neutrophils always look rather darker than the others because of their closely-set granules. In none of them, however, should there be the faintest trace of red or brown. In normal blood this colour is only seen occasionally in the masses of blood plates which are scattered about the films. The amount of this "extracellular" glycogen varies greatly in different cases. The only disease in which it seems to be uniformly increased is diabetes, in all other conditions it follows no ascertained law, and it is, therefore, always disregarded.

The appearance described is regarded as a "negative"

reaction. In a "positive" reaction the change occurs in the polymorphs alone; lymphocytes and eosinophiles are never affected, and the rare cases of myelaemia in which glycogen appears in myelocytes and basophiles may be disregarded. The cells affected may give the brown or reddish-brown colour of glycogen in three ways: (1) As a diffuse coloration; (2) as fine granules scattered through the whole or part of the cell body; (3) as coarser granules or masses which may be scattered through the cell body, but are more usually found at or near the periphery, sometimes indeed projecting as pseudopodia from it. The last form is usually seen only in well-marked reactions, the two former both in these and in fainter ones. All may be studied by the beginner in pus, though the staining in pus is usually much darker than in blood leucocytes. A beginner will only observe the more deeply-stained cells in blood. I am satisfied that the granules of glycogen do not correspond with the neutrophile granules of the cell body, which I have elsewhere shown to be identical with the nodes of the reticulum of the cell, but that they are paraplasmic and embedded in the inter-reticular substance. This accounts for the fact that the larger masses are pushed to the outside of the cell. The nuclei are never affected.

The nature of the substance so stained has given rise to some discussion, but there seems little doubt, from the facts adduced by Best, that it is not pure glycogen, but probably a rather loose combination of glycogen with some other substance, possibly proteid in character. In cases where the blood reaction is positive it is not found, according to Katsurada, in leucocytes in the bone marrow, so that the substance would seem to be taken up or elaborated by leucocytes in the blood stream. Emigrated leucocytes in inflammatory exudations and in pus show it in larger amount than those in the blood.

The number of cells affected in a "positive" reaction varies greatly, almost every one may show the staining, or only 2 or 3 per cent. If, after five minutes' searching, or passing a hundred polymorphs in review, no "positive" cell is seen, the reaction may be regarded as negative. A much shorter time is usually all that is required to make out a positive reaction; the first glance at a film may suffice. The degree of reaction or the number of cells affected generally gives a very good index of the severity of the causal condition.

CONDITIONS UNDER WHICH IT OCCURS.

The general conditions in which the intracellular reaction occurs are generally regarded as four in number.

1. Severe disturbances of respiration.
2. Anaemia.
3. Toxaemias of metabolic origin.
4. Suppuration and bacterial infection.

1. Severe Disturbances of Respiration.

The reaction occurs in such conditions as laryngeal stenosis, extensive atelectasis of the lungs, extensive pneumothorax, terminal dyspnoea, severe heart failure with dyspnoea. In none of these is the reaction usually marked, and it disappears when the causal condition is removed, unless pneumonia or broncho-pneumonia sets in.

2. Anaemia.

In ordinary cases of chlorosis, in moderate secondary anaemia, mild or chronic pernicious anaemia, and in some leucocythaemias the reaction is negative. In severe secondary anaemia, in late and severe pernicious anaemia, and in late and in acute leucocythaemias the reaction is often positive. Secondary anaemia, however, is so often caused by septic conditions and by malignant disease, in the late stages of which a marked reaction usually occurs, and patients with bad pernicious anaemia and leucocythaemia are so notoriously prone to bacterial infection, that I am very doubtful whether the anaemia *per se* has anything to do with the reaction.

3. Toxaemias of Metabolic Origin.

It occurs in such conditions as uraemia and diabetic coma. It is possible that the reaction occurring in the late stages of malignant disease—it is absent in early cases—should be classed here. It is, of course, well known that tumour cells contain large amounts of glycogen. In many cases of cancer the accompanying ulcerative and inflammatory processes account for the positive reaction. It has also been found in chronic morphinism.

4. Suppuration and Bacterial Infection.

The foregoing headings are mainly of pathological interest;

it is in the conditions presently to be cited that the diagnostic interest centres.

Kaminer has made a series of experiments on animals in order to discover what organisms, when injected, will cause the reaction. He obtained positive results with streptococcus, staphylococcus, pneumococcus, bacillus anthracis, bacillus pneumoniae (Friedländer), bacillus coli communis, bacillus typhosus, bacillus pyocyaneus, and bacillus diphtheriae; and Sorochowitsch has also got positive results with the toxins of these organisms; negative results with the organisms of tetanus and fowl cholera, and with such haemolytic agents as potassium chlorate.

But Weiss has since shown that only those cases of diphtheria in the human being give the reaction which are associated with much inflammation and infiltration, and Locke and others have shown that in typhoid fever the reaction is never intense, and does not appear until the end of the second or third week, if at all. Infections in the human subject with the other organisms named give a positive result.

Clinically, the following are the chief conditions in which a positive reaction is constant:

(a) *Croupous Pneumonia*.—Here the reaction is early and usually intense. I have found it well marked within ten hours of the rigor. In the early days of a deep-seated pneumonia with few physical signs I have found it useful. It persists until the crisis, soon disappears thereafter, and if it persists should excite suspicion of delayed resolution or empyema.

(b) *Broncho-pneumonia*.—The reaction is rarely so well-marked as in croupous pneumonia, but I have found it of value in cases where there was doubt whether this condition was present in addition to bronchitis, in which the reaction is negative. In a case of healed phthisis, where there was an attack of fever with vague signs in the chest, and a fear of recurrence of tubercle, the presence of reaction enabled one to negative this suspicion.

(c) *Empyema*.—The reaction is always well marked, and this is a valuable aid in diagnosis from serous effusion, in which the reaction is negative, in cases where the fears of the patient, or other reasons, make exploratory puncture impossible. In dry pleurisy the reaction is also negative, and this is of importance in severe cases in diagnosing it from pneumonia.

(d) *Abscess and Gangrene of Lung*.—The reaction is positive unless there is free drainage.

(e) *Septicaemias and Pyaemias of all Kinds*, accidental, puerperal, and post-operative, and such conditions as ulcerative endocarditis. The reaction is always very marked, while leucocytosis is by no means constant.

(f) *All Advancing Suppurative Processes*.—In these the reaction is constant when any of the pus-producing organisms are concerned, unless the abscess is quite trivial or the condition is early, and varies in amount according to the severity of the condition and the amount of constitutional disturbance produced. The actual size of the abscess does not affect the reaction, thus a carbuncle will give a reaction as intense as a large abscess or an osteo-myelitis, and I have seen a teaspoonful of pus in a retrocaecal abscess give as intense a response as a croupous pneumonia. Free drainage very soon puts an end to the reaction, and pus-pocketing at once brings it back. Recently I have seen a very striking instance of this in a case of pyelitis or pyonephrosis, in which pus was discharged intermittently with the urine from the affected kidney. Whenever the urine was clear, coming obviously from the unaffected side, the reaction was intense, while a discharge of thick pus-containing urine was regularly followed by a remission, though not a disappearance, of the reaction. Tuberculous abscesses do not give the reaction.

(g) *Septic Gangrene of all Kinds*.—Gangrene of the bowel in strangulated hernia or intestinal obstruction, or of a limb in the late stages of diabetes, will alike produce a marked reaction. Small aseptic sloughs do not cause it.

(h) *Appendicitis and Peritonitis*.—In regard to these conditions, Locke's statistics are so striking that I cannot forbear quoting them. In 8 cases of interval operation the reaction was invariably negative. In 13 cases of acute appendicitis without general peritonitis or local abscess, the reaction was always positive, but varied in degree from slight in cases where there was simply moderate inflammation of the appendix to marked in cases where the appendix was gangrenous. In 20 cases of appendicitis with local abscess, but without general peritonitis, the reaction was always good, sometimes very marked, except in one case, where there were only a few drops of pus thoroughly walled off, and the reaction

was faint. In 21 cases of general peritonitis, from various causes, the reaction was always present and usually intense, especially where pus was present. It was faint in only one case, after nine hours of a mild inflammation from perforating gastric ulcer. My own experience, though much less extensive, exactly bears this out. In abdominal cases in particular the reaction is a much more trustworthy guide than leucocytosis, for while a large leucocytosis, of more than 20,000, practically always indicates operation, the majority of appendicitis cases have an annoying way of showing a leucocytosis of from 15,000 to 17,000, even with a gangrenous appendix, while some, and those the very worst cases of peritonitis, have no leucocytosis at all. In these, however, the glycogen reaction is always well marked. That the converse holds good the following case will indicate: I was asked some time ago by one of my surgical colleagues to see a case in which the history, symptoms, and signs were so vague that the diagnosis was about equally balanced between perforating gastric ulcer and broncho-pneumonia. A leucocyte count had been made and had given 17,000, but the time and place did not allow a more complete blood examination, and it was decided to operate. Nothing was found in the abdomen, and the patient afterwards went through a broncho-pneumonia. When I had an opportunity of examining the films I found a polymorph percentage of only 68 and a doubtful glycogen reaction. Had the circumstances of the case allowed me to make the complete examination at the time I should have refused to sanction operation. I might multiply instances of the sort, but the point is sufficiently well illustrated by what I have said. A point of some importance is the time after the onset of symptoms at which the reaction appears. Locke found it faint three hours after the perforation of a typhoid ulcer, well marked six hours after. I have found it very intense twelve hours after perforation of a gastric ulcer; well marked fifteen hours after the onset of symptoms in a gangrenous appendix case; and quite recently, well marked an hour and a-half after the onset in an inflamed appendix with peritonitis.

(i) There are numerous other conditions of less importance in this connexion in which the reaction is present, such as late typhoid, advanced phthisis (in both of which it is probably due to secondary infection), severe malaria, acute cystitis, cerebro-spinal meningitis, miliary tuberculosis (sometimes), severe enteritis (slight), gonorrhoeal arthritis, etc.

CONDITIONS IN WHICH IT IS ABSENT.

The conditions in which the reaction is uniformly absent are equally important from the point of view of diagnosis. In addition to those already named—rheumatic fever, chronic rheumatoid arthritis, chorea, rickets, infantile atrophy, congenital heart disease and adult heart disease (unless compensation has failed badly), catarrhal jaundice, uncomplicated tubercle of all kinds, dry and serous pleurisy, bronchitis, whooping-cough, asthma, alcoholism, nervous conditions, early cancer, lead colic, diabetes (except when coma has occurred), and such abdominal conditions as ruptured extrauterine pregnancy, obstructed hernia, intestinal obstruction from bands, etc., unless gangrene or peritonitis has set in, and in stationary abscesses.

The relation of the reaction to leucocytosis has already been hinted at, and may be stated briefly thus—that while many of the causes which produce the reaction also cause leucocytosis, there is no necessary connexion between the two, for in rheumatic fever, for instance, where leucocytosis is the rule, the glycogen reaction is absent, and frequently in the leucocytosis-producing diseases the infection is either so slight or so severe that the leucocytes do not rise, though the glycogen reaction is positive, and in the latter case, of great severity, is always intense. Thus in septicaemia I have seen counts of 7,200, 7,400, 2,100 and so on, with marked glycogen reaction. There is a much closer relation between the reaction and a high percentage of polymorphs (over 75 per cent. in the differential count), in the bacterial infections, and one generally finds the two running parallel, a marked reaction with a high polymorph count. Even this, however, is not invariable, and I have found 66, 68, 72 per cent. of polymorphs in septic cases with marked glycogen reactions. One is therefore entitled to regard it as the most delicate test that we have of constitutional disturbance in the conditions named.

PATHOLOGICAL SIGNIFICANCE.

The actual pathological meaning of the reaction is not very clear. It is almost certainly not a degenerative change, for leucocytes with broken down nucleus do not show it, and all

other evidence goes to show that glycogen is usually found in young and active cells. It is probably associated in some way with the resistance of the organism to poisons, and especially to those which produce positive chemotaxis.

It is unnecessary to repeat in detail the various ways in which the reaction may be used in diagnosis, but it will be obvious that a method which enables us to approach greater certainty of diagnosis in deep-seated pneumonias; to distinguish gonorrhoeal arthritis from ordinary rheumatism, septic or cerebro-spinal meningitis from the tuberculous variety—perhaps, though, on this point observations have not yet been made—cerebral abscess from cerebral tumour, obstructed from strangulated hernia, and which possesses, in addition, the wide range of application already indicated in septic conditions, deserves a more frequent application than has yet been accorded to it. One point which Locke makes is worthy of note, that patients who show it are always "sick," to use the expressive Americanism. Its presence, therefore, in cases which do not admit of a positive diagnosis should always put us on our guard against the possible development of some serious condition.

It must also be clearly understood that, while the method is simplicity itself, it demands in the observer some previous acquaintance with the appearances of blood films, and that it takes some practice before the reaction can be read aright. In its interpretation, also, it necessitates the same precautions as other blood tests, and, indeed, as all laboratory tests. It requires a thorough previous examination of the patient, the exclusion, as far as possible, of complicating conditions, and the endeavour to keep in view a clear issue for diagnosis. If this be done, the method will be found to be of great value.

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OBSERVATIONS ON SOME TESTS FOR ALBUMEN IN URINE.

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IN connexion with what is probably the most commonly employed clinical test for albumen in urine—namely, the application of heat combined with acidulation—my attention has been directed to some facts which I believe are not generally well known, and an explanation of which I have not been able to find in any published work. The great point in this test is the amount of acidulation, and the fallacies which are apt to mislead one in using the test generally arise from inaccurate acidulation. This is especially the case if strong nitric acid is employed, as is still done by many physicians and recommended in many textbooks, diverse directions being given as to the amount of acid to be used.

In connexion with the use of strong nitric acid in performing this heat-coagulation test, Bence-Jones long ago (about 1840) pointed out the fact that, if too little nitric acid be added (2 to 3 drops to 10 c.cm. of albuminous urine), or too much (30 to 40 drops), one may fail altogether to detect the presence of albumen, although it is present in appreciable quantity. On the other hand, if 10 to 12 drops are added, and the upper stratum of the fluid rapidly heated, the test is positive—that is to say, a white turbidity or coagulum is produced. Moreover, when 2 or 3 drops of nitric acid have been used and the test tube boiled with a negative result, the further addition of a certain amount of nitric acid (for example, 6 to 10 drops) leads to coagulation.

These peculiar facts as observed by Bence-Jones seem to have been almost entirely forgotten, for very few, if any, of the present-day textbooks point out this fallacy, and I have not been able to find any published work which gives experimental evidence to explain the above phenomena.

Is the formation of acid-albumen (not coagulable by heat) the reason of the negative result with 2 to 3 drops of nitric acid? There does not seem to be any definite evidence that such is the case, nor any explanation why coagulation is got on a further addition of 6 to 10 drops of nitric acid, since all the textbooks state that solutions of acid-albumen are not coagulable by heat. Again, why should not the use of 10 to