in order to trace their origin it is necessary to observe closely the changes in the other forms seen in the same blood. Only the mature forms of the organism are seen to undergo any changes in the fresh slide of blood, the half-grown and younger forms remaining unchanged for a long time. The mature forms become rounded off, and are extruded from the corpuscle, which remains as a shadow lying in the plasma.

Both in the fresh and in the stained specimens of blood there can be seen differences which sharply distinguish two forms of the organisms. The forms are identical in outline, but the protoplasm of one is granular and opaque as compared with the clear hyaline protoplasm of the other. This distinction is well brought out in the stained specimen, in which the hyaline form remains almost entirely unstained, while the other takes on a well-marked blue stain with methylene blue. Of these it can be determined that the hyaline forms alone become flagellated.

These two forms, then, become extruded alike from the corpuscle and lie free in the plasma, but generally only a very short time elapses before the hyaline forms become flagellated, according to the process so often and so accurately described by workers on malaria. The granular forms lie quiet beside the nuclei and shadows of the red blood corpuscles which lately contained them, but are soon seen to be approached by the flagella which, having torn themselves away from the hyaline organism from whose protoplasm they were formed, struggle about among the corpuscles. These flagella, which so concentrate their protoplasm as to form a head, swarm about the granular spheres, and one of them plunges its head into the sphere and finally wriggles its whole body into that organism. Immediately on the entrance of this flagellum it seems to become impossible that another should enter, for they may be watched circling about, vainly beating their heads against the organism. The flagellum which has entered continues its activity for a few moments and the pigment of the organism is violently churned up. Soon it becomes quiet again, and remains so for from fifteen to twenty minutes, when a conical process begins to appear at one side of the organism, the pigment collecting mainly to the opposite side. This process grows larger and the pigment becomes more and more condensed until finally we have a fusiform organism with a small spherical appendage crowded with pigment at one end. The other end is hyaline, and the pigment granules which are not crowded into the small appendage are distributed superficially over the posterior part of the body. This spindle-shaped organism moves forward with a gliding motion, sometimes turning at the same time on its long axis, sometimes going through amoeboid contortions. Red corpuscles lying in its path are either punctured by the hyaline anterior end, so that the hæmoglobin is allowed to escape into the plasma, or passed over and dragged along by the adhering posterior extremity.

In an intense infection a great destruction of corpuscles occurs; thus in a fresh slide after standing some time even leucocytes may fall victims to the destructive force of these organisms which have been seen to dash through them, scattering the granules into the plasma. As to the ultimate fate and true significance of these forms nothing definite can as yet be stated. In the slide they keep in motion for a long time but finally quiet down and disintegrate. The idea suggests itself from their great power of penetration that they may be the resistant forms that escape from the body during life into the external world. The whole process described above seems to be a sexual process analogous to the sexual process seen in the lower animals and plants which occurs under unfavourable conditions and results in the formation of a resistant "spore."

Recently I have examined the blood of a woman suffering from an infection with the æstivo-autumnal type of organism in which a great number of crescents were to be seen. These in the freshly-made slide of blood with very few exceptions retained their crescentic shape for only a few minutes (this activity in the change of form varies greatly in specimens of blood from different patients). They soon drew themselves up, thus straightening out the curve of the crescent while shortening themselves into the well-known ovoid form. After the lapse of from ten to twenty minutes most of them were quite round and extracorporeal, the "bib" lying beside them as a delicate circle or "shadow of the red corpuscle." After from twenty to twenty-five minutes certain of the spherical forms became flagellated; others, and especially those in which the pigment formed a definite ring and was not diffused throughout the organisms, remained

quiet and did not become flagellated. The flagella broke from the flagellated forms and struggled about among the corpuscles, finally approaching the quiet spherical forms. One of them entered, agitating the pigment greatly, sometimes spinning the ring about; the rest were unable to enter, but swarmed about, beating their heads against the wall of the organism. This occurred after from thirty-five to forty-five minutes. After the entrance of the flagellum the organism again became quiet and rather swollen; but although in the two instances in which this process was traced the fertilised form was watched for a long time no form analogous to the vermiculus was seen.

Note by Professor WILLIAM OSLER—These observations of Dr. MacCallum are of very great interest and importance, and illustrate another step in our still scanty knowledge of the life-history of the malarial parasite. During the past two years Dr. MacCallum and Dr. Eugene Opie have been studying the hæmatozoa of birds, particularly with a view of ascertaining points in the life-history which might be suggestive in the study of the hæmatozoa of malaria. Their paper will appear in an early number of the *Journal of Experimental Medicine*.

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CONTRIBUTION TO THE SURGICAL ANATOMY OF THE TYMPANIC ANTRUM.

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THOSE who have frequent occasion to open the tympanic antrum must constantly be forcibly reminded of its irregular position, especially as affects its relationship to the lateral sinus; those with the tympanum itself and also the facial nerve being fairly constant and only affected by the size of the antrum, whether that size be the result of disease or not. The results of careful measurements of twenty-eight temporal bones not affected with disease has enabled me to form a series of sketches, each typical of a certain number of sections. This number, whilst sufficiently large to give a fair approximate idea of the relationship of the sinus and antrum, is far too small to enable one to assume with any degree of certainty that it is correct.

The sections are cut horizontally, passing through the suprameatal fossa, which lies immediately above and behind the suprameatal spine, and is probably the best guide and landmark for the antrum which we possess. Each section has been carefully traced, these tracings compared by being superimposed. In this way the groups were formed, and a typical section was drawn for each group. In the figures an asterisk marks the position of the suprameatal fossa. These original groups are six in number, and may advantageously be further reduced into three main divisions—viz., (1) Those in which the groove for the sinus lateralis must be opened and the sinus exposed during the mastoid operation; (2) those cases in which the antrum is operated on—the probabilities are that the sinus will be exposed, yet it may escape; and (3) consists of those cases in which the sinus will not come into view during the operation. The bones used were all from adult skulls, children's and young adults' and diseased bones not being used. Group 1 is illustrated by Fig. 1, which shows the result of two sections; Group 2 is illustrated by Fig. 2, which shows the result of two sections; and Group 3 is illustrated by Fig. 3 (nine sections), Fig. 4 (six sections), Fig. 5 (seven sections), and Fig. 6 (two sections).

From these figures one would expect to expose the sinus about once in six operations, and by reference to my case-book I find that my own give a proportion or ratio of one in six. Besides these types certain exceptional varieties occur, notably those in which as a result of long standing chronic suppurative otitis media the antrum is almost or entirely obliterated. In such cases the usual advice in text-books is not to pursue our researches to a greater depth than 15 mm.¹ This advice is certainly based on careful anatomical measurements, but apart from the difficulty of such measurements

¹ Politzer's Diseases of the Ear, English edition, 1884, p. 513.

there is a better guide now that most operators remove the posterior superior bony wall of the meatus, and that is to be careful not to proceed deeper than the level of the internal tympanic wall. Again, in cases of disease of the antrum where the cavity is of such a large size, as in Figs. 5 and 6, the curette must be used with considerable care on the anterior wall of the cavity, for having had a facial paralysis in such a case after operation which took some time to pass away, I examined the anterior wall of several such

FIG. 1.

FIG. 2.

FIG. 3.

FIG. 4.

FIG. 5.

FIG. 6.

Figs. 1, 2, 3, 4, 5, and 6 represent the six primary groups of mastoid antra subdivided as above. S, Lateral sinus (at posterior end of section). * Suprameatal fossa. The antrum is not complete in Figs. 2, 3, and 5.

specimens and in more than one I found the facial canal imperfect for a certain distance or with an extremely delicate bony wall.

The act alone of exploring the sinus is one which, provided antiseptic precautions are taken, seems to be entirely without danger, and even where the sinus itself is opened careful plugging with iodoform gauze controls the bleeding and in no case has any ill effect been recorded, though the

same cannot be said for puncture of the sinus with the drill. The use of the electric or dental burr is likely to reduce the number of times the sinus is exposed, as one can work with a straighter, that is a less funnel-shaped, wound in the bone, and it is usually due to this alone that such accidents occur if the operator is working with a knowledge of the general position of the cavity. Continuing the relative measurements as far as one can from these sections, maintaining the original reservation that such a number can only give approximate accuracy, one finds the average depth of the attic to be a little over three-tenths of an inch, taken in a direct line from the point of election, and the distance of the nearest point of the sinus 0.48 in. on an average, with 0.2 in. as a minimum and 0.7 in. as a maximum; this last measurement demonstrates clearly that exposing the sinus by a continuation of a previous antrum operation is, as a rule, not only the proper surgical procedure, but the quickest route to the sinus, as the distance of the sinus is often less than a quarter of an inch from the suprameatal fossa.

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Clinical Notes :

MEDICAL, SURGICAL, OBSTETRICAL, AND THERAPEUTICAL.

NOTES ON THREE CASES OF FRACTURE OF THE CORONOID PROCESS OF THE ULNA.¹

By W. GIFFORD NASH, F.R.C.S. ENG.

OWING to the influence of Hamilton's writings the occurrence of this fracture is supposed to be extremely rare. Erichsen, in the ninth edition of his "Science and Art of Surgery," says that "it is one of the rarest accidents in surgery." Keating, in his "Cyclopædia of the Diseases of Children," says that he only knows of records of four cases in children—viz., those of Hamilton, Duer, Liston, and Annandale. In Hamilton's case, a boy, aged nine years, had a backward dislocation of the elbow, easily reduced, but recurring as easily. In Duer's case the fragment could be grasped between the thumb and the finger. Liston gives no details of his case. Annandale, whilst excising an old unreduced backward dislocation of the elbow, found the tip of the coronoid process broken off. Sir Astley Cooper, in his work on "Fractures and Dislocations," relates two cases. Case 1 was a man who fell and hurt his elbow; there was a dislocation of the ulna backwards, which recurred whenever the arm was extended. Case 2 was found in a dissecting-room subject and was complicated with fracture of the external condyle. Mitchell² records a case of backward dislocation of the ulna, in which he believed the coronoid process to be fractured, as the ulna easily slipped out of place when the elbow was flexed. I have reason to believe that fracture of the coronoid process is not such a very rare condition, as I have seen three cases which could not be diagnosed as anything else.

CASE 1.—A boy, aged twelve years, came to the casualty department at the Middlesex Hospital on Sept. 28th, 1888, having fallen on his outstretched hand and hurt his elbow, which, he said, moved in and out. On examining the elbow there was no dislocation present, but a swelling over the insertion of the brachialis anticus. On flexing the elbow crepitus could be felt, and whilst trying to determine the origin of this both bones suddenly became dislocated backwards. The dislocation was just as easily reduced and reproduced. There was no injury to the condyles or shaft of the humerus or to the olecranon process.

CASE 2.—A boy, aged eleven years, fell off a wall on to his left arm and hurt his elbow. Next day, Oct. 18th, 1890, he was admitted to the South Devon Hospital, Plymouth, where I was house surgeon. When seen the left elbow was much swollen and deformed, there being dislocation of the ulna and radius backwards and outwards. The head of the radius rotated with supination and pronation. The olecranon

¹ Read at a meeting of the Bedford Medical Society on Oct. 28th, 1897.

² Brit. Med. Jour., vol. ii., 1894.