# SINUS SEPSIS AND MENTAL DISORDER.*

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IN the consideration of sinus sepsis in mental disorder it is first necessary to define in our own minds what we understand by the terms used, and their joint significance. A short summary of work already done is therefore given.

At the British Medical Association Meeting in Leeds in 1889, Guye of Amsterdam, coined the word "aprosexia" to describe the condition of mental dullness and stupidity associated with nasal obstruction due to adenoids. This symptom, however, could hardly be called a mental disease. Deafness and the misery of a blocked and running nose would easily account for it, and it clears up directly on the removal of the cause.

We are not concerned with the conditions of intracranial disease caused by fulminating sinus disorder: conditions such as meningitis, sinus thrombosis and brain abscess, were fully described by Macewen (20), and considered in detail by StClair Thomson in 1906 (1). Cases were recorded in which signs of mental disorder accompanied brain abscess. Such cases are not under discussion in this paper. Such infections are gross, and often spread by direct contact. They are ably considered in a careful and elaborate monograph recently written by Logan Turner and F. E. Reynolds (2).

We are to consider the infections which spread by what Atkinson has called preformed paths (3, 4)—the connections of the pia-arachnoid with nerve-sheaths at the exits of a nerve, and perivascular spread along blood-vessels. Nowadays, the existence of a lymphatic system in the brain and membranes, a system comparable to, and in connection with, the extracranial lymph-stream, is doubted. Yates and Eden (5) showed that indigo-carmine dye placed in accessory sinuses was rapidly absorbed—presumably by lymphatics—and appeared in the urine within fifteen minutes. In the other direction, Le Gros Clark (6) and others found that dyes absorbed by the nasal mucous membrane appeared within the cranial cavity within an hour. Such absorption took place mainly around the olfactory nerve-filaments. It is accepted that perivascular infection can occur, and Pickworth (7) stresses this particularly

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in relation to mental disease. He quotes cases of local atheroma of the internal carotid arteries in sphenoidal sinusitis, and suggests the possibility of sympathetic irritation by such infection, causing periodic spasm, particularly in such conditions as epilepsy. Evans states that the cerebral vessels are normally in a state of passive dilatation (8).

The discovery of the certain source of infection of the central nervous system in the naso-pharynx in epidemic poliomyelitis, and the probable similar source in epidemic encephalitis, led to the search for naso-pharyngeal sepsis in acute and chronic diseases of the nervous system.

In 1927 Yates and Eden (5) investigated and treated the nasal sinuses in cases of post-encephalitic Parkinsonianism. They found 45 individual cases infected out of 64 examined, and attributed relief of symptoms to washing out affected sinuses. Stewart and Evans (9) found a 90% sinus infection in a similar series, and Cotton (9) demonstrated the colon bacillus in every case he investigated. I know of little further work in this direction, and as a method of treatment sinus irrigation has not been generally adopted. It is not mentioned in a recent article on the treatment of post-encephalitic Parkinsonianism by Sir Arthur Hall (10). This writer, in fact, gives a warning against the many and diverse treatments tried out and recommended from time to time. He states that in this, as in so many chronic nervous conditions, any new line of treatment gives temporary relief and hope, but that disappointment often follows.

I have washed out the accessory sinuses in four cases of post-encephalitic syndrome in this mental hospital. In two cases, the pathological report on the washings stated that no cells or organisms were present. In the third, *Staphylococcus albus* was recovered. In the fourth, gross infection was present. All the specimens were put up for *B. coli*, which was not found.

Since 1925, work on the associated conditions has proceeded in two directions. In one, the pathological investigations of Pickworth (7) stand out unique and without comparison. A full report is given in his book published this year. Many of his specimens are illustrated: 314 specimens taken from individual cases in 471 consecutive post-mortem examinations of cases dying in mental hospitals showed signs of sinus disease.

I have neither the qualifications nor experience to criticize post-mortem findings. On general grounds I must, however, state some of my views:

1. We have no comparable series of post-mortem examinations on people not the subjects of mental disease by which we could check Pickworth's findings. Largely on account of the scant attention which is paid to these sinuses in routine anatomical teaching, they are rarely investigated by medical men in routine post-mortem examinations. There is no doubt that most people at some period of life suffer from a sinus disorder—you will all be aware that in acute rhinitis some or all of the sinuses are infected. It must have been the experience of many of us to have had a temporary sinusitis

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persisting after the ordinary symptoms of a " cold " have subsided. I believe that a careful post-mortem examination would show the residua of such infection in many cases dying outside mental hospitals. It has been stated that 1 in 20 of all bodies examined post-mortem show nasal polypi (12).

2. Sinus infection is frequently demonstrable in general disease. Campbell (11) in 130 cases, and Eadie (9) in 11 cases, showed sinus infection in the course of lobar or bronchial pneumonia—that is, in every case they examined. It is presumed that many cases dying in mental hospitals suffer from a terminal pneumonia or septicæmic condition—such as would in itself cause a sinusitis.

3. Fluid exudation in the upper respiratory or alimentary tract is frequent in the post-mortem room. It is the experience of every nasal surgeon that fluid such as blood easily enters the accessory sinuses in certain positions during operations—I can imagine conditions under which fluid could enter the sinuses after death.

The other part of the work has been clinical. Graves and Stirk Adams, working in Birmingham, undertook a prolonged investigation of this aspect of the subject. Their results have been recorded in a special monograph number of the *Journal of Medical Science* for July, 1932. They claim to have demonstrated infection in 818 out of 1,000 cases, examined by the exploration suction technique. Over 50% of the cases so recorded have subsequently been discharged from hospital, presumably after appropriate treatment.

Pierson has done similar work. In the special number of the journal mentioned, Clarke and A. K. McCowan, working at the Chartham Mental Hospital, recorded their findings upon 789 routine cases investigated in an ably constructed scientific paper. They were less enthusiastic, but demonstrated infection in 9·4%.

The subject naturally attracted wide attention, and a long editorial in the *British Medical Journal* for December 31, 1932, was devoted to it. Much work has followed. If only the probability of connection between sinus disease and mental disorder has resulted in routine work by ear, nose and throat specialists in mental hospitals, alongside the dental surgeon, good has come of it.

I was doing such routine work in this hospital in 1931. The publication of the reports mentioned stimulated the interest of the medical staff and myself, and particular attention was paid to this aspect of the speciality.

All routine admissions, and most re-admissions, have been examined. As no operating theatre is at present available, work has been carried out in the ordinary wards of the hospital. The methods of examination are not without difficulties in fractious cases. Most of the sinus explorations have been carried out under local anæsthesia. Where general anæsthesia has been used, the investigations have been carried out with very strict aseptic precautions and operating theatre technique—we cannot yet fully estimate the effect of anæsthetics upon ciliated epithelium.

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A digression into the applied anatomy and physiology of the nasal sinuses is advisable. These sinuses are: the ethmoid, a cellular labyrinth connected with the middle nasal meatus, consisting of three main groups of cells, the anterior, the middle and the posterior, arranged above and behind each other; the frontal sinus, an upward prolongation of the ethmoidal into the diploë of the frontal bone; the antrum, connected with the middle meatus again—a large cavity occupying the maxilla; and the sphenoidal, which develops from the spheno-ethmoidal recess at the extreme upper and back part of the nose.

The two sphenoidal sinuses occupy the body of the sphenoid bone, and in their development burrow into and around adjacent structures. The two cavities, developing asymmetrically, are separated by a median septum, frequently dehiscent. The sphenoidal sinus may extend into the occipital bone, and curve round relating structures to an amazing degree. Its main important relationships are the optic nerves, the carotid arteries, the cavernous sinus and the pituitary gland. Any of the first three may be exposed by anatomical dehiscences; all may be exposed by gross disease. Communications between the sinuses are frequent, particularly between the sphenoid and posterior ethmoid group. The natural drainage of infected ethmoid cells in the erect posture is into the antrum. Although it is stated that the sphenoidal sinus is the one most likely to be associated with mental disorder (13), it must be noted that Howarth has stated, from a rhinological standpoint, that in sinusitis the antrum rarely escapes (14).

The part which the sinuses play in the integrity of the organism is obscure. One function is to lighten the weight of the skull. In the human being they play a part in giving resonance to the voice—the absence of this peculiar resonance is well exemplified in nasal obstruction which involves swelling of the sinus orifices such as acute rhinitis or polypoid formations. I wish to point out particularly that the cavities are in intimate communication with the nasal airway, and show fluctuations in the intracavital pressure with the nasal inspiratory and expiratory streams. O'Malley has shown that small particulate matter easily enters the sinuses with the usual form of nose-blowing (15).

It is presumable that organisms enter the sinuses in ordinary respiration. The nose and sinuses in health, however, remain sterile by the action of a lysozyme present in nasal mucus. They remain clean by the action of ciliated epithelium on the mucus sheet, sweeping away organic or inorganic particles (17). Gross infection results in swelling of the lining membrane and cellular exudation, as in inflammation elsewhere. Should this swelling involve the region of the sinus orifice, with occlusion of it, retention of mucus, muco-pus or pus will occur. Recent work indicates that the occlusion of the sinus orifice is of more importance than ciliary paralysis (16)—Proetz has been able to demonstrate active ciliary motion in a membrane bathed in

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pus (17). Watson-Williams (21) has stated that infection without inflammatory reaction is of more importance than examples of infection calling upon, and responded to by, the defensive mechanisms of the body, in sinusitis as elsewhere. He attributes many of the sequelæ of sinusitis to such types of infection. The statement is difficult to prove clinically, and is dependent on accurate and carefully controlled post-mortem room work. In my experience it has been unusual to find bacteriological infection of a sinus without some routine clinical sign of such infection—intranasal signs, changes on transillumination, X-ray signs, exudation in a sinus wash-out, or evidence of occlusion of a sinus orifice. I am aware that in this my views differ from those of other workers in the field.

Sinusitis is diagnosed on the following grounds :

1. The presence of pus or polypi in the middle turbinal region of the nose, or of pus in the superior meatus.

2. Dullness of an antrum on transillumination. The method is only available in the case of the antra, and being comparative, in unilateral disease. There is, in addition, a positive and a negative error to an extent of 19% (18).

3. A thickened membrane, or an apparent fluid level, will show up on skiagraphy. Here again we have an error proved at 12% (18).

These two methods give a combined error of 7·3% (18). It is found that what may be taken as evidence of infection in one method may not be shown by the other.

4. Evidence based on the examination of sinus wash-outs. Watson-Williams's suction exploration method is used. A cannula of suitable size and shape is introduced through the wall of a sinus, or into its natural orifice, and a small quantity of sterile saline washed in and out of the cavity. The washing is then examined. The method is not devoid of error :

(i) The sinus may be emptied of discharge by the patient having blown his nose just before the wash was made.

(ii) If the natural orifice of the sinus be blocked, it will be impossible, for physical reasons, to draw back the fluid.

(iii) Organisms may be drawn into the sinus from the nasal cavity, through the natural ostium, and so into the syringe.

The method is a good one, and the best at our disposal. Combined with the other clinical methods just mentioned, it renders it improbable that many cases of sinus suppuration will be missed. Whether, however, we are justified in diagnosing sinus suppuration, or rather infection, in a case where organisms only are obtained from the wash on culture of the centrifugalized deposit is another matter. Personally I do not feel justified in doing so unless the wash shows desquamated cells, lymphocytes or polymorphs, in addition to the bacterial content or growth. It is important to mention this point because Pickworth has stated that the chances are 3 : 1 (22) in favour of finding organisms in sinus wash-outs from mental hospital cases. I append a series

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of reports on wash-outs taken seriatim—the last of my series, given by an independent pathologist, Dr. H. A. Cookson, to whom I am indebted for the pathological work throughout. It will be seen that I have been less fortunate than Pickworth, the greater proportion of the fluids being sterile.

### Specimen Pathological Reports.

These were washes which were macroscopically doubtful.

Mary C—, Sunderland Mental Hospital; S.R.I., ref. 695/35.

1. Washings in saline from L. antrum: Blood, no pus. No organisms seen. *Culture*: sterile.

2. R. sphenoid: Blood, no pus or organisms. *Culture*: sterile.

John B—, private patient; S.R.I., ref. 693/35.

3. L. antrum:
4. R. sphenoid: Washings were sterile.
5. L. sphenoid:

6. R. antrum: On culture gave very scanty colonies of streptococci on blood media, but these were not green.

Gladys P—, Sunderland Mental Hospital; S.R.I., ref. 900/35.

7. R. antrum: Very few epithelial cells. *Culture*: *S. albus*.

8. R. sphenoid: Few red cells. Gram-positive organisms. *Culture*: sterile.

R. B—, Sunderland Mental Hospital; S.R.I., ref. 901/35.

9. R. antrum: Red cells, few staphylococci. *Culture*: *S. albus*.

10. R. sphenoid: *Culture*: sterile.

Mr. W—, Sunderland Mental Hospital; S.R.I., ref. 1303/35.

11. Antrum wash: Red blood-cells numerous. A few lymphocytes. No organisms seen. *Culture*: sterile.

Elsie H—, Sunderland Mental Hospital; S.R.I., ref. 1471/35.

12. L. antrum wash: Report (H.A.C.): "I did not get any pathogenic organisms in culture except diphtheroids and *S. albus*, but in the film I thought I saw one or two pneumococci. There was no definite pus, and the amount of blood present made cytology a difficulty. There did, however, appear to be rather a large proportion of polymorphs."

Ethel S—.

13. Sinus wash: No pus and no pathogenic organisms in films or culture.

Ethel S—, Sunderland Mental Hospital; S.R.I., ref. 1550/35.

14. Sinus wash (sphenoid), post-encephalitic, for colon bacillus especially. Report: Red blood-cells plus. No pus, no pathogenic organisms in films or culture.

*Ten out of fourteen sinus washes in sterile saline proved to be sterile on culture. These were consecutive washes. Moreover, they were from cases where sinus infection was suspected on other grounds. Compare this with Pickworth's statement that the chances are* 3 : 1 *in favour of positive cultures.*

In the Annual Report of the Board of Control for 1931 the request was made that in the computation of statistics the mode of exploration used should be stated, to allow of comparison. The use of Watson-Williams's suction exploration technique was advised. In compiling my figures this mode of exploration was used throughout. I have presumed that gross anterior and middle ethmoidal disease, shown by the presence of pus and polypi, could also be included.



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Comparison with the figures given by Graves (23) and Stirk Adams is impossible. Firstly, their cases were not routine examinations. In some cases the patients were picked out as having rhinogenous symptoms or signs. In some others the general condition had to permit of general anæsthesia. Secondly, few rhinologists would agree to accept criteria such as osteoporosis or osteosclerosis, found on puncturing the sinus wall, or excessive hæmorrhage in the washing as definite evidence of sinus disease. These were considered positive signs in attaining the incidence of 80% sinus infection in mental hospital cases. Twelve years' work with this method of sinus wash-outs has shown me that, apart from individual variations in the thickness of the sinus wall, it is not always possible to hit the "soft spot" or to avoid hæmorrhage in two successive explorations of the same sinus.

Comparison with Clarke and McCowan's (24) figures for general incidence of sinus disease is possible. Their statistics were compiled from routine cases, and the criteria under criticism above were not used by them.

### Incidence of Sinus Infection.

Number of patients examined, 500.

*Group* 1 :

Definite sinus sepsis, i.e., nasal polypi, suppurative ethmoiditis, purulent or mucopurulent sinus wash-outs, doubtful fluids pathologically examined and found to contain organisms and/or significant changes in cellular content, 38 (7·6%).

This figure would be reduced to 6·8% if cases where the diagnosis was dependent entirely on histological and bacteriological findings were excluded.

*Group* 2 :

Sinus suppuration suspected, but proof not absolute, i.e., unequal sinus transillumination with suspicious nasal features, mucoid or flaky epithelial washes, post-nasal crusting or discharge with or without suggestive pathological findings, and some cases with features of the former group not satisfactorily investigated for other reasons, i.e., general health, restiveness and short stay as voluntary patients, 18 (3·6%).

Tonsillar sepsis, 24 (4·8%).
Chronic suppurative otitis, 36 (7·2%).

*Staff* :

Total number of staff, 184.
Members examined at their request, 34.
Proved sinus infection, 9 (5·0%).
Suppurative otitis, 2.
Tonsillar sepsis, 8 (4·4%).

The routine examination of 500 mental hospital cases showed sinus infection, of which I was fully satisfied, in 38—7·6%. In a further 3·6% I considered that sinus infection was possible on some findings, but some point, such as gross variation between clinical and pathological findings, or unavoidable

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personal factor, kept each case out of the first group. Although I am in hopes of investigating this series more fully later, I do not feel that Group 2 is acceptable for statistical purposes. Presuming that with further investigation I shall satisfy myself that some of this group—18 cases—really have sinus suppuration, my figure will approximate to Clarke's of 9·4% (24) incidence among nearly 800 cases.. Clarke's figures (24) for otitis in a state of active suppuration are 5% ; mine are 7·2%.

Comparisons with Clarke's tables showing the relative incidence in different types of mental disease are not possible, owing to differences in nomenclature used.

Figures giving the incidence of sinus disease in the general population are various and not very reliable. Chiari (19) put it at 2%, and of 66,350 hospital cases at Edinburgh 3% were found to have sinusitis (7). Since my work began here my services have been openly available to the staff, 184 in number. Thirty-four members have been examined at their own request. Sinus infection has been proved in 5% of the total staff—9 cases. In 6 of them it has been necessary to carry out operative procedures. One can surmise from experience that the figure would have been higher if routine examinations had been possible. The compared incidence of 7·2% sinus infection among patients and 5% among the members of the staff is not without interest.

From the other side of the question, I have attempted to discover how many cases of sinus disease which I have operated upon have had mental disorder. The work is tedious and requires some tact. I am not yet able to submit definite figures, but from our work so far the only cases in my series of 500 operations found to have suffered from mental disease have been those transferred from this hospital.

I have no figures to offer in respect of the results of treatment. I must reiterate Clarke and McCowan's plea (24) that only those cases which had not responded to general measures, and then improved after treatment of sinus sepsis, should be included in statistical records.

I wish also to utter a word of warning. Drainage of an affected sinus does not necessarily remove the infection from it in a short time. General symptoms may be relieved and the comfort of the patient increased, but a septic membrane may persist. I have in mind here a case of functional neurosis treated privately. Before I saw him he had been in the hands of a famous nerve specialist, and a diagnosis of sinus infection made by an equally eminent rhinologist, on the presence of *Streptococcus viridans* in a sinus wash—there were no other indications of sinus disease. The antrum affected was opened and good drainage persists. For another reason—an acute otitis media—I did a round-trip wash-out of his nasal sinuses. Those that were closed remain sterile ; the open one, with good drainage, shows a scanty growth of streptococci. It is two years since the operation.

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## Summary.

1. Before conclusions can be drawn from post-mortem pathological material collected in mental hospitals, the great incidence of sinus infection at some period of life in all individuals must be considered. That residua of such past infections would be found by careful examinations of the sinuses in people dying outside mental hospitals is probable. Further, in the tabulation of such specimens in mental hospital cases the cause of death in each must be noted, and the effect which this might have had in sinus infection, as an ætiological factor, considered.

2. Suction exploration, although the best method at our disposal, is not universally accurate. Cases where the ordinary naso-pharyngeal flora are found in the wash should be considered with suspicion, and some reliance placed on the histology of the actual wash, i.e., desquamated or exudative cell types, where gross pus or muco-pus is not evident. In general, rhinologists would not accept osteosclerosis, osteoporosis or blood in the wash as evidence of sinus disease in the absence of other more conclusive signs.

3. A series of 500 routine cases of mental disease has been examined. Nasal sinus infection has been proved in 7·6%. This percentage is compared with a similar one found in a similar series of cases, using similar criteria (24). It shows only a slight difference.

4. In a control series of 184 mentally normal individuals the incidence of sinus suppuration was found to be not less than 5%.

5. Pioneer workers in this field claimed a higher incidence. Their findings have promoted general investigation of the nasal accessory sinuses in mental disorder. Although subsequent investigations may prove a lower incidence of sinus disease in mental hospital patients than at first claimed, an incidence of up to 10% infection demands investigations and treatment on grounds of general and possible local pathology.

## Conclusion.

It would appear from the above figures that the incidence of sinus disease in mental disorder is not greater to any appreciable degree than among the general population. That such sinus disease may seriously affect existing predispositions to disease in the nervous system, as it may seriously affect such predispositions in any other system, is unquestioned, in view of clinical and post-mortem work carried out. There is no intention to decry the work of Pickworth and Graves, who have laboured hard and long at this problem—indeed, many of the doubtful points raised are known to them and have been discussed by them. It is common experience that pioneer enthusiasm is often dulled at the wheel of practice. Without this initial enthusiasm we could not reach any truth.

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