Both these drugs are given intravenously. In most cases this presents no great difficulty, but, as everybody knows, there are patients who seem absolutely destitute of suitable cutaneous veins. Both these compounds are freely soluble in water, and as they are always sent out by the manufacturers in sealed glass ampoules, it is very convenient to dissolve them *in situ* and to draw the solution straight into the syringe to be used for injection. They are both very unstable in solution, and the solution must on no account be kept from day to day. Sanoerysin solution is quite colourless, but it soon precipitates metallic gold, not as a shining metal, but in the form of an impalpable black stain, which it is difficult to remove wholly from the wall of the syringe, and which also frequently leaves a black mark in the skin of the patient at the site of repeated injections. The dose of these two compounds is very different. That originally prescribed for krysolgan was initially 0.015 grain, and the maximum dose was 1.5 grains. In the case of sanoerysin, however, we begin at 0.05 gram, and as much as a whole gram of sanoerysin may be given in one injection. Lately, however, I have given up doses larger than 0.5 gram. When one considers that there are fifteen grains in every gram, it follows that, on the whole, the dose of sanoerysin prescribed is from ten to fifteen times as great as that of krysolgan. Probably much larger doses of krysolgan could be given to many patients with impunity, but one hesitates to exceed the limits laid down by the manufacturers. Personally, I have never had any toxic symptoms following its administration, but several instances where these have occurred have been published. Gold is, as we are all aware, a metal powerful both for good and for evil, and although the benefits from the use of sanoerysin in lupus erythematosus are unquestionable, and I believe that its reputation among those who treat phthisis is gradually becoming enhanced, there is no doubt that it is not a drug to be put in the hands of children.

The clinical response in the administration of these drugs is, as might be expected, by no means uniform for every patient. My practice is always to begin with krysolgan, and a very small dose—that is, 0.015 grain, and gradually work up by weekly doses to 1.5 grains. Not infrequently a distinct improvement is seen after the first one or two doses, but, on the other hand, after about six weeks' treatment progress frequently slackens. I then switch on to sanoerysin, beginning with a dose of 0.05 gram, and gradually work up to either 0.25 or 0.5 gram, occasionally even to a whole gram. Patients who have been favourably affected by krysolgan almost always improve further under sanoerysin. Sometimes the improvement is preceded by a local reaction occurring immediately after the injection, during which the affected areas become redder and slightly heated. In other patients the areas fade gradually and the scaling diminishes without any temporary exacerbation.

As to the ultimate result of this form of treatment, I regret that I have no proper statistical analysis of my cases to set out. I suppose in the last three years I have treated about forty cases. I can remember ten certainly which have been discharged as cured, and have remained cured. The great majority of the remainder have been greatly improved. Some of the lesions have cleared up completely, although perhaps one may remain obstinate or, after apparent cure, relapse has taken place. This much I think I can claim conscientiously, that in every case except one the disease has been arrested and has ceased to spread. When I remember the cases which I used to see in former times, and the inexorable way in which the disease used to invade and destroy the complexions of nice-looking people (and you must remember that lupus erythematosus is commoner among women than among men), I think that much credit must be attributed to the gold treatment. I mentioned above one patient who had grown worse under krysolgan and sanoerysin. Finding that this treatment was unsuccessful I tried neo-silver salvarsan, and I am happy to say that, under this, considerable, and I believe permanent, improvement has taken place. In this case the disease was chiefly on the hands.

Additional evidence of the value of the gold treatment of lupus erythematosus is afforded by the action of the manufacturing chemists. Imitation is the sincerest form

of flattery, and since krysolgan was introduced by Schering, other manufacturers have imitated and claim to have improved upon it. There are quite a number of other organic gold and sulphur compounds now on the market, made by various chemists. Among these I may mention aurophos, triphal, lopien, allocrysin. Schering has lately introduced one which is claimed to be a great improvement on krysolgan; it is called solganol, and, like all the others, is said to have increased therapeutic value combined with less toxicity. The maximum dose may be as much as a whole gram, but I have as yet had no personal experience with it.

I must not conclude without mentioning some of the possibly unpleasant effects of these compounds. One, very frequent but unimportant, is a metallic taste in the mouth immediately following the administration. This is a phenomenon common after the injection of many metallic drugs—for example, salvarsan, antimony, and sodium cacodylate. Some diarrhoea occurs occasionally, and there may be a febrile reaction, which soon passes off. More serious are the effects on the skin and mucous membranes. A follicular pruritic eruption is not uncommon, and unless this be regarded as a danger signal and the administration of gold be immediately ceased, it will probably be followed by a generalized exfoliative dermatitis. One such case has occurred in my experience, and gave me considerable anxiety for nearly a month, but it ultimately cleared up, and with it the erythematosus. Another serious complication may be a troublesome and painful stomatitis with a very sore tongue. This may be so bad as to interfere with swallowing and cause the patient to refuse food. In lupus erythematosus this is not of vital importance, but when it occurs in phthisical patients may do great harm.

There is one way in which the risk of the unpleasant accidents may be minimized. All these toxic effects are probably the result of the fixation of gold in the liver cells. If the liver cells are fully occupied by some harmless or beneficial substance they will not be able to take up the metal, consequently it is a wise precaution to give patients who are being treated in this way plenty of dextrose a few hours before each injection. This gives the liver something to do and prevents it getting into mischief. In addition, it is wise after patients have had several injections of their maximum dose to lengthen the spaces between doses to two, three, or even four weeks; and one is encouraged to do this by the fact that often improvement continues to make progress as long as three weeks after the last injection.

I myself feel that gold will one day be held to be at least as valuable in tuberculosis as mercury is in syphilis, and although the time is not yet, I hope I have shown that this is a promising field for further work.

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THE STRUCTURE OF THE HUMAN ERYTHROCYTE.

BY

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IF we accept the definition of structure as "the mutual relation of the constituent elements of the whole as determining its peculiar nature and character," and if we remember that cytological structure is brought into evidence only by alteration of the physico-chemical properties of various parts of the cell contents by the action of reagents, then no apology need be tendered if, to render the constituent elements of the erythrocyte visible, an unusual method is adopted.

Walker and Allen (1927) have shown that Golgi bodies and chondriosomes can be artificially produced by adding lipins—lecithin and cephalin—to certain colloidal and protein mixtures and subjecting them to the same processes as are utilized for the demonstration of Golgi bodies in cells; and Walker (1928) has made out an excellent thesis for the study of these artefacts as a guide to variations of the physiological state and pathological conditions. He has shown that saturation or oxidation of the lipins produces similar pictures in the artificial emulsions as in certain cell states.

PLATE I.
(Magnification 1,000 diameters.)

- FIG. 1.—A megaloblast of the first generation.
FIG. 2.—A polar view of a spireme.
FIG. 3.—A first generation megaloblast in late telophase.
FIGS. 4 AND 8.—Daughter nuclei in the process of reconstruction.
FIGS. 5, 6, 7, 12, AND 13.—Second generation megaloblasts showing the process of karyolysis.
FIGS. 9, 10, 11, 14, AND 15.—Second generation megaloblasts showing the processes of pycnosis, karyorrhexis, and karyolysis. FIG. 15 illustrates a megalocyte containing Howell-Jolly bodies.
FIGS. 16, 17, AND 18.—These illustrate the bizarre figures produced by pycnosis and karyorrhexis. In FIG. 17 is seen a schizocyte.
FIG. 19.—Illustrates a Cabot's ring in a polychromatic megalocyte.
FIG. 20.—Illustrates a megaloblast with the appearance of a cell membrane at its upper pole.
FIGS. 21 AND 22.—Illustrate punctate basophilia obtained with Giemsa's stain.
FIG. 23.—Illustrates stippling and reticulation obtained with brilliant cresyl blue.

Mention of Professor Walker's work is necessary, because the method of approach to the demonstration of the structure of the erythrocyte would appear, in some respect, parallel. In both, consideration of the lipins plays an important part. The methods differ in that Walker has built up certain cell structures from lipins and deduced from their reactions chemical changes in the normal and pathological cell. The micro-chemical dissection of the erythrocyte, on the other hand, is based on a known reaction of lipins. Advantage was taken of this to unbuild

the corpuscle and fix the protein of the stroma so as to render it visible. Bütschli (1894) and Hardy (1899) have shown that fibrillar structure can be demonstrated in stretched films of colloidal solutions by the fixatives used for cells, and Bütschli suggested that some of the fibrillar structure seen in fixed cells was due to pre-existent stresses.

A volume could be written on "the peculiar nature and character" of the erythrocyte, but as we are concerned with the microscopic aspect of its architecture, its homogeneity, shape, elasticity, and the effect of injury will be mentioned; and then only in so far as they assist in the visualization of its structure.

The erythrocyte by the usual staining methods or by dark-ground illumination appears structureless. By incident light, in fresh specimens, the homogeneous biconcave disc is sometimes seen to bulge in the centre, but the bell-shaped corpuscle returns to the biconcave shape. Corpuscles in the capillaries curve as they come in contact with obstructions and elongate under pressure, but quickly return to the original shape when the pressure point is passed. The haemoglobin is contained in the biconvex peripheral ring, and does not vary its position with the movements of the corpuscle. On scission, little, if any, haemoglobin is lost, and the resulting parts assume the biconcave shape of the original cell. In Plate I, Fig. 17, a schizocyte is seen below the nucleated red cell, and its appearance suggests that the haemoglobin is confined to the periphery of the distorted corpuscle. Ehrlich (1881) naïvely explained the phenomenon by saying that it is the nature of the red cell protoplasm to take on this biconcave shape, just as it is the nature of a drop of oil to assume a globular form when split off from the parent bulk. The cut surfaces of the divided corpuscle unite at once; but in the absence of a nucleus there cannot be actual repair except in a purely physical sense. These facts lead one to imagine the haemoglobin to be retained in an invisible spongy stroma which prevents loss on injury and which, by its form and position in the corpuscle, is responsible for the shape. An envelope or membrane containing lipins surrounding the cell completes the mental picture. The shape, elasticity, and the result of scission suggest the presence of stresses within the erythrocyte. How true is this conception, and to what extent it is demonstrable, will be seen later.

There are several problems bearing directly on the question of structure which call for attention. The fate of the erythroblast nucleus, the presence or absence of an envelope or cell membrane, and the basophilic substances found in erythrocytes, must be considered.

I.—THE FATE OF THE ERYTHROBLAST NUCLEUS.

The nucleus of the erythroblast undergoes certain changes which are represented in Plate I. The first generation cell (Fig. 1) undergoes mitosis. Fig. 2 is a polar view of a spireme, Fig. 3 a stage in late telophase, and Figs. 4 and 8 the daughter nuclei in the process of reconstruction.

After reconstruction the nucleus of the second generation cell may disappear by simple karyolysis, by pycnosis and karyolysis proceeding simultaneously, or by a combination of pycnosis, karyorrhexis, and karyolysis. The stages of pure karyolysis are represented from the reconstructing nucleus (Fig. 4) by Figs. 5, 6, 7, 12, and 13. Fig. 13 shows the final remnant of the nucleus before karyolysis is complete, and even at this late stage nuclear structure is still visible.

Commencing at the daughter cell Fig. 8, the stages of pycnosis, karyorrhexis, and karyolysis combined are shown in Figs. 9, 10, 11, 14, 15, and 19. The nuclear chromatin soon becomes aggregated into structureless masses from which particles are separated and scattered irregularly in the cytoplasm. The final stages of this process are seen in the Howell-Jolly bodies in an orthochromatic corpuscle (Fig. 15), and in the Cabot's ring in a polychromatic megalocyte in Fig. 19. Pycnosis and karyorrhexis may take place at any stage and the familiar bizarre forms be produced as in Figs. 16, 17, and 18.

The cells in the photomicrographs are megaloblasts, but similar changes take place in normoblasts. In normoblasts the usual stages in the disappearance of the nucleus are pycnosis and karyolysis. Nuclear structure soon becomes indiscernible and the chromatin particles fused into one dense mass which undergoes solution. The end-result of these processes is the complete disappearance of the nucleus, and the erythrocyte normally enters the blood stream without any trace of chromatin.

This brief survey is necessary because the statement that the basophilic substances—punctate basophilia, diffuse polychromasia, and reticulation—are nuclear remains, continues to be made. The normoblast is sometimes illustrated and described as extruding its nucleus. The molecular disruption preceding this phenomenon is very difficult to imagine, and, if it ever does occur, must be the unique example of cellular *hara-kiri* in biology.

II.—THE ENVELOPE OF THE ERYTHROCYTE.

There is no reason to believe that in its nucleated state the red cell differs from its neighbours and does not then possess a cell membrane. Occasionally, in blood films, there is evidence that an envelope exists. In Plate I, Fig. 20, the envelope of the megaloblast appears fixed at the upper pole and a thin delicate membrane can be traced; but after the nucleus has undergone solution no limiting membrane to the normal erythrocyte can be demonstrated. Rohonyi (1916) and Knaff-Lenz (1918) deny that there is a true covering membrane because the rate of absorption of ions by pure haemoglobin and by red corpuscles is identical. And if haemolysis with water be observed under dark-ground illumination diffusion of the haemoglobin takes place, but no alteration in the exterior of the corpuscle can be seen. The "ghost" is still homogeneous.

The work on monomolecular films of oil on water commenced by Pockels (1891) and Rayleigh (1899) was applied to fatty acids in solvents, such as ether, by Langmuir (1917). On these lines Görtner and Grendel (1925) extracted the lipins of a known number of erythrocytes with acetone and found that the quantity of lipins obtained would cover each erythrocyte with a layer two molecules in thickness. They conclude that there is a bimolecular layer of lipins on the surface of the erythrocyte. They do not take into consideration the possibility of lipins being combined with the protein of the stroma—the lecitho-protein of some writers—but whether their contention is strictly correct or not is immaterial to the present work.

PLATE II.
(Magnification 1,000 diameters.)

FIG. 1.—Illustrates the suggestion of pores obtained by the action of hydrogen peroxide and weak alcohol on erythrocytes.

FIGS. 2, 3, 4, 5, 6, 7, AND 8.—Illustrate various forms of punctate basophilia obtained by the method described in the text.

FIGS. 7, 8, 9, 10, 11, AND 12.—Illustrate various forms of reticulation obtained by the same method.

FIG. 13.—Illustrates two polychromatic erythrocytes obtained as above.

FIGS. 14 AND 15.—Illustrate the spongy stroma of the erythrocyte. Fig. 15 shows the haemoglobin in the process of being discharged.

FIG. 16.—Illustrates the spongy stroma of the erythrocyte with a limiting membrane. In one erythrocyte the haemoglobin is seen leaving the corpuscle *en masse*.

We are forced to the conclusion that the erythrocyte does not possess a cell membrane, but has on its surface a molecular condensation of lipins—lecithin and kephalin. These contain unsaturated fatty acids which are insoluble. If, however, the fatty acids are saturated or oxidized they are rendered soluble in water and dilute alcohol.

If erythrocytes are treated with a mixture of hydrogen peroxide, industrial spirit, and water, the lipin covering is oxidized and dissolved either partially or completely. Partial solution is seen in Plate II, Fig. 1, and the result gives the appearance of pores. The weak alcohol has fixed the cell, but before fixation has become complete oxidation and solution of areas of the covering have taken place.

The benzidine test for blood depends upon the oxidation of benzidine by hydrogen peroxide in the presence of a catalyst. The catalytic agent in this case is haemoglobin. If to the mixture of alcohol, water, and hydrogen peroxide, benzidine be added, we have a means of proving by the blue meri-quinonoid product whether or not the haemoglobin has been reached.

III.—PUNCTATE BASOPHILIA, DIFFUSE POLYCHROMASIA, AND RETICULATION.

The above are the three basophilic conditions described by Ehrlich (1885), but for completeness and contrast Howell-Jolly bodies and Cabot's rings, Plate 1, Figs. 15 and 19, deserve brief note. As mentioned in a previous paragraph, Howell-Jolly bodies and Cabot's rings are minute granules of chromatin, and represent the final remnants of the

nucleus. They are visible in fresh preparations by dark-ground illumination and stain purplish red, as chromatin does with methylene blue-eosin dyes, in fixed films. On these grounds I think we may accept them as nuclear remains.

On the other hand, there is every reason to believe that punctate basophilia, diffuse polychromasia, and reticulation (Plate I, Figs. 21, 22, and 23) have no relationship to the nucleus. The arguments for this belief have been the subject of preliminary papers (1928, 1929). The reasons for denying them any connexion with the nucleus are that the conditions are not visible by dark-ground illumination, nor do the staining reactions with methylene blue-eosin preparations resemble those of chromatin.

The abundance of reticular substance in embryos and young animals (Gruner, 1913) and in diseases associated with normoblastic crises, such as Addison's anaemia, von Jaksch's anaemia, and myeloid leukaemia, is not associated with changes in the nucleus (1928). There does not appear to be any connexion between the younger normoblasts and the older normoblasts and the amount of reticular substance. That the basophilic substance is the same in the three conditions is supported by the work of Hawes (1909) and Key (1921, 1924), who pointed out the close numerical agreement between stippled and polychromatic cells and reticulocytes, and is I think confirmed by the following results. If the reagents mentioned in Section II are flooded on to fresh blood films, and the proportions of the reagents altered in the several films, any type of punctate basophilia and reticulation may be produced. In Plate II, Figs. 2 to 8, are seen various types of stippling. The extremely fine granules, coarser granules, and granules of irregular shape, single, and aggregated into clumps, are reproduced, and Fig. 7 shows punctate basophilia with the bar form of reticulation in the same corpuscle. Reticulation is seen in Figs. 7 to 12. The unfragmented granulo-filamentous form is seen in Fig. 9, the fragmented reticulum in Figs. 8, 10, and 11, and the bar form in Figs. 7 and 12.

The granulo-filamentous form of reticulation requires some explanation. Whether demonstrated by brilliant cresyl blue, itself an oxidizing agent, or by the method described above, two facts are apparent. The first is that around

PLATE III.

This is an enlargement of Fig. 13 in Plate II. ($\times 2,000$ diameters.)

the mass of filament there is a pale areola; and the second that the unfragmented reticulum frequently appears in the centre of the corpuscle. The biconcave centre of the corpuscle, being almost devoid of haemoglobin, is the place where one would not expect reticulation if our arguments were sound. There is, however, the fact that no other substance in the erythrocyte except haemoglobin gives the blue meri-quinonoid end-product with benzidine and hydrogen peroxide. The probable explanation is that the lipins covering the centre of the corpuscle have been solutioned

and allowed the benzidine and hydrogen peroxide mixture to enter, and at the same time the alcohol has slowly fixed the protein at the periphery of the stroma. The result has been the squeezing out of the haemoglobin into fine strands from the meshwork of the stroma to the centre of the corpuscle where it has come in contact with the reagents. A corpuscle is shown in Plate IV in which the haemoglobin

PLATE IV.

This is an enlargement of Fig. 16 in Plate II. ($\times 3,000$ diameters.)

has been expressed into the centre and is being expelled. In fact, this is merely the stage farther than Fig. 9 in Plate II.

Diffuse polychromasia is the most difficult of the basophilic conditions to reproduce artificially. The two cells in Plate II, Fig. 13, of which Plate III is an enlargement, closely resemble the condition except for the surrounding rim of uncoloured substance.

IV.—THE STRUCTURE OF THE ERYTHROCYTE.

In the production of the basophilic conditions the unsaturated fatty acids of the lipin covering of the erythrocyte have been oxidized and partially dissolved, the protein of the stroma fixed by the alcohol, and reaction has taken place between the haemoglobin, benzidine, and hydrogen peroxide. The various stages of the reaction seen in the photomicrographs are explained by the degree of penetration of the lipin covering and the relation between the fixation of the protein of the stroma and the amount of haemoglobin set free before fixation is complete. This is suggested by the corpuscles in Plate II, Figs. 6 and 13, and is better illustrated by Plate III, in which all the stages are seen.

If a larger percentage of hydrogen peroxide and water is used, solution of the lipins occurs and the haemoglobin is discharged. The protein of the stroma, however, is not immediately fixed, with the result that before complete fixation has taken place the colloidal protein of the stroma has filled up the central depression of the corpuscle. This is seen in Plate II, Fig. 14, the previous stage of which is Fig. 15. In the latter figure the haemoglobin is in the process of being discharged, and the protein is seen to have obliterated the central depression.

If the alcoholic solution of benzidine is used undiluted, and the percentage of hydrogen peroxide increased, we have rapid oxidation and solution of the lipins, rapid discharge of the haemoglobin, and rapid fixation of the stroma. The fixation of the stroma protein is so sudden that the central depression is not encroached upon to any great extent. The final result is seen in Plate II, Fig. 16, and in the enlargement of this (Plate IV). The haemoglobin is seen being expelled in a mass from the corpuscle in one of the figures, the spongy stroma is illustrated and fine trabeculae are seen at the periphery connecting the stroma with a faint ring suggestive of a fine covering.

We have, then, our mental picture of the structure of the erythrocyte demonstrated—the condensation of lipin molecules on the surface which acts as a limiting membrane enclosing a spongy stroma in the interstices of which haemoglobin is contained.

CONCLUSIONS.

1. The normoblast nucleus disappears by karyolysis or by pycnosis and karyolysis, with or without karyorrhexis, and when the erythrocyte enters the blood stream no trace of the nucleus remains.

2. The erythrocyte does not possess a histological cell membrane, but has on its surface a molecular condensation of lipins which acts as an envelope. Whether or not this is a bimolecular layer, or what physico-chemical relationship between the lipin covering and the protein of the stroma exists, are fields for further investigations.

3. The basophilic conditions of the erythrocyte—punctate basophilia, reticulation, and diffuse polychromasia—are expressions of the same process and vary only in degree. The staining substance is not chromatinic.

4. The presence of these conditions, when obtained by the usual staining methods, would appear to indicate a defect in the lipins on the surface of the erythrocyte.

5. During the course of the work it was noticed that not all blood films behaved in the same manner. Accurate standardization of the reagents and the time, or the employment of other methods on similar lines, might lead to the elucidation of certain problems in connexion with the genesis and life-history of the erythrocyte, and also with its behaviour in disease.

The photomicrographs are by W. E. Cooke and C. F. Hill.

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TYPES OF ACUTE MASTOID INFECTION.*

BY

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WHILE, in what may be described as the classical textbook cases of acute mastoiditis, the diagnosis is easy, experience has taught me that atypical cases are frequent and that, in these, diagnosis is often extremely difficult. It is probable that in all cases of acute middle-ear inflammation the lining of the mastoid antrum and cells participates in the inflammatory process. It is only, however, in those cases in which the inflammation spreads to the bone, owing either to defective drainage or to the intensity of the infection, that the term "mastoiditis" should be properly applied. The early recognition of such a condition is of the utmost importance, both from the point of view of preservation of the hearing and also of the general health.

As an aid to diagnosis, I have tried to classify cases into groups, but, in dealing with them in this way, I wish it to be clearly understood that cases are not infrequently met with showing characteristics of two or more groups in combination.

The Classical Type.

Dealing first with the classical type, there is present a history of recent earache with discharge, and tenderness and swelling over the mastoid process. Fever and constitu-

tional disturbance are present. Characteristically, the discharge has either suddenly ceased with the onset of the mastoid swelling or has been distinctly intermittent in type, being sometimes profuse and sometimes scanty. The periods of diminution in the discharge are generally accompanied by an increase in the pain. In contradistinction to such intermission, the discharge may be continuously very profuse. This profusion indicates involvement of a wide area, and therefore of the mastoid antrum and cells. The character of the temperature chart is of some assistance. Most usually, after a few days' fever, the temperature falls, and then, after a short period, commences to rise again. While this remission, if present, is very significant, not infrequently it does not occur, the temperature remaining high from the commencement of the acute otitis.

A characteristic factor in the tenderness over the mastoid process is that it is confined to one particular spot, and is deep and not superficial. In testing for this the finger should be firmly passed down over the mastoid process while the eye is being watched. The presence of tenderness is always evidenced by a flinch. This obviates, to a large extent, the personal factor of the patient.

Having thus detailed the characteristic symptomatology, it may be said that any, or all, of these symptoms or signs may be absent.

Cases Without Aural Discharge.

Cases presenting signs of inflammation of the mastoid process, but with a normal middle ear, are not infrequently seen. In these a history of previous aural discharge may be present. The explanation is simply that while the middle-ear inflammation, suppurative or catarrhal, has cleared up, the infection in the mastoid process has progressed.

Latent Type.

The characteristic of cases in this group is the triviality of the signs and symptoms, and I can best illustrate this class by a description of a case recently dealt with.

The patient, a clergyman aged 52, following a "cold," had earache with discharge for twenty-four hours only. For two months afterwards he suffered from a vague ache in the ear, with considerable diminution in the hearing and a general feeling of unfitness. During this period the temperature was normal and he was able to continue his duties. The diagnosis of a suppurating focus in the mastoid was made on this history, combined with the presence of a localized tender spot towards the apex of the process, with some opacity and injection of the tympanic membrane. Operation showed pus under tension in the mastoid cells, and drainage produced rapid restoration of the hearing, with return to health.

The difficulty in such cases is to persuade the patient that he has a condition sufficiently severe to need an operation. If left, the suppuration will probably eventually reach the surface and produce manifest symptoms, but complications may supervene.

The points that I have found of most help in diagnosis in this group have been: the presence of a dull ache in the ear; a point of localized tenderness, which may be situated at any portion of the mastoid process; if discharge is present, either its profusion or intermission; the persistence of a defect in hearing of a conductive type; some bulging of the posterior superior meatal wall; and, finally, a haziness in outline of the mastoid cells, in a skiagram, as compared with the other side.

Fulminating or Osteomyelitic Type.

While in the majority of cases of acute mastoiditis the disease will progress for a considerable period without any great risk to life, in the class which I am now trying to describe I believe that early operation is of paramount importance. The cases are associated with a streptococcal infection, frequently haemolytic in type, and, in them, the infection from the beginning widely invades the bone and produces severe constitutional disturbance. They are most commonly met with in association with epidemics of acute sore throat and are due to a spread of infection up the Eustachian tube. There is high fever from the commencement, and the discharge from the ear is unusually profuse, watery, and often blood-stained. Widespread tenderness over the mastoid occurs early. Such cases not infrequently

* Read at a meeting of the Bath and Bristol Branch of the British Medical Association, January 29th, 1930.