

and the useful range for that indicator is a pH of 6.8 to 8. It is evident, therefore, that Ganges water will have a pH favourable to the growth of cholera vibrios at or about Ross and Bagchi's neutral points, which as already mentioned, coincide more or less closely with the two cholera waves. Ganges water must be subject to repeated infections throughout the year, but it is possible that the infection dies out rapidly at times when the reaction of the water is either too acid or too alkaline for the organism to multiply rapidly, and when the temperature also is unfavourable.

I suggest that this interesting relationship between the reaction of Ganges river water and the two rises in cholera in each year may be more than a coincidence, and that the change which takes place in the reaction may prove to be a factor of importance in the epidemiology of cholera.

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EAR, NOSE AND THROAT DISEASES AMONG CALCUTTA UNIVERSITY STUDENTS.

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THE Calcutta University Student Welfare Committee have very kindly asked for my views in the matter of medical examination of college students with reference to ear, nose and throat diseases. As I consider the subject to be of great importance not only from the point of view of the college students but also from that of the community in general, and hence deserving of much more attention than it generally gets, I thought I might write something about the significance of these diseases in the *Indian Medical Gazette*.

The committee have been conducting the medical examination of the Calcutta college students since March 1920, with a view to ascertaining the general condition of their health. These examinations have revealed a most appalling state of affairs, which demands most urgent and immediate attention. It has been found out that 71 per cent. of the students suffer from some sort of physical defect or other. Most of these are preventable, if attended to at a sufficiently early stage.

The importance of these health examinations cannot be over-estimated and this effort is certainly a move in the right direction. But the usefulness of these examinations would have been greatly enhanced if instituted at a much earlier state. What I mean is that a comprehensive system of *school* medical examination should be adopted in addition to these college examinations, as is done in England and other European countries. The reason for this is obvious. Many of the ailments from which our college students are suffering date back to their childhood or school days, and it is then that the disability, if detected, being at its very onset, would have the best chance of being easily corrected. This is applicable very particularly to ear, nose and throat diseases.

Unfortunately there is no branch of surgery which is so much neglected in this country as that of ear, nose and throat diseases. Every day in the hospital clinics are seen numerous cases where an acute inflammatory condition of the middle ear has been allowed to progress until a state of chronic suppuration, with all its attendant sequelæ, has resulted. What an enormous number of students—both in the schools and in the colleges—there are who have got diseased tonsils, adenoids and enlarged glands in the neck, with broken-down constitutions and flat, deformed chests. The pity of it is that the patients do not seem to realise the seriousness of these diseases at their early stage and even when they are fairly advanced they do not generally undergo proper treatment. This deplorable state of affairs is due mainly to ignorance and apathy of the general public and to some extent, if I may be allowed to say so to indifference on the part of the attending physicians.

Over 70 per cent. of all ear diseases are middle ear diseases and these may be catarrhal or suppurative in nature. These, if long-continued and not properly treated, will end in deafness. Infectious diseases, e.g., measles, influenza, whooping-cough, small-pox, typhoid fever, scarlet fever, etc., are responsible for the majority of the worst types of suppurative middle ear disease and it is at their beginning that so much can be done to prevent a progressive and chronic disease with consequent deafness. It goes without saying that once deafness has set in and has been moderately severe, it renders a man incapable of being useful in any sphere of life. There is the further handicap that none of the prominent life insurance companies will accept an applicant with chronic or intermittent otorrhœa and here we are brought face to face with the business man's view of the disease. Hence it is very important not to neglect these ear diseases at their early stage.

What then are the early symptoms of these troubles? I will give here, in the briefest possible manner, a few typical symptoms in illustration. The patient will say that all on a sudden

one night he felt a severe pain in his ear and since then it has been "stopped" and he cannot hear distinctly with that ear. Along with this there may be a slight rise of temperature and a general feeling of illness. From this short history we can guess that the patient is suffering from acute otitis media. Again a father will come with his child, with the story that the boy has of late been listless and does not respond to questions unless these are repeated twice or thrice. Another patient will complain that he feels "very heavy" in his ears and is being disturbed with all sorts of buzzing noises in them. Here we have before us cases of catarrhal otitis media with the beginning of deafness. Naturally we are asked if there is anything wrong in their ears. We examine the ears but our examination must not stop there. The ear is never thoroughly examined until we have examined the nose and throat. It is not recognised by the public, and not much importance is placed by the general practitioner and those not practising the speciality, on the fact that an aural condition may have been—has been, indeed, in a large proportion of cases—caused by some abnormal or diseased condition of the nose or throat: the recognition of a nasal or nasopharyngeal abnormality is often the first step in the amelioration or cure of aural disease. In this connection adenoids may be mentioned as an instance, not only in children but also in adults: their detection at any age is a gain.

Here I may describe the two simplest tests which I consider most suitable for testing the hearing of students. These are the voice test and the watch test.

The voice test.—The practical test of hearing is the ability to hear ordinary conversation, but as the pitch and loudness of the spoken voice vary considerably in different persons and often in the same person at different times, the whispered voice, being more uniform, is more reliable as a test of hearing, provided the deafness is not so intense that the whisper is heard with difficulty or not at all.

Method.—The patient stands at one end of a quiet room with the ear to be tested towards the examiner, the other ear being stopped with the index finger. The examiner begins the test from without the range of the patient's hearing, say at a distance of about thirty feet, and gradually comes nearer until the patient repeats correctly what is spoken or whispered to him, and the distance so found is entered on the record. The spoken or the whispered voice is used according to the degree of deafness, and the record should state which method of speech is used.

If the ordinary conversational voice can be heard correctly at about twenty or thirty feet, the hearing for the voice may be considered normal. Any distance less than that indicates defect, as a rule. The whisper may be heard in a quiet room by a normal ear at about twenty feet.

The watch test.—This test is not as good as the previous one; watch-ticks are not standardised, and the hearing for the watch is no indication whatever of the hearing for conversation. Its advantage is that it can be carried on with comparative ease and hence is universally applicable.

Hold the watch beyond the point at which it is normally audible, and gradually bring it near the patient's ear. Note the distance of the watch from the ear when the patient first hears the tick. During the test the other ear must be stopped with the finger and the eyes must be closed.

The nasal affection which may cause harm to the patient may be obstructive or infective, though in many cases both are commonly present together. There may be deviation of the nasal septum, hypertrophy of the turbinal bones, polypi, or suppurative in the nasal accessory sinuses. Troubles in the middle ear, such as deafness or otorrhœa, may arise from any of these. These nasal conditions may also be factors in the causation of various local and remote symptoms. Amongst the local manifestations may be mentioned stuffiness in the nose, inability to breathe through one or the other nostril or through both, repeated attacks of coryza, offensive breath, headache, pain varying in situation and degree, purulent nasal discharge, etc. The significance of a nasal condition in the causation of headache must be kept in mind and in every such case the nose should be examined as a routine measure, which, if done, will obviate many unnecessary troubles. Here I may mention the case of a patient, a young adult, who came to me in May, 1925, complaining of frontal headache of about a year's duration. He had been under various treatments but without any improvement. Glasses had been ordered but his headache remained as before. He used to suffer from colds in the nose. On examining his nasal passages I found the left middle turbinal bone much hypertrophied. Transillumination showed the frontal sinuses and maxillary antra clear. I performed turbinectomy of the enlarged bone and ever since then he has been free from the headache. Here the turbinal bone was interfering with the proper drainage of the frontal sinus leading to increased intra-sinus pressure and consequent headache.

Regarding the remoter manifestations, gastric, respiratory, ocular, cardiac, muscular or arthritic symptoms may be complained of, and amongst the nasal affections the infected accessory sinuses are the most important factors in their causation. As illustrating these, I shall describe here the history of two patients who have been under my care.

One patient, an adult male, suffered from dyspepsia for a long time. Various methods of treatment were adopted but without any improvement. He suffered from chronic catarrh in the nose. Nothing abnormal could be found in the pharynx or the post-nasal space but on examining

the nasal passages. I found yellowish-white, tenacious, pus-like discharge sticking on to the left middle turbinal bone which was also slightly enlarged and oedematous. The maxillary antra and the frontal sinuses were clear on transillumination. I thought the case to be one of ethmoidal suppuration. The hypertrophied middle turbinal was excised and the ethmoidal cells were exenterated and the cavities were disinfected with collosol argentum liquidum. The removal of the septic focus in the nose led to improvement in appetite and general health and the patient felt relief from his stomach disorder.

The second case is of interest as showing how an infection in an accessory sinus can cause evening rises of temperature, general debility, anæmia, cough and all the symptoms suggestive of pulmonary tuberculosis. No focus in the lung could be detected, still the patient, an adult female, suffered from the above symptoms. There were a few granules on the posterior wall of the pharynx but excepting these no other abnormality could be found in the pharynx and the post-nasal space. The larynx was quite normal. On examining the nasal cavities I found pus sticking on the medial surface of the right inferior turbinal bone. Transillumination revealed a dark maxillary antrum on the right side. Proof puncture and syringing brought out purulent fluid. Obviously the symptoms were the result of septic absorption from a suppurated maxillary antrum. Nasal antrostomy being refused, the right maxillary antrum was washed and disinfected with collosol argentum liquidum. The patient gradually showed signs of recovery. The evening rises of temperature dropped, cough disappeared and she put on flesh and was once again a cheerful soul.

I cite these two cases only to show the significance of a focal infection in the nasal accessory sinuses, and this should never be forgotten even when the symptoms complained of by the patient refer to distant organs. And I cannot leave this point without mentioning, nay emphasising, the relationship of a diseased sinus to defective vision. In this connection the sphenoidal sinus and the posterior ethmoidal cells must be borne in mind and disease in these is one of the most common causes of retrobulbar neuritis with defect or loss in sight. And this is easily explained when we think of the anatomical relationship between the optic nerve and the sphenoidal sinus and posterior ethmoidal cells, only a thin bony partition separating the structures, whilst the optic nerve is very sensitive to toxins. Defective vision is quite common amongst the students and in its investigation the question of the accessory sinuses should never be overlooked: here is an opportunity for the ophthalmologist and the rhinologist to work hand in hand for the common good.

Amongst the throat and naso-pharyngeal conditions diseased tonsils and adenoids are the most potent factors in causing mischief to the

person, suffering from these, in various ways. The tonsil is a collection of lymphatic tissues situated between the two pillars of the throat. In young children the tonsils are at the height of their physiological activity and they are in some measure a protection against the invasion of micro-organisms. A healthy tonsil readily absorbs the pathogenic germs and has the power to destroy them.

The tonsils are very commonly enlarged and this enlargement is due to chronic infection and is often associated with adenoid vegetations in the post-nasal space. From their very bulk the tonsils sometimes cause difficulty in swallowing and respiration. Enlarged tonsils are septic tonsils and so these patients, both children and adults, are subject to repeated attacks of tonsillitis, quinsy and pharyngitis; to laryngitis, bronchitis and asthma; to acute rheumatic fever with its bad after-effects, diseases of the heart and chorea; sometimes to acute nephritis; and even, it is said, to appendicitis and other forms of gastro-intestinal disorders. Patients with chronic tonsillitis sometimes suffer from chronic rheumatism with repeated attacks of pain in the joints and osteo-arthritis, and I have got records of two cases who were permanently cured of their pains in the joints after I had removed their diseased tonsils. The strongest indictment against the tonsil is that it is the portal of infection for tubercle bacilli, which, passing through, often leads to enlargement of the lymphatic glands in the neck and tuberculosis in them, and at times to tuberculosis in the lungs. Conditions of anæmia combined with indigestion from toxæmia, often associated with evening rises of temperature and general debility are not uncommonly seen. Various eye troubles, e.g., retro-ocular neuritis and retinitis, phlyctenular conjunctivitis, may have their ultimate source of origin in diseased tonsils, which are also the factors in the causation of middle ear disease, catarrhal or suppurative, with deafness. All these diseases can be prevented or cured if suitable remedial measures are taken at the proper time. Medical treatment may do good at the beginning, but once the tonsils are chronically enlarged nothing short of surgical interference can effect any cure or improvement: the diseased tonsils must be removed *in toto*.

The public very often ask, if the tonsils are useful organs and have some protective value, why should it be prudent to remove them. The argument is that the tonsils may be compared to forts around a city, useful at first but not when in occupation of the enemy, when, therefore, they must be destroyed. The tonsils are useful when they are healthy, but once they are diseased, they are not only not harmless and functionless but are a definite menace to health and hence must be removed.

Before advising their removal the tonsils should be properly examined. Generally these organs are examined rather carelessly and hurriedly. Simply illuminating the pharynx and

putting a tongue depressor in position will not show the tonsil fully and properly. It must be borne in mind that its surface looks towards the middle line. Much—it may be most, in some cases it will be all—of the gland is hidden behind the anterior pillar of the fauces, and at the most only its anterior part is properly seen. The correct way to examine the tonsil is to draw back the anterior pillar and so to turn the tonsil towards the observer. This can be done by making the patient "gag"—during this act the muscle in the posterior pillar contracts and lifts up the tonsil out of its bed and at the same time rotates it forwards, making the gland fully visible. Or the anterior pillar can be hooked outwards by the tip of the tongue depressor and thus the face of the tonsil can be turned forwards. Whilst this is being done pressure can be made on the gland to see the condition of the crypts and the supra-tonsillar fossa: if there is any pus in these, it will be made evident. Many diseased tonsils, especially in adults, are overlooked, simply because these little procedures are not employed.

Adenoids.—Normally there is present at birth a variable quantity of lymphoid tissue in the roof and posterior walls of the naso-pharynx. By the term "adenoids" is meant a chronic enlargement of these lymphoid tissues. The incidence of adenoids is universal and is quite common in this part of our country. Though not exactly hereditary, it is in many instances a familial disease, three or four members of a family are often found suffering from this malady. Chronic or repeated attacks of nasal catarrh are the principal factor in their causation; the infectious fevers, particularly measles, whooping cough, diphtheria and scarlet fever, are also a frequent cause of this hypertrophy.

These hypertrophied adenoid growths gradually disappear or shrink by the formation of fibrous tissue in their substance. This process, however, does not depend on the age of the patient, and is not one that must commence at or about the age of puberty, but may occur at any age: it may even be more evident in the very young child than in the adult; sometimes the adenoid growths may remain up to old age, though in many cases these atrophy and disappear by the age of twenty or thereabouts. Thus, it follows that we cannot say in any particular case that a growth may be left to disappear by itself. Because a patient is approaching puberty or adult life it does not necessarily follow that the adenoid hypertrophy will in a short time cease to exist.

These facts ought to be given a wide circulation among the medical profession because physicians too often advise their patients to "wait for puberty" as the adenoids will "shrink" by that time. This adenoid tissue is always subject to infection and the patient suffers from repeated attacks of naso-pharyngeal catarrh. So while waiting, this inflammation is ever progressing, and may and actually does, in the

majority of the cases, spread into the Eustachian tubes and middle ear, causing symptoms which may linger on throughout the whole life of the patient. So even if the adenoids shrink, their bad effects do not disappear along with them but remain behind as a permanent legacy. Need we then wait for the adenoids to shrink when we know that that event is so uncertain, and when their presence is associated with so much risks? "Waiting for adenoids to shrink is always a foolish and dangerous thing."

The symptoms of adenoids are many and various and are secondary to (1) the liability of these growths to infection or catarrh; (2) the extension of the inflammation to neighbouring organs; (3) the obstruction they present to nasal respiration; and (4) the reflex processes attributed to irritation and lowered vitality. These patients are always suffering from "colds" and easily get "catarrh of the nose." Their breath is often fœtid and their taste and smell are often impaired. The terribly common catarrhal and suppurative affections of the middle ear, leading to deafness if long-continued and neglected, are in an overwhelming majority of cases the result of adenoids. The presence of a chain of slightly enlarged lymphatic glands along the posterior border of the sternomastoid muscles is an almost constant sign of a mild infection of the pharyngeal tonsil. Sometimes these glands attain quite a large size and are often associated with slight rises in the evening temperature. Tuberculosis of the glands is usually due to the passage of the tubercle bacilli through these portals, i.e., the adenoids, and tubercle bacilli may enter the whole system after primarily infecting the lymphoid tissue. Slight bleeding from the nose (epistaxis) is quite a common symptom and is due to congestion of the naso-pharyngeal adenoid tissue. Owing to the same cause bleeding may occur into the throat and if to this, slight evening rises of temperature, cough and general malnutrition are added, the clinical picture of tuberculosis is very much suggested. Looking back into my case notes I can find the records of several cases in young adults who have been permanently cured of their symptoms by the removal of adenoids.

The inflammation from the naso-pharynx may spread to the larynx causing laryngitis, spasm of the glottis and hoarseness; to the trachea and bronchi causing bronchitis and possibly asthma, and leading along with the nasal obstruction to round shoulders, flat chest and depressed lower costal cartilages. Adenoid subjects are mouth-breathers and they snore at night. Restlessness during the night is a prominent symptom. Persistent nasal obstruction during the period of growth leads to some deformities in the jaws and face, the person having a dull, vacant and expressionless face or what is known as "adenoid facies" or "rabbit-shaped face." They suffer from chronic anæmia and malnutrition and their bodily development is poor. Their mental faculties are often much impaired. They are

inattentive, possibly because they suffer more or less from deafness, and they cannot concentrate their attention on anything for a long time. Defective speech is a symptom of considerable diagnostic and economic significance. The voice is muffled and articulation is thick and imperfect.

How to detect the adenoids? This can easily be done if the attending surgeon uses his special senses. On inspection he will notice the open mouth, thick, everted lower lip, and dull, vacant and expressionless face. If the case has gone on for years deformed chest may also be evident. The post-nasal mirror will show the dark-red growths in the naso-pharynx. By the sense of touch the surgeon will feel with his finger the soft, velvety masses occupying the roof and posterior wall—and it may be, also the upper part of the lateral wall of the naso-pharynx. The olfactory senses will appreciate the foetid odour of the patient's breath while the auditory sense will detect, in some cases at least, the peculiar muffled character of the voice.

What is the treatment of these adenoid growths? "There is but one treatment worthy of the name, and that is the surgical removal of the growth (i.e., adenoids). Astringent applications have been and are still advocated by some writers, but in my opinion their use is but a means to postpone the day when their removal must take place. I can conceive how a congestion and inflammation of the lymphoid masses might be relieved and greatly improved by the local use of alkaline and astringent washes, but when true hypertrophy has occurred the curette offers the best means of treatment."

The improvement in the mental development after operation is often marvellous, provided the operation is done sufficiently early in life, but if this is delayed until the individual has attained full growth, the mind will rarely develop so well as it would have done had the operation been performed at an earlier period. The general health rarely improves and the person is always ailing so long as adenoids remain. If, however, these are removed, the general toxæmia disappears, the blood becomes oxygenated and red and all the vital energies are quickened and increased. The dull "adenoid facies" improves somewhat with advancing years, though it often remains as a permanent disfigurement. In fine, the early removal of adenoids often prevents serious aural diseases, improves the general health, and beautifies the face.

Persons with diseased tonsils and adenoids are very subject to the infectious diseases, e.g., measles, influenza, diphtheria, scarlet fever, etc. The public may think that the removal of these lymphatic tissues, which have some protective functions, will render the individuals more susceptible to infections but experience shows that this is not the case. The resistance to infections possessed by the individual in whom diseased tonsils and adenoids have been removed is certainly not lowered but is rather increased by the removal of the septic focus. Investigations in the

London County Council Schools as to the relation of tonsils and adenoids to the incidence of scarlet fever and other infectious diseases were made some years ago, and it was found that (1) cases of enlarged tonsils and adenoids provided the largest number of cases of infectious diseases; (2) persons who never had enlarged tonsils and adenoids came next; (3) the least frequent were those who had had tonsils and adenoids removed. The conclusion seemed to be that the frequency was decreased by removal.

I have attempted to write, briefly, about the significance of the commonest of the ear, nose and throat diseases; enlarged tonsils and adenoids stand most prominent amongst these. The treatment of these latter is entirely surgical. The public in India have a peculiar dread of surgery and cannot tolerate the idea of their children being subjected to a surgical operation and instead stuff them with syrup ferri iodide and cod-liver oil and use every known variety of gargle and paint, though deriving no benefit from these. I must confess I cannot sympathise with this attitude, fine in itself but cruel in its results; in my experience hard heads contain more real kindness than soft hearts. It is generally forgotten that the tonsils and adenoids are at the very gates through which all sorts of disease germs enter the body. Just as one's treasures are never safe unless the gates of the house are well secured, so unless the throat and nose are perfectly healthy and well-toned, one never knows when disease may not enter the body stealthily and rob the patient of health, the greatest of all treasures. Before making a decision one may naturally ask if there are any risks attending such an operation. Complications, such as septic infection of the wounds leading to troubles in the ear and hæmorrhage occur only very rarely indeed, and with proper precautionary measures the chances of their occurrence can be reduced almost to nil. If I may be permitted to speak from my personal experience, I may say that during the last nine years that I have been doing ear, nose and throat work—both in England and in India—I have operated on several hundreds of cases of enlarged tonsils and adenoids, and not one case even has suffered from any septic complication and I had to interfere in only one patient for slight bleeding which occurred on the fourth day after the operation and stopped on the application of tincture perchloride of iron. And I have not had a single fatality. This will show how baseless are the fears entertained against these operations.

The Calcutta University Students' Welfare Scheme is an important institution and it can do really useful work. The students are the young "hopefuls" of the nation and it is a national problem to investigate their health, to find out their defects and disabilities and to correct these by suitable remedial measures. As has been mentioned before, ear, nose and throat diseases are very much neglected in our country and these are allowed to progress till in most cases it

becomes too late for any successful treatment. The responsibility for this state of affairs rests both with the public and the medical men. The ignorance of the public with regard to the health of their children must be removed and with a view to educate them in this matter propaganda work, in the form of lantern lectures, etc., showing the signs and effects of these diseases, may be arranged. A system of *school* medical examination should be adopted. Every boy should be examined once on admission into the school, say, at the age of six, and secondly, when the student is twelve years old, and after that according as the boy's health necessitates him to be medically examined. There should be a service of school medical officers to undertake this work and to look after the health of the students generally. When a student is found suffering from any disability he should be referred to his family physician or to the specialist for necessary treatment. The care that is taken of the children in the schools is impressed upon the parents and they learn to regard a high standard of health as of value. In order to equip the general medical practitioner for this special work the following suggestions may be recommended:—(a) compulsory training with examination of the medical student in ear, nose and throat diseases; (b) establishment of a lectureship in the subject in the medical colleges; (c) appointment of an ear, nose and throat surgeon on the visiting staff of all teaching hospitals. In addition to an out-patient department, there should be a few special beds in every such hospital for these diseases, as there are for ophthalmic and children's diseases, so that medical students may get instruction in every variety of such cases from the special surgeon.

If these suggestions are acceptable to the Student's Welfare Committee, they may request the University authorities to adopt necessary measures and to instruct the medical colleges accordingly.

REDUCING SUBSTANCES IN THE URINE: THEIR DETECTION AND IDENTIFICATION.

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WHEN glucose is present in the urine in abnormal amounts its detection by any of the well-known tests is a simple matter. It is only when sugar is present in minute quantities that difficulty is experienced in its detection by one or other of the ordinary tests. It may be noted that Fehling's test is generally used and still considered by many to be practically infallible for the detection of sugar in the urine. But the fact that many substances other than glucose, often present in the urine, contribute to the reduction of the copper solution must not be lost sight of. It may further be observed that Fehling's test often gives fallacious results for

reasons which I shall deal with presently. In doubtful cases, therefore, it is always advisable to apply other tests such as Benedict's, Nylander's, the osazone test and polarimetric examination for confirmation or otherwise of the results obtained by Fehling's test. The object of this paper is to state briefly the nature of these reducing substances in the urine, the conditions under which they appear in it, and modes of differentiating them from glucose.

At St. Bartholomew's Hospital I conducted an investigation into the nature of these reducing substances in the urine in collaboration with Dr. Mackenzie Wallis, and we tried to find out a method by which we could remove these interfering substances from the urine and estimate the actual amount of glucose present in normal urine. We systematically applied all the classical tests I have mentioned above to every doubtful sample of urine that was sent to us, and on the findings of these tests we were able in most cases to decide definitely whether an abnormal amount of sugar was present in the sample or not. There were, however, instances when a sample of urine was found to give indefinite reductions by both Fehling's and Benedict's tests but yielded definite results by the osazone test. The question arises as to whether such cases are cases of true glycosuria or not. The determination of this point is often of great practical importance, not only for diagnostic purposes, and especially in cases of life insurance examinations, but also for the right interpretation of the glucose-tolerance test or in observing the effects of treatment. We also wanted to find out the line of demarcation, if any, between the normal sugar content of the urine (glycuresis of Benedict) and clinical glycosuria. This subject has attracted the attention of several observers for many years and it is beset with difficulties. The chief disturbing factor in all the methods which we tried was the presence of creatinine. In the method which we have now found, practically all the difficulties encountered have been overcome. The precipitating reagent which we have found to answer the purpose throws down all the creatinine from the urine, all the pigments, the greater part of the uric acid, urea and other interfering substances. Briefly, the method is as follows:—

REAGENTS AND APPARATUS REQUIRED.

(1) Boiling tubes of resistance glass with graduation marks at 12.5 and 25 c.c. The lower end of the tube is provided with a bulb of 4 c.c. capacity and a narrow neck above, 2 cm. in length and not more than 8 mm. in diameter. The bulb is designed to hold the mixture of the urinary filtrate and copper solution and the constricted neck serves to prevent reoxidation of the copper oxide by reducing the volume of the liquid exposed to the air in the tube above.

(2) A boiling water-bath with holes of a suitable size to hold the special boiling tubes in an upright position.