and continued by the London County Council is a reasonable one—namely, $\frac{1}{12}$ for the higher standards, $\frac{1}{18}$ for the lower ones.

1. Of the total number of children who need glasses on this basis, about one quarter need simple convex spheres. In the case of these children, since their accommodation is as a rule quite equal to any demands likely to be made on it out of school hours, it is not necessary, except in the case of exceptionally high hypermetropia, to prescribe glasses for constant wear.

2. Excluding cases of myopic astigmatism, nearly half, or including them, more than half, of the children who need glasses at all need cylindrical glasses, or a cylindrical combination. The importance of this fact is sociological rather than surgical. The great expense which seven shillings is to a great number of poor parents has hitherto prevented a large proportion of the children in poor districts from obtaining properly correcting glasses, even when they have obtained the proper prescription at a hospital. This is a matter which has been under the consideration of the education authority, and steps are now being taken whereby through voluntary agency the difficulty may, it is to be hoped, be solved. Meantime, it may be pointed out to the medical men and women who work in our ophthalmic hospitals that in the case of children it is rarely necessary to correct astigmatism which does not exceed 1 D. Those with astigmatism of a higher degree need glasses for constant wear.

3. Myopic children, with or without astigmatism, are about 3 per cent. of the whole number in all elementary schools. For these the constant wearing of correcting glasses is especially important, because of the tendency of myopia to increase.

4. In very young children myopia exists to a greater extent than has hitherto been generally realized. In cases where the tendency is inveterate it is highly desirable that they should be caught while still in the infant school (and the same may be said of a certain number with central corneal nebulae in both eyes, the result of phlyctenular disease, etc.), so that, instead of their being set to do tasks which they are quite incapable of performing without doing still further injury to their eyesight, some suitable curriculum, specially adapted for children with weak sight who are not blind, may be arranged for them.

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THE VARIETIES OF RINGWORM AND THEIR TREATMENT.*

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THE object of this paper is to show how far recent advances in therapeutics have solved the difficulties which have hitherto rendered the treatment of the common forms of this disease so unsatisfactory and tedious. We all, no doubt, can recall cases in which remedy after remedy has been tried, and as months passed the cure seemed as far distant as ever. The fact that the peculiarly rebellious variety of the disease is prevalent at the school age has a serious influence upon education, and the enforced quarantine for what, after all, is a comparatively trivial complaint, is exceedingly troublesome to parents and teachers. It is not too much to claim that we are now able to shorten the duration of the disease and that the period of contagion can be reckoned in weeks instead of months and even years.

The diseases classed as ringworm—and with them must be included favus—are caused by several varieties of fungus. In this country the commonest by far is the *Microsporon audouinii*, which is found in nine cases out of ten of the ringworm of the scalp in children. Next in order of frequency come the large-spored *Tricophytons*, and last the favus fungus, the *Achorion schönleinii*.

Microsporon Audouinii.

The *Microsporon audouinii* affects the hair of the scalp, and sometimes also other parts of the body. The changes produced in the scalp by this parasite are familiar. The patch or patches are usually covered with a fine scurf, often of an ashen-grey colour, and projecting through this we notice groups of broken hairs standing up like stubble. The margin of the patch (best seen when the head is shaved) is well defined, slightly raised above the surface, and often presents a ring of papules. When extensive this form of ringworm is often mistaken for dandruff, but the diagnosis is at once settled by finding the broken hairs and examining them under a microscope with a little liquor potassae. The hairs removed from a patch of this variety of ringworm are thicker than normal, and the thickened root has a peculiar white sheath which is very characteristic. This sheath is found on microscopical examination to be made up of spores arranged in layers. The spores are closely packed, so closely that they produce an appearance which resembles mosaic. In stained specimens, in addition to spores, short straight or slightly curved rods of mycelium are found inside the hairs. The fungus has a peculiar keratolytic action on the hair, making the shaft brittle, and this is the cause of the broken stumps. If an infected hair be planted in maltose agar a characteristic white ringed culture can be obtained. This variety of fungus is most commonly met with in children between the ages of 5 and 10 years, and in schools or families it spreads from child to child directly, or indirectly by hats, caps, etc. The liability to infection is very slight after the age of 15, and the disease is extremely rare in adults. I have seen it in young infants, and it has been known to occur in babies less than a week old. The disease, if untreated, spreads slowly, and may last for two or three years or more. It is exceedingly difficult to treat because the fungus extends into the hair follicles, and remedies applied to the scalp even under pressure cannot penetrate sufficiently. Where the disease affects parts which are not hairy circular red patches form, and, though the fine lanugo hairs are infected, the fungus is easily reached by parasiticides.

In a few cases the inflammatory condition known as kerion develops. In most of the cases I have examined at the London Hospital I have found a small spored fungus which microscopically and in cultures appears to be identical with the *Microsporon audouinii*.

The Tricophytons.

In a small proportion of the cases of ringworm of the scalp, and in most of the ringworm seen on other parts, parasites differing considerably from the microsporon are found. These are the large-spored tricophytons. On the scalp the patches do not present the scaly character with stubbly hair characteristic of the common variety. The hairs break off short, level with the scalp, and the broken stumps cause an appearance which has been well named the "black-spot" ringworm. On removing the hair the root is found to have no white sheath. Under the microscope the fungus is seen to consist of mycelium in the form of jointed rods, and the spores are arranged in chains like rows of beads. In diagnosis we do not rely upon the comparative size of the spores, though there is an appreciable difference, but upon the fact that they are arranged in chains. The large-spored fungi are of two great varieties—*Tricophyton megalosporon endothrix*, affecting the interior of the hair, and *Tricophyton megalosporon ectothrix*, affecting the outside of the hair. In some cases the fungus is found both inside and outside the hair, and is then called ectoendothrix.

To M. Sabouraud we owe the classification and differentiation of the forms of fungus in ringworm. The tricophytons are of several varieties. They differ chiefly in their cultures, which are usually tinted. Some are of a reddish-brown, some pale brown, others yellow, and occasionally a culture of a pinkish hue has been grown. The pathological effects also vary. Some are more irritant than others, and easily set up an intense inflammation with the formation of pustules in the skin and follicles. The tricophytons may occur at any age; and though they may be conveyed from one human being to another directly or by infected articles, such as shaving brushes and razors, the ectothrix fungus is often derived directly, and in most cases probably originally, from animals, such as horses, cattle, dogs, cats, and birds. With the exception

* A paper read before a joint meeting of the City of London and Tottenham Divisions of the British Medical Association.

of those cases in which the beard is affected, the ectothrix ringworms are less resistant to treatment than the diseases due to the endothrix and microsporon fungi. Ringworm of the nails is usually due to the ectothrix fungus, but in a recent case under my care in which there was extensive ringworm of the body and extremities, the fungus found in scrapings from the skin, the nails, and from an ulcer at the umbilicus was of the endothrix variety.

Favus.

Though rarely seen in private practice this disease is not uncommon in the East End of London. It occurs usually in the Russian and Polish immigrants, and in other pupils attending the schools where there are many children of these nationalities. Both at the London Hospital and at the East London Hospital for Children at Shadwell it is frequently seen. The scalp is most commonly affected. The fungus attacks the hair and the scalp itself. The early spots are circular, cupped, and of a sulphur-yellow colour. They have a peculiar odour, which is well described as mousey. On removing old crusts, a raw surface is seen, and in sections of the infected scalp the fungus is found to penetrate the true skin. The whole scalp may be involved. The fungus is peculiar and easily recognized under the microscope. The mycelium is made up of branching rods, and the spores are large and in great numbers. Occasionally favus is found on other parts of the body, sometimes without any involvement of the scalp at all. In 1889 I saw a case in which the tongue had been affected and instances have been reported on the Continent in which there has been extensive infection of mucous surfaces.

The disease usually starts in infancy or early childhood, and may persist until adult life. In this country, however, we very rarely meet with it in adults. When it has existed for a long time, it leaves scars which are characteristic. The scalp presents numerous small bald patches, which close examination shows to be of a cicatricial character, the hair follicles having been destroyed by the fungus.

There is no doubt that cases of favus are sometimes diagnosed as ringworm, and it appears from recent researches that more than one variety of favus fungus is met with.

Treatment.

The treatment of ringworm of the non-hairy parts is rarely a matter of great difficulty. Parasiticide remedies thoroughly applied are always efficacious. The compounds of mercury are most useful. A good plan is to thoroughly wash the surface with soft soap and warm water, and then rub in the white precipitate ointment. Oleate of mercury in an ointment is another good preparation. Oleate of copper has also its advocates. An extensive case of endothrix ringworm which resisted mercurials, rapidly improved on the application of a strong solution of iodine. The blistering produced by the iodine removed the infected epidermis. Sulphur and sulphurous acid are also valuable.

When the nails are affected the difficulty is to get the parasiticide in contact with the fungus. I have found that removal of the nail and the application of salicylic acid and ammoniated mercury ointment give satisfactory results.

The greatest difficulty has always been found in the

treatment of ringworm of the scalp and beard region. Frequent shaving of the scalp, with thorough washing with soft soap and the inunction of strong antiseptic ointments, is often not enough. Carbolic acid, sulphur, chrysarobin and the mercurials are often applied month after month in vain. Formalin in solution as strong as 10 per cent., iodine regularly painted on to the extent of setting up a sharp inflammation often fail. Any of these remedies would easily destroy the fungus, but they cannot get at it. The only way in which a rapid cure can be attained is by the removal of the infected hairs, and the prevention of the spread of the fungus to healthy follicles. To remove the hairs singly or in batches by epilation instruments is tedious, painful and unsatisfactory for ordinary purposes. Aldersmith's method by setting up a folliculitis by means of croton oil and thereby causing a shedding of the hairs proved efficacious, but we have now a much more satisfactory epilating agent in the *x* rays.

For years now the *x* rays have been used for this purpose, but their application has been attended with certain risks, which could scarcely be run except in very obstinate cases. The danger lay in the fact that the *x*-rays treatment was applied without

any means of regulating the dose. The patient was treated several times a week, and in some cases thirty, forty and even more sittings were given before epilation took place. The operator, not having any means of measuring the dose, was obliged to give exposures of short duration, and when the accumulated doses began to produce their effect he stopped. This empirical method of treatment was often successful when the operator had had sufficient experience of *x*-ray treatment, but sometimes the accumulated doses produced a reaction of a severe character. It was always unreliable and tedious. Thanks to the work of Sabouraud, we now know that the dose of rays given at one sitting was too small. When a sufficient dose has been given to an area of the hairy scalp the hairs begin to fall off at the end of a fortnight, and at the end of three weeks the patch is completely bald. If this dose be exceeded an inflammatory reaction occurs, and with heavy doses the reaction may be so severe that the hair follicles are

permanently damaged. With a smaller dose the hair does not fall out. It will be readily seen that when frequent small doses are given, and the operator waits for the hair to come out, the scalp has received a fortnight's more treatment than is necessary to cause epilation.

After the hair has fallen out the scalp remains bald for some weeks, and this is a great advantage because there is little risk of reinfection. In most cases the hair starts growing again in six to eight weeks after treatment. In some cases I have seen the new growth delayed as long as three months, and in two cases as long as four months. It may be objected that this is a serious matter, but when we remember that under old methods a child treated by frequent shaving was often kept bald for a year or more, it is not a matter of great moment. I find that epilation occurs more easily in children with thin fair hair than in children with tough dark hair, and I moderate the dose accordingly. The beard reacts more easily than the hair of the scalp, and where there is considerable follicular and perifollicular inflammation the effect of the exposure to *x* rays is to increase temporarily the severity of the inflammation.

Fig. 1.—Case of ringworm. Epilation three weeks after *x*-ray treatment.

It must be remembered that the x rays have no lethal effect on the parasite. Their sole virtue is that they bring out the hairs with the fungus. It is essential, therefore, that the rest of the scalp be protected against infection from the falling hairs.

The estimation of the dosage of x rays is the important matter, and we are now in possession of instruments of precision which enable us to gauge with some approach to accuracy the output of rays from our apparatus. The current in the primary circuit can be measured by means of the voltmeter and the ampèremeter. When working from the main or from accumulators the voltage in the primary remains fairly constant. At the London Hospital I work with a current of 60 to 62 volts. In my own installation I work from the main with a current of 240 volts. It is necessary to have each coil wound for the voltage used. I work with the ampèremeter at five. The interruptions are also regulated. With large coils I find that too rapid an interruption is a disadvantage. When there are 500 to 600 interruptions a minute we get much better results than when the interruptions are 1,000 a minute. This has for a long time been my experience in x -ray treatment. The selection of the tube is an important matter. We are now able by Benoist's apparatus to estimate the penetrating power of the tube. A tube with penetration corresponding to No. 6 or No. 7 on Benoist's scale is the most useful. The spark gap is also measured. The best results are obtained with a spark gap of 12 to 15 cm. The "softer" tubes are not suitable. The current in the secondary circuit is measured by a milli-ampèremeter. I find it best to keep the current in the secondary at about 0.7 milliampere.

The general procedure is as follows: The patient, we will suppose, has a single patch of ringworm. The hair is cut short, and the infected area is exposed for a definite time to the rays at a distance of 15 cm. from the anode of the tube. With the interrupter making 500 interruptions a minute, and the conditions as above described, sixteen minutes is sufficient to cause complete epilation of the area exposed. The exposure is controlled by the Sabouraud pastille. This little disc coated with platino-cyanide of barium is placed midway between the anode of the tube and the area under treatment. When a sufficient dose of x rays has been given to produce epilation the pastille changes from a yellowish-green tint to an orange. It is a useful adjunct to our means of estimating the dose of x rays, and though there is some variation in the pastilles I find them of great value in checking the dosage. It is essential that the pastille be placed exactly midway between the anode and the area treated, and that it be not exposed to light, for the orange tint vanishes on exposure to strong light. At the end of the sitting the area which has been treated is covered with collodion and the patient goes home. The collodion is painted on to prevent the rest of the scalp from becoming infected. At the end of a fortnight the hair begins to fall out, and at the end of three weeks, it is completely shed. Once more it is important to insist that the x rays do not kill the fungus, and therefore it is a wise precaution to apply a mild antiparasitic remedy to the rest of the scalp.

In extensive cases it may be necessary to expose the whole scalp. This requires great care to prevent over-lapping, for if any area gets a double dose of x rays a troublesome erythema, and possible vesication and ulceration, with risk of permanent alopecia, may result. The area treated is marked out with iodine, and it is advisable to expose as small an area as possible each time. For if a large area be exposed the parts in the centre get a larger dose of x rays than the margin. This is particularly the case when curved parts of the skull are treated.

In treating an area 10 cm. in diameter, the centre of the patch may get a dose 30 per cent. larger than that received by the periphery. I think that this difficulty may be obviated, and am at present directing my attention to overcoming it. It will be seen that to get a complete epilation of the scalp it is necessary to make several exposures. To do this carefully requires two to three hours, but when we remember that the hair falls three weeks after the treatment, and that as soon as the hair has fallen the patient is free from infection, the time saved is enormous. I have already indicated that great care is required, for it is easy to give an overdose and it is easy to give an insufficient dose.

The ringworms of the beard are treated in an exactly similar manner. The pustular varieties are at first aggravated by the application of the rays, and the increased inflammation requires fomentations of boracic acid.

Kerion of the scalp does not, in my experience, require x -ray treatment. The inflammatory process itself loosens the hairs and causes them to fall. I find that fomentations of boracic acid constantly applied are sufficient to bring about a cure.

Favus is treated exactly as the ringworms of the scalp. I have now applied the x rays in about 150 cases of ringworm and favus, and in 115 in my hospital and private practice epilation by the Sabouraud method at one sitting has been performed. The following particulars may prove of interest:

The 115 cases included 107 of *trichosporon tonsurans* (the microsporon found in every instance), and 8 cases of favus.

The 115 cases required 455 exposures to the rays; many of the cases being complete epilations, and others requiring treatment of several spots.

In 2 cases only epilation was incomplete.

In 2 cases there was slight overlapping. In 1 an erythema resulted, and in the other vesication. In no other case was there any inflammatory reaction which called for treatment.

In 15 cases the hair was found to be growing again at the end of one month.

In 46 cases the hair began to grow again at the end of two months.

In 23 cases the hair did not start growing until after three months.

In 2 cases the hair did not appear until after the lapse of four months.

In 21 cases the patients failed to come up to the hospital until three months had elapsed, and then only when they were written for. It must be understood that many of the patients at the London Hospital are children of foreigners, and it is difficult to keep in touch with them.

Twenty-five cases of sycosis and tinea barbae have also been treated by the rapid method. Epilation has been satisfactorily produced in all.

In conclusion, I have to acknowledge my indebtedness to my assistant, Mr. Blackall, for his care in carrying out

Fig. 2.—Case of favus. Epilation three weeks after exposure to x rays. A small triangular patch on parietal region has escaped treatment.

the arrangements made for dosage at the London Hospital, and to my clinical assistants, Dr. T. Smith and Barclay, for their valuable supervision and assistance.

[The paper was illustrated by lantern slides showing the clinical features of the cases, the parasites, and the results of treatment, and by specimens of cultures.]

THE ELECTRICAL RESISTANCE OF THE BLOOD AND URINE AS A TEST OF THE FUNCTIONAL EFFICIENCY OF THE KIDNEY.

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In a communication made to the Royal Society of Edinburgh on December 21st, 1891, the author gave an account of the experiments he had made to ascertain and compare the electrical resistances of various kinds of urine both in states of health and of disease.

The fluids were held in a U-shaped electrolysis tube containing two disc-shaped platinum electrodes arranged so as just to rest upon the surfaces of the fluid, 21 c.cm. of which were used for each experiment. The measurements were made by Kohlrausch's method, and at a temperature of 65° F.

As a result of the observations, which extended also to artificial urines, it was found that the specific resistance of a normal urine amounts to about 45 ohms, and that the resistance is a measure of the salts, chlorides, phosphates, sulphates, etc., present in the urine; the greater the concentration the less the resistance and vice versa. In disease the resistance was found to be increased chiefly in acute croupous pneumonia (due to the diminution in the chlorides), in diabetes mellitus, acute and chronic Bright's disease, and in pernicious anaemia. As it is believed that the glomeruli are mainly responsible for the presence of salts in the urine, a high electrical resistance, other things being equal, would indicate an impairment of the function of the glomeruli.

Within the last ten years the author has made many attempts to measure the electrical resistance of the blood; various methods (dilution with distilled water, measurement of a column of blood in a capillary tube, etc.) have been employed and subsequently rejected. The principal difficulty is due to the fact that only very small quantities of blood can generally be obtained at one time. The best results were obtained by placing 5 c.mm. of freshly-drawn blood between two cup-shaped electrodes 3 mm. in diameter, coated with spongy platinum, and fixed at 0.75 mm. apart. The length of the cylinder of blood between the electrodes is of less importance than its diameter, because the cross-sectional area varies with the square of its diameter, and the resistance of a conductor varies directly as its length and inversely as its cross-sectional area. By employing electrodes of fixed diameter and at the same distance apart, and the same quantity of blood for each observation, and by making the measurement at once before such changes as coagulation or evaporation could occur, fairly consistent results were obtained. The average specific resistance of normal blood measured in this way is 93.5 ohms, but it may fall to 85 or rise exceptionally to 130. The resistance depends again upon the salt concentration of the blood.

A striking change is to be observed in pernicious anaemia, the resistance in this disease being usually about one-half (50 ohms) that of normal blood. The deduction is that the blood in this disease contains an abnormal amount of salts due either to destructive metabolism or to renal inefficiency, or to both. Light is thrown on this question by examining the resistance of the urine; this will be found to be abnormally high. Hence we have the striking fact that while the urine contains too few salts, the blood contains an abnormal amount. This, then, is a clear case of renal inefficiency.

In view of this fact (impairment of the glomerular function of the kidney) the pathology and treatment of pernicious anaemia require reconsideration. These results, obtained some years ago, and the introduction of cryoscopy, have led me to compare this method of deter-

mining the renal efficiency with that of cryoscopy, and to originate a ratio which I will call "The Haemo-renal Salt Index," namely:

The Electrical resistance of the blood.
The Electrical resistance of the urine.

In health this would be equal to two or three whole numbers, for example:

$$\frac{\text{R. of blood}}{\text{R. of urine}} = \frac{93.5}{45} = 2.08.$$

If this number increases it indicates that the blood contains fewer salts and the urine more, and that the functional activity of the kidney is increasing; if, however, the haemo-renal salt index diminishes it indicates that the functional activity of the kidney is diminishing. Thus in a bad case of pernicious anaemia the haemo renal salt index is less than one, it is a fraction, but with an improvement of the patient it will at once increase, and with his recovery it will return to normal.

The following are some illustrations:

1.—A. B.: Healthy:

$$\frac{\text{R. of blood}}{\text{R. of urine}} = \frac{119}{38.25} = 3.1 = \text{haemo-renal salt index.}$$

2.—M.: Advanced pernicious anaemia, a patient of Dr. G. Gibson, examined July, 1906:

$$\frac{\text{R. of blood}}{\text{R. of urine}} = \frac{40.8}{68} = 0.6.$$

3. A. D.: Pernicious anaemia with many relapses, a patient of Dr. A. James, examined February, 1902:

$$\frac{\text{R. of blood}}{\text{R. of urine}} = \frac{51}{115} = 0.44 = \text{index.}$$

4. A. B.: Secondary anaemia, patient of Dr. Gibson, examined July, 1906:

$$\frac{\text{R. of blood}}{\text{R. of urine}} = \frac{85}{56.1} = 1.5 = \text{index.}$$

5. A. T.: Chronic rheumatism, patient of Dr. Gibson. Index 3.3.

6. W.: Chronic interstitial Bright, patient of Dr. Gibson. Index 2.1.

7. H.: Recovery from pernicious anaemia; R.B.C. nearly 5 million. Patient of Dr. Gibson. Index 1.7.

This method is more sensitive, more rapid, and more accurate than cryoscopy, but it does not measure exactly the same thing. Cryoscopy measures the total molecular concentration, and is independent of the kind of molecule, provided they are not dissociated (salts, acids, and bases are exceptions).

Electrical resistance depends only upon the salts, acids, and bases, and of these sodium chloride is by far the most important; it is practically unaffected by the presence of albumen, sugar, and other non-electrolytes.

Urea has a small effect only. The combination of cryoscopy with the determination of the haemo-renal salt index would give us more precise information as to renal capacity than the use of either method alone; the one method should not be regarded as a substitute for the other, but rather as complementary to it, but of the two the electrical method is so much more convenient and rapid that it is likely to come into extended use in the future.

THE name of Dr. John T. Collier has been placed on the Commission of the Peace for the City of Lincoln.

THE foundation-stone of the first sanatorium to be erected by the National Association for the Establishment and Maintenance of Sanatoriums for Workers suffering from tuberculosis was laid at Benenden in Kent on July 14th. The grounds extend to 250 acres, and the buildings, when complete, will accommodate 200 patients. They will be chiefly of steelwork, with fireproof "frazzi" filling. Of the funds which have been collected, about £1,000 have come from the working classes, the maintenance of the beds being secured by subscriptions from Friendly Societies and trade unions. The patients will be distributed in ten bed pavilions, the maintenance of each being secured by subscriptions before its erection. The Chairman (Mr. C. H. Garland), in his speech, stated that there were at present not more than 3,000 beds for open-air treatment in England altogether, and that considerably less than one-third of them were available to the industrial classes.