WOOD'S GLASS IN THE DIAGNOSIS OF RINGWORM

BY

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It is now nearly six years since Margarot and Deveze¹ drew attention to the fluorescence of hairs infected by ringworm in light filtered through glass containing nickel oxide, known as Wood's glass. They differentiated between the fluorescence of microsporon and trichophyton infections, and laid the foundation of a diagnostic method of very great value to those who have to deal with this disease. I have used Wood's glass in hospital, school clinic, and private practice since the autumn of 1927, and, though I believe it is indispensable for such work, I have found that it has very definite limitations, which do not seem to have been stated with sufficient clearness in the literature.

PHYSICAL PROPERTIES OF WOOD'S GLASS

This glass was first described by Professor R. W. Wood of Johns Hopkins University, but a similar glass was discovered independently in this country. If, by means of an ordinary glass prism, the beam of light from a carbon arc be split up after passing through Wood's glass and the resulting spectrum thrown on a white screen, it will show a narrow band of red and a broader band of violet light. If this screen is replaced by a sheet of paper coated with vaseline, a bright band of bluish fluorescence will be seen just outside the violet end of the spectrum, a narrow band of comparative darkness separating this fluorescing portion from the band of violet light. Hairs infected by *Microsporon audouini* show the same phenomenon; they fluoresce only when held opposite this part of the spectrum. During various experiments, microscopical and macroscopical, it was obvious that ordinary soda glass was transparent to the rays causing this fluorescence, and on application to the makers I was not surprised to learn that it was soda glass containing nickel oxide. Thus, in choosing the source of light for use with this glass, attention need be paid only to intensity of light (an important factor, as the glass is very dense and allows only a small amount of light through) and to convenience, as any ordinary source of white light produces the long ultra-violet rays necessary to give the fluorescence. I have demonstrated the fluorescence of ringworm hairs, although dimly, using an ordinary gas-filled electric bulb, but I prefer a small carbon arc lamp, such as is used in a "magic lantern." This apparatus, without its lenses, has been found very useful, both in the examination of heads and in microscopical work with Wood's glass, the glass being placed in the slide carrier, and hairs examined with great ease in this light or in ordinary light by moving the slide carrier, interposing the Wood's glass at will. It should be noted that this glass is very brittle when exposed to heat, and cracks easily, especially if irregularly heated. Margarot and Deveze² have implied that a mercury vapour lamp is necessary for this method, but Roxburgh³ states that a small carbon arc is also a suitable source of light. I agree with other observers that total darkness is not necessary or even desirable, especially if several children have to be examined. A little light is not a hindrance to the recognition of the fluorescence, and allows of easy movement of the patients and also of their parents, whom I encourage to be present. The demonstration of this fluorescence is a salutary object lesson to parents who are reluctant to realize that there is much wrong and that epilation is necessary.

RINGWORM OF THE SCALP

The results obtained with the different types of fungus responsible for ringworm of the scalp vary so greatly that they must be considered separately. It must be noted that attention should be given only to the presence or absence of fluorescence in the hairs themselves. Any scaly condition of the scalp may give a fluorescence indistinguishable from that due to ringworm infection of the skin, and, conversely, infected hairs may be seen fluorescing in a non-scaly, non-fluorescing scalp. It is only necessary for the scales to be removed, say, by washing, for this to occur. The fact that any scales may fluoresce is due to the fluorescent properties of keratin itself. Clinically this is best seen in the nails, which are almost pure keratin; they show a white fluorescence, but the fluorescence of a scaly skin is much less than that of hairs infected by ringworm.

Microsporon Infections

With regard to infection by *M. audouini* I agree entirely with other investigators. The brilliant green fluorescence of the affected hairs is characteristic and unmistakable. I have never found an infected head on which the hairs did not fluoresce, nor have I seen a hair fluoresce in this way which on microscopical examination proved to be uninfected.

One fact which this method has brought to light is that slight infections of the scalp can easily be overlooked on naked-eye examination. There may be, especially in long-standing cases where the infection is attenuated, no scaliness of the scalp, and the hairs may be unbroken; the infection of the hair is not sufficiently intense to render it brittle, yet, as soon as the light from Wood's glass is thrown on such a head, individual hairs, often several inches long, are seen to stand out like lighthouses, and if these hairs are epilated and examined in liquor potassae under the microscope, the infection is invariably confirmed. This has been brought to my notice especially after epilation by thallium acetate. Thallium epilation is not so complete as that following the application of x rays, and several times it has been found that a case which clinically showed no evidence of infection after thallium treatment still showed several fluorescing hairs scattered through the scalp. I now accept no case of ringworm of the scalp due to *M. audouini* as cured until examination with Wood's glass shows no fluorescing hairs. On the other hand, it is very easy by means of Wood's glass to prove that a child is free from this infection—a proof which is practically impossible to obtain by any other method. This is a point of great practical importance, and one on which the user need have no dubiety.

The striking results obtained with *M. audouini* led me to conclude that if the hair did not fluoresce, microsporon infection could definitely be excluded. I was surprised, therefore, when a child's hair obviously with a microsporon infection failed to show any fluorescence with Wood's glass. Microscopical examination of the hairs in liquor potassae, however, confirmed the diagnosis of microsporon infection, and on examining epilated hairs under the light from Wood's glass the lower ends—that is, the intrafollicular portions—were seen to fluoresce, though less than in the case of hairs infected by *M. audouini*. Microscopically the whole length of the hair was infected, and under Wood's glass the fluorescence was seen gradually to disappear, whereas in *M. audouini* infection the fluorescence remains indefinitely in liquor potassae, and is coextensive with the infection. I have in my possession hairs infected by *M. audouini* cleared in liquor potassae and mounted in glycerin over a year ago which are still fluorescent. On culture on Sabouraud's medium this

fungus was found to differ distinctly from *M. audouini*; it has not so far been identified, and no other case of infection by this microsporon has come to my notice. I mention this case merely to point out that infection of the scalp by microspora other than *M. audouini* may not show the same fluorescence, and thus lead to error. The occurrence of such infection is, of course, very rare in this country.

Trichophyton endothrix

It has been stated that hairs infected by trichophyton exhibit less fluorescence than those infected by microsporon, but still show a characteristic reaction. This view is upheld by Margarot and Devezé¹ and by N. Gray Hill⁵. I have seen many cases of infection by *T. endothrix*. On culture, *T. crateriforme*, *T. acuminatum*, *T. sulphureum*, and a fourth variety showing polygonal craters (? *T. polygonum*) were found to be responsible. In no case was there any demonstrable fluorescence due to infection of the hairs. In one or two cases a pale white fluorescence of a few hairs has been observed, which seems to correspond to the fluorescence described by other authors. On microscopical examination of these hairs they were seen to be surrounded by a sheath of epithelial cells, evidently an exfoliation of the lining of the hair follicle; if this sheath was removed all fluorescence ceased though the hair was badly infected. A similar phenomenon (described later) was also observed in heads free of ringworm. The scalp in a trichophyton infection is scaly, especially round the orifices of the hair follicles, and little points of fluorescence corresponding to these orifices may be seen. This condition also occurs in diseases other than ringworm. In several cases I have seen heads obviously infected by trichophyton in which there has not been any sign of fluorescence, even of scales. Even if hairs infected by trichophyton did fluoresce, they are frequently found twisted up under the scales, and such fluorescence would not be visible.

Fluorescence in heads infected by *T. endothrix* is therefore inconstant; it is not due directly to the infection of the hairs, as in infection by *M. audouini*, and cannot be relied upon either for diagnosis or for estimation of cure.

Trichophyton ectothrix

I have examined about a dozen cases of kerion of the scalp and beard, and in each case *T. asteroides* was the parasite responsible. In no case were fluorescing hairs found; but the clinical diagnosis of kerion is easy, its extent obvious, its duration self-limited, and a cure clinically simple to ascertain. The necessity for a means of diagnosis, such as Wood's glass, is not nearly so great as in the other varieties of ringworm.

Favus

Infection of the scalp by *Achorion schönleini* is usually easy to recognize, since the typical scutula are unmistakable. Sometimes, however, where a head has been well kept and is free from scutula, and thus the typical alopecia not allowed to develop, the diagnosis may be very difficult, the favus closely simulating a chronic dermatitis of the scalp. Wood's glass is of definite value in such cases.

If a scalp infected by favus is examined with Wood's glass it will be noticed that tufts of hair to a greater or less extent, according to the degree of the infection, show a pale white fluorescence, much weaker than in microsporon infection. These tufts of hair will be seen to correspond to the areas of dull lustreless hair typical of this condition. If such hairs are examined under the microscope in liquor potassae the first thing one notices is that they are full of bubbles of air; mycelium is absent, or scanty, being most profuse towards the base of the hair. The explanation seems to be that the fungus

gradually dies out as the hair grows, and leaves the hair a more or less empty cylinder, with loss of its colouring matter; thus the natural fluorescence of the keratin becomes visible. Very fair or white hair also fluoresces for the same reason, but this phenomenon is easily distinguished from that found in favus, in which the tuft-like arrangement cannot be mistaken. I have on one or two occasions diagnosed favus where scutula were absent from the result of examination by Wood's glass alone, and had the diagnosis confirmed afterwards by microscope and culture tube.

WOOD'S GLASS IN OTHER DERMATOSES

I have not found Wood's glass of value in other dermatoses. In ringworm of the body it is not nearly so effective as naked-eye examination; the scales may certainly fluoresce, but in the same manner as in any other scaly affection. Margarot and Devezé,² and Goodman⁶ give a detailed description of the skin viewed with this glass in a variety of conditions, but the only case in which I have found it of use has been in mild pityriasis simplex of the scalp, where a demonstration of the tiny fluorescent scales to the parent has shown the need of treatment when "dandruff" was not suspected before. I have seen one case of pityriasis simplex of the scalp where not only did the scales on the scalp fluoresce, but a large area of hair on the vertex showed distinct evidence of fluorescence for about half an inch from the base of each hair. There were no broken hairs, and no parasite was found on microscopical examination of the hairs; it seemed as if the pityriasis had affected the lining of the hair follicles, which had been shed as a sheath to the hair. No real difficulty was experienced in excluding ringworm as there was no clinical evidence of its presence beyond scales, and the fluorescence was the pale white of keratin, not the brilliant green of microsporon infection; it is an easy matter to epilate a single fluorescing hair and examine it microscopically. In a case of ichthyosis, besides the usual body lesions, there was a hyperkeratosis of the mouths of the hair follicles, and the scalp was dotted with fluorescent points corresponding to these orifices; again no difficulty was experienced in excluding ringworm.

The presence of vaseline on the scalp is sometimes a difficulty, as its intense blue fluorescence may hide that due to ringworm. Thorough washing with soap and water is all that is necessary to obviate any chance of missing a positive case.

There is great difficulty in arresting the fluorescence of microsporon-infected hairs. I have tried various methods, but have never succeeded in doing more than cause the fluorescence to disappear for an hour or so. The hair soon seems to lose any substance with which it has been coated. This is important from the point of view of the constancy of the results.

EXPLANATION OF THE FLUORESCENCE

Little is known about the production of fluorescence. It appears to be due to the absorption of light of one particular wave-length and its re-emission on another wave-length. Microscopical examination of fluorescing hairs with light filtered through Wood's glass shows that it is the fungus itself which fluoresces. The dissociation of the hair in liquor potassae may be watched, and it can be seen that while the hair with its contained mycelium still glows, so also does the detached sheath of spores. The illumination is too faint to show up a single spore, but where there is a group of even half a dozen a distinct fluorescence will be observed.

I have not been able to confirm the observation of Margarot and Devezé that "cultures on Sabouraud's medium are equally as fluorescent" as microsporon ring-

worm and favus. I have had the opportunity of observing over forty different varieties of ringworm fungi on Sabouraud's medium under the light from Wood's glass, and have been struck by the entire absence of fluorescence from any of them, no matter to which group they belonged. They certainly varied in colour under this light, sometimes yellow or red, usually a dull brown, but it was only when the cultures were quite dried up that any fluorescence was seen.

SUMMARY

Hairs infected by *M. audouini* are brilliantly fluorescent in light filtered through Wood's glass. This fluorescence is characteristic and constant, and is coextensive with the infection. The diagnosis and estimation of cure of this form of ringworm is easy and certain by this means. Hairs infected by other forms of ringworm are, in my opinion, incapable of detection by this method with any certainty.

Hairs affected by favus give a faint fluorescence. Wood's glass is of value in aiding the diagnosis of this condition.

Almost any scaly condition of the skin will give a fluorescence; attention should therefore be paid only to the presence or absence of fluorescing hairs in the detection of ringworm of the scalp. I have not been able to arrive at any useful conclusion in the differentiation of other dermatoses by this method.

The fluorescence is due to the presence of *M. audouini* in the hair in the case of microsporon ringworm; in other cases to the fluorescent properties of keratin. Any ordinary white light may serve as a source of illumination, provided it is of sufficient intensity, and ordinary glass does not impede the necessary rays; condensers, etc., may therefore be used without interfering with the phenomenon.

REFERENCES

- ¹ Margarot and Devez: *Bull. Soc. Méd. de Montpellier*, 1925, vi, 375.
- ² Idem: *Ann. de Derm. et de Syph.*, 1929, x, No. 6, 581 (with very full bibliography).
- ³ Roxburgh: *Brit. Journ. of Dermatol. and Syph.*, 1927, xxxix, Nos. 8 and 9, 351.
- ⁴ Hill, N. Gray: *Brit. Journ. of Actinotherapy*, 1928, iii, No. 5, 84.
- ⁵ Idem: *Clin. Journ.*, 1929, lvii, 558.
- ⁶ Goodman, Herman: *Brit. Journ. of Dermatol. and Syph.*, 1928, xl, Nos. 8 and 9, 105.

APPENDICEO-CAECAL INTUSSUSCEPTION

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While the apparent rarity of this condition (it is not mentioned in the usual textbooks or in Clubbe's monograph)¹ is alone sufficient to justify a report, there is also a possibility that its occurrence is in reality more frequent than the literature suggests.

CASE HISTORY

A boy, aged 8, was admitted late at night to the Central Hospital. No historical data were sent. He appeared comfortable, and fell asleep before I saw him; the temperature was 98.3° F., pulse 88. Next morning he complained of pain in the right iliac fossa. His bowels had acted. Temperature 98.6°; pulse 92. The abdomen moved freely with respiration, and there was no definite rigidity or tenderness; accurate palpation was impossible, as the child cried. Four hours later the temperature was 99° and the pulse 88. There was marked hypertonus in the right iliac fossa; deep palpation now demonstrated just above McBurney's point a mass about the size of a walnut, freely movable, slightly tender, and dull on percussion. A diagnosis of appendicular abscess or early intussusception was made. The abdomen was opened immediately by Kuttner's incision, and the caecum delivered. It was observed that two-thirds of the appendix

was invaginated into the caecum, and the remaining portion, which protruded, was reddened and obviously inflamed. An attempt to reduce the intussusception succeeded in delivering a further third. The effort was then abandoned, as the adhesions between the two viscera were too dense to be broken down safely. A clamp was applied above the apex of the intussusception, the meso-appendix was ligatured and divided, an incision was made at the junction of ensheathing and entering layers, and the appendix, with the head of the caecum, was removed. The caecum was closed with two layers of sutures, and the abdomen was stitched up without drainage. Convalescence was uneventful.

The doctor who had first seen the case stated that the child was ill for fourteen days with "bloody diarrhoea," but the parents refused to allow his removal to hospital; he also said he suspected intussusception. The appearance of the part removed is shown in the accompanying photograph.

Appendix and cuff of caecum, which has been stitched in place by two sutures.

DISCUSSION

Szenes,² quoted by Huddy,³ gives a total of fifty-eight cases of intussusception in the ileo-caecal region, of which nineteen, as well as Huddy's own case, were of this variety; unfortunately, he omitted ten case reports. The division into appendiceal and appendiceo-caecal varieties is, however, not of great moment, as the symptoms are the same, and intussusception of the appendix proper may be secondarily inverted into the caecum. The fairly frequent occurrence of such cases was suggested to me in a personal communication from Sir Thomas Myles, who mentioned that he had operated in two such cases; Mr. O'Connor of Croom had told him of another. The typical clinical course, as described in the literature, is:

1. Pain first around umbilicus, later in right iliac fossa, sometimes also in back; colicky in nature, intermittent; may extend over several months.
2. Vomiting may occur early in attack or may be a late symptom.
3. Reflex constipation, or when intussusception has become congested, diarrhoea with mucus and blood in stools.
4. No rise in temperature or increase of pulse rate until appendix is inflamed.
5. No rigidity unless appendix is inflamed.
6. A palpable tumour usually just above McBurney's point, slightly tender, dull on percussion, and freely movable unless fixed by adhesions.

On considering the musculature around the ileo-caecal junction (the commonest starting-point for intussusception) and comparing it with the arrangement at the base of the appendix, we are struck by the similarity presented—namely, a sphincteric ring, capable of becoming, through spasm, a hard, relatively fixed mass held at the apex of a tube which exhibits peristalsis; we are surprised at the relative infrequency of the condition described above, and are inclined to wonder if recurrent intussusception, spontaneously reduced, may not frequently be the real lesion in many cases which, though presenting