acting on body, body acting on mind, and body acting on body as *causae agentes*." It is also important to remember that "single pathology" is uncommon in that two or more (apparently) unrelated symptom-complexes may coexist in the patient and may follow different courses. Gould's (1953) dictum, "Affect is the mordant of conditioning," throws light on the significance of emotion in suggestion and auto-suggestion.

Notoriously, throughout the ages, many sufferers respond to any method other than the orthodox treatment of the time. Suggestion with or without hypnosis in the hospital or consulting-room is less likely to result in the disappearance of a wart than, for example, the burying of half a potato in the light of a full moon. It may be of significance that many forms of treatment which are successful while the rationale is accepted by the therapist begin to fail when new information casts doubt on this acceptance. The sword of logic pierces the shield of conviction, and treatment technique is no longer successful—one of the main factors in the "suggestion" situation having been eliminated. Too much, but still not enough, knowledge may thus be a handicap in therapeutics.

Summary and Conclusions

About a hundred cases, all claimed to have received full or partial benefit from a healer, have been followed up.

No single case revealed conclusively that the healer's intervention *alone* resulted in improvement or cure of a measurable organic disability.

Three cases showed marked improvement or cure of such a condition after the intervention of a healer, but the healer's case can be explained away in terms of orthodox medical experience.

It is possible that the healer may have some power to influence the progress of disease, although this has not been established during the present survey.

Many thousands, possibly millions, of sufferers are constantly seeking unorthodox aid, and it is important to assess whether, in general, the healer is a power for good or harm. Even if many who have not been helped by doctors are given hope, does the healer, by his intervention, prevent a significant number of patients from receiving adequate medical care in good time? Clinical psychiatrists, employing suggestion as a specific therapeutic technique, continue to achieve healing results at least as encouraging as those met with in this series, and on the evidence to date it is difficult to conclude that the healer's art is more than an empirical technique.

There remains a wide unexplored field of inquiry, and much individual case-work in different racial and social groups is necessary, first, to establish the facts of paranormal diagnosis and treatment, and then to correlate their relationships and significance. This field work might usefully include a review of cases in which improvement has occurred *after* the cessation of medical treatment *without* the intervention of a healer. Long-term controlled experiments in absent healing could be devised. It is possible that the exploitation of suggestion (other than placebos) in rehabilitation following disability of all types might prove to be a valuable adjunct to normal therapeutic practice, and it may well be that the attitude of doctor to patient, or to the disability, is of far greater significance than has hitherto been recognized, except in the psycho-analytic "counter-transference" context.

Case histories apparently substantiating the claims of the healer should be investigated by a suitable panel with access to the opinions of sub-specialists, since the

accumulating evidence of body-mind relationship constantly reveals new psycho-physiological rationale in "cures" hitherto inexplicable. It may be useful to recall that Williams (1954) exhorts us "in medicine [to] expect the unexpected—but be surprised if it occurs."

Thanks are due to Mrs. K. M. Goldney, Mr. Harry Edwards, doctors, patients, hospital records officers, and others who have made this survey possible.

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TREATMENT OF ROUNDWORM WITH PIPERAZINE CITRATE ("ANTEPAR")

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Piperazine in various forms has been used by French workers for the treatment of ascariasis (Fayard, 1949; Mouriquand *et al.*, 1951; Turpin *et al.*, 1952; Cavier, 1953). More recently, White (1954) has used "antepar," a syrup containing piperazine hydrate and citric acid, for the treatment of three children with roundworm infection. They received 0.5 g. twice daily (68 mg./kg./day), 1 g. twice daily (130 mg./kg./day), and 0.5 g. thrice daily (81 mg./kg./day) respectively. The worms were passed on the second or third day. Follow-up showed that complete elimination had been achieved. O'Brien (1954) used piperazine adipate in the treatment of two cases of ascariasis in children, giving 0.3 g. of the drug twice daily for several days. Worms were passed from the third to the sixth day of treatment. Apparently, no follow-up was made to determine whether or not all worms had been eliminated. In view of White's results and reported absence of toxic side-effects, it seemed likely that a single-dose treatment would be effective, and for this purpose tablets of piperazine citrate were prepared for use in East Africa. A syrup is a convenient vehicle for the administration of the drug to children, but it was thought that a tablet preparation would be more suitable for the treatment of adult populations overseas.

Methods

Field trials were carried out in a highly endemic area of Tanganyika in the neighbourhood of Kasulu. Patients were selected from out-patient departments, a school, and a native village, on the basis of direct microscopical examination of the stools in diluted Lugol's iodine. Only those showing numerous ascaris eggs of normal appearance were selected for treatment. Piperazine citrate was given in the form of tablets, each equivalent to 0.5 g. of the hydrate, and were swallowed with a draught of water. No restrictions were imposed upon the intake of food or alcoholic beverages, and no purge was given before treatment. Each patient was given a carton in which to place any worms passed with the stool, and was instructed to return with them. A second stool examination was made, where practicable, five or seven

days after treatment. Most patients were given magnesium sulphate twenty-four hours after the dose of piperazine, whether they had passed worms or not.

Results

Preliminary Tests.—Tests made upon patients in hospital showed that a single dose of 3 or 4 g. for an adult yielded a large crop of worms which appeared in the stools about twenty-four hours after the dose. A child, aged about 4 years, produced 14 male and 37 female adult worms after a dose of 2 g. An infant who was given 1 g. of the drug produced a number of worms, but still showed eggs in the stool a week later. No toxic side-effects were observed in any patient.

Schoolchildren.—The stools of 118 children aged 8 to 14 years from the Middle School at Kasulu were examined, and 39 were found to contain numerous ascaris eggs. The infected children were given a dose of piperazine citrate approximately related to body weight; those weighing 50 kg. and over received 3 g., those weighing 30 to 50 kg. received 2.5 g., and smaller children received 2 g. Of the 37 children who presented a second sample of stool for follow-up, 1 had been given 3 g. and was free from eggs; of 26 given 2.5 g., 19 were free from eggs; of 10 given 2 g., 7 were free from eggs. It is clear that this dosage was not sufficient to remove all the worms, although most of the children returned with parasites which they had passed on the morning following treatment.

Kabanga Mission Hospital.—A group of 37 patients showing ascaris eggs in the stools were treated by Sister Margaret at the Kabanga Mission Hospital near Kasulu. They were divided into two main groups, which were given 3 g. or 2 g. of the drug, irrespective of body weight. No toxic effects of any kind were observed, although some of those who received 3 g. were children. Nine patients received 3 g. of drug, and at a second stool examination five days later all were free from eggs, except for one woman with a heavy worm load, who produced 21 adult worms on the day following the dose. Of 19 patients who received 2 g., 12 were freed from eggs. Most of the patients returned with worms that they had passed. One child aged 1½ years was given 1 g. and was free from eggs five days later. Eight patients did not return for follow-up.

Village at Heru Juu.—Sixty-one inhabitants of an African community were examined and 29 had numerous ascaris eggs in the stools. Adults were given 3 g. of the drug and children 2.5 or 2 g. The numbers of worms brought for inspection varied from 1 to more than 200 per patient. The largest yield of 2 male and 15 female adult worms, together with a mass of more than 200 immature specimens, was returned by a child aged about 2 years who had received 2 g. of the drug. Yields of 15 to 20 adult worms were common. No follow-up examination of these cases was possible.

There was no evidence in any patient infected with hookworm or *Strongyloides* that the drug had any action upon these parasites.

Discussion

The above results show that piperazine citrate was effective in removing roundworms from the gut when given in a single large dose. In none of the cases treated was any toxic side-effect observed.

When treatment with piperazine salts is to be maintained for seven days, as for threadworm infections (White and Standen, 1953), care must be taken not to exceed the level of drug in the tissues tolerated by the patient. In the case of a single-dose treatment the problem of accumulation of drug in the tissues does not arise. A single large dose of 3 g. is usually sufficient to produce an effective concentration in the small intestine, but does not give toxic side-effects. The results of the trials suggest that all patients except children weighing less than 20 kg. should be given a dose of 3 g., and that the smaller children should be given 2 g.

Unpublished *in vitro* experiments made by one of us (O. D. S.) have shown that pig ascarides immersed in Ringer's

solution containing piperazine citrate in concentrations of 1:500 or more slowly became immobilized in six to eighteen hours, although metabolism continued and the worms were not killed. Similarly, worms passed twenty-four hours after piperazine treatment in man recovered in a few hours when placed in Ringer's solution and kept at 37° C. It is likely that the slow immobilization of the worms produced by the drug, and its failure to excite violent movements, will lessen the risk of accident due to occlusion or perforation of the gut during the treatment of heavy infections in small children. However, the fact that the narcotic effect is transient has a bearing upon the efficient use of this anthelmintic.

If the patient is costive it may well be that the effect of the drug will pass off before the worms are eliminated, and in such cases a purge would seem to be necessary. Most of the patients treated in Kasulu produced their worms in a normal stool passed within twenty-four hours of treatment, and a purge in such cases was of doubtful value except as a means of removing residual eggs likely to invalidate follow-up examinations. In view of the slowness of action of the drug *in vitro* and the probable similarity of action in man, the question of the most suitable time to give a purge for the removal of narcotized worms is important. Where conditions permit, it would be appropriate to give a dose of piperazine citrate before the evening meal and a saline purge before breakfast on the following morning. Such a regimen would be impracticable in African out-patient departments and in mass treatments in the field. In such circumstances it would be best to rely upon normal bowel movement.

It is of interest to speculate upon the possible use of piperazine citrate for the mass treatment of populations in endemic areas. In the Kasulu trials the drug eliminated both adult and immature worms; it is not known whether it has any action upon embryonic forms in the tissues. It is therefore possible that a person harbouring embryonic forms might show a return of eggs in the stool eight weeks after elimination of the gut forms, and a second treatment would be necessary. Also, in an endemic area the problem of reinfection would arise. Ascaris eggs will survive for several months in a desiccated condition and remain a possible source of infection even if the population has ceased to pass fresh eggs. For the eradication of a focus of infection it would be advisable to treat the whole population at monthly intervals for at least four months.

Summary

Piperazine citrate ("antepar") was effective in removing roundworm from the gut when given in a single dose.

The results indicate that a dose of 3 g. should be given to all except children weighing less than 20 kg.; small children should be given 2 g.

No toxic side-effects were observed.

The worms were narcotized by the drug and not killed; they recovered in a few hours when placed in Ringer's solution at 37° C.

No effect was observed against hookworm or *Strongyloides*.

We are greatly indebted to Sister Margaret, Medical Sisters of Mary Mission Hospital, Kabanga, for her co-operation in these trials. We acknowledge the help given to us by Colonel W. M. Laurie and the staff of the East African Medical Survey, whose guests we were, and by the staff of the Tanganyika Medical Service, especially Dr. A. G. Farr, Acting A.D.M.S., Lake Province, and Mr. Morton, African Medical Assistant at Kasulu Hospital.

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