

jejunum which has been brought up and attached to the stomach.

At the commencement of this paper certain of the sequelæ of gastro-jejunostomy were stated to be unavoidable at the present time, but retrograde or ascending intussusception and ulceration of the jejunum are of such importance as to deserve special mention.

Retrograde or Ascending Intussusception of the Distal or Efferent Loop.

Retrograde or ascending intussusception of the jejunum through a gastro-jejunostomy stoma is now a well recognized complication, but the chief interest in this condition lies in the difficulty of explaining the factors which are responsible for its occurrence. It does not appear to matter which type of gastro-jejunostomy has been performed nor does the condition appear to be dependent upon the position of the stoma, but nevertheless gastro-jejunostomy appears to be in some way the primary cause of the condition.

The condition is alleged to be due to too rapid emptying of the stomach, which causes irritation of the jejunum and sets up forcible antiperistalsis. The condition is characterized by sudden griping, epigastric pain, vomiting of blood, often a palpable tumour in the left hypochondrium with absence of rigidity, distension and acute tenderness. Some eighteen cases have now been recorded. The treatment, as in all forms of intussusception, is immediate laparotomy.

Postoperative Ulceration of the Jejunum.

Postoperative ulceration of the jejunum formerly occurred in 5% or 6% of all patients subjected to gastro-jejunostomy, but with greater care better operative technique and absorbable suture material probably not more than 2% result from it today. The division of postoperative ulceration into true jejunal ulceration, in which one or more ulcers form in the jejunum at some distance from the anastomotic opening, and gastro-jejunal or stomatal ulceration, in which the ulceration occurs on the line of the anastomosis, is of the utmost importance.

Jejunal Ulcers.

Jejunal ulcers nearly always occur opposite the stoma in that descending or efferent loop of the jejunum and are probably due to imperfect neutralization of the gastric hyperacidity, associated either with failure to discover the original cause of the ulcer (a fresh infection originating another ulcer in the vicinity of the new opening) or possibly the vitality of the jejunum has been lowered mechanically by the trauma induced by two tight clamps. The late A. J. Ochsner was of the opinion that these ulcers followed gastro-jejunostomy when the opening was not at the lowest point in the stomach, so that acid contents could accumulate, thus reproducing the condition which caused duodenal ulcer in the first place.

Gastro-jejunal Ulcers.

Gastro-jejunal, stomatal or marginal ulcers are probably due to a failure of the gastro-jejunostomy

wound to heal completely. It must be remembered that an ideal gastro-jejunal anastomosis will be the site of a healing ulcerated surface for fourteen days and for the first five or seven days the process is largely destructive, at least as far as the mucosa is concerned. Definite hyperacidity of the gastric contents, trauma, for example, from solid food passing over the granulating area and the presence of an unabsorbable suture in the granulating area, all tend to delay this repair which is normally complete in from twelve to fourteen days.

But there must be an added ætiological factor in the production of these ulcers, for although the control of all the above causes materially reduces their incidence, it will fail to prevent their occurrence entirely. The majority of these ulcers occur in men and in most instances symptoms develop within the first two years after gastro-jejunostomy. The symptoms are quite like those from which the patient was suffering before the primary operation; this shows that the same disturbance may come on with suture ulceration as that manifested by the original lesion. X ray examination offers the most accurate method of differential diagnosis.

A gastro-jejunal ulcer is more resistant to treatment and the temporary relief which often follows the medical treatment of primary ulcer, is not often obtained. When such relief is experienced, the prompt reappearance of the pain on the return to a normal diet, is of diagnostic significance. The patient with ulceration of the jejunum is in a much worse state than with gastro-duodenal ulceration, for this is not only a more crippling complaint, but a very formidable operation is necessary to cure it.

Gastro-jejunal ulceration may be treated by trans-gastric excision or excision of the entire anastomosis.

Flint points out that an ulcer at the line of anastomosis never occurs after gastro-duodenostomy; hence he advocates excision of the gastro-jejunal or jejunal ulcer, suture of the openings in the stomach and jejunum and the performance of gastro-duodenostomy.

A solicitor's clerk, aged forty-two years, had posterior "no loop" gastro-jejunostomy performed at another hospital six years ago for chronic duodenal ulcer. He remained in good health for nearly five years. For the last year he had complained of attacks of pain following food and there was a tender area under the upper part of the left rectus near the costal margin. The pains appeared always at the same point and after a similar interval, but the interval was shortest after a small meal and longest after a heavy one.

On X ray examination the barium could be seen escaping partly through the pylorus and partly through the stoma. Gastric analysis after a test meal revealed a total acidity of 60, combined acidity of 48, free hydrochloric acid of 40.

At operation the scar of the original ulcer in the duodenum was visible. The pylorus readily admitted the index finger on invaginating the stomach through it. The gastro-jejunostomy opening was midway between the two curvatures and easily admitted two fingers. The anterior surface of the jejunum immediately distal to the anastomosis was adherent to the wall of the stomach about 3.75 centimetres from the line of union. On separating the adhesion which was comparatively recent, a perforation was found in the jejunum about one and a quarter centimetre (half an inch) from the anastomosis. The

ulcer of which the perforation was, the centre, was excised together with the line of anastomosis adjacent to it. The opening in the two viscera thus made was closed by the usual suture method, reestablishing the stoma. Convalescence was uninterrupted, the patient was in good health for sixteen months and then succumbed to lobar pneumonia.

Conclusions.

In conclusion I wish to point out that every patient who has had a gastro-jejunostomy performed, should have full instructions as to his diet and habits of eating. The physician and the surgeon in cooperation can accomplish results impossible of attainment for either alone. Many of the troubles encountered by the patient and many of the reflections cast upon the surgeon are due to lack of supervision and advice following the mechanical work of surgery.

The physician and surgeon, each of whom should be thoroughly conversant with the indications and limitations of both the medical and the surgical treatment, should enter into the closest cooperation, not competition. The results of gastro-jejunostomy are not perfect and no such claim should be made at the present time for this or any other treatment for chronic gastro-duodenal ulcer. On the other hand a recent writer of the European school of radical gastric surgery claims that gastro-jejunostomy is a disease. If this hypothesis be correct, at least this operation has the virtues of being both preventable and curable.

After all is said and done, that operation for gastro-duodenal ulceration will alone survive which with the smallest risk brings about a complete subsidence of all symptoms, a permanent freedom from any recurrence and immunity from any disorder associated with the operation in consequence of its mechanical or physiological effects.

NOTES ON THE TREATMENT OF THE INTESTINAL PARASITIC WORMS WHICH MAY BE MET WITH IN AUSTRALIA.

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It is not always easy to get satisfactory results in the treatment of persons harbouring intestinal worms. To get rid of all the worms is often very difficult. Considerable improvements in the methods of treating some worm infestations have been introduced in recent years. Of the many drugs which may be found recommended in various books of reference, some are certainly not the best for the purpose. In these notes the methods considered to be the best at present known will be indicated. The mere giving of a particular drug in the proper dose is not always all that is needed and lack of sufficient attention to other details of management is sometimes responsible for failure.

The purpose of these notes is to give hints on treatment only and such matters as methods of diagnosis, pathogenesis and prophylaxis are not dealt

with. A few remarks on some of these subjects, however, and on other matters of interest have been included.

The parasitic worms of man belong to one of three groups. These are the flukes (*Trematodes*), the tapeworms (*Cestodes*) and the round worms or thread worms (*Nematodes*). Fortunately none of the flukes which commonly parasitize man, are endemic in Australia at present, although they may be met with occasionally in Asiatic immigrants. Only the other two groups, the round worms and the tapeworms, will be considered here.

Round Worms and Thread Worms (Nematodes).

The following are the intestinal nematode parasites with which we are concerned:

The hookworms, *Anchylostoma duodenale* and *Necator americanus*; *Ascaris lumbricoides*; *Enterobius vermicularis* (*Oxyuris vermicularis*); *Trichuris trichiura* (*Trichocephalus dispar*); *Strongyloides stercoralis* (*Strongyloides intestinalis*).

The hookworms, the normal host of which is man, are the two species *Anchylostoma duodenale* and *Necator americanus*. Both species may be found in those parts of Australia where hookworm is endemic, those parts with suitable conditions of temperature and rainfall, but *Necator americanus* is much the more common. The distribution of hookworm infection in Australia has been determined by the surveys of the Australian Hookworm Campaign and some light thrown on the regional and racial distribution of the two species. They found *Necator americanus* to be predominant in most of the endemic areas and *Anchylostoma duodenale* mainly in the extreme north-western part of Queensland and the endemic areas of Western Australia and the Northern Territory (also in certain institutions outside the endemic area). *Anchylostoma duodenale*, however, is the predominant hookworm in Southern Europe and it is likely that the many Southern Europeans who enter areas suitable for the spread of hookworm, such as the sugar districts of Queensland are importing many anchylostomes to mingle with the necators formerly introduced by the kanakas. Several patients, Spaniards and Italians, have recently been investigated at Townsville, who were suffering severely from hookworm disease and who had heavy and in some instances pure infections with *Anchylostoma duodenale*. They were workers on the sugar farms of the North Queensland coastal districts. They had apparently acquired their heavy infections there from soil infected by their compatriots.

Information is lacking on the question, ethnologically interesting, of the species of hookworm, if any, originally harboured by the aborigines of North Australia. In more recent times *Necator americanus* was introduced into Australia by the kanakas from the Pacific islands, *Anchylostoma duodenale* by Chinese and Southern Europeans.

What is seldom sufficiently recognized, is that there is a very great difference in pathogenicity between the two worms, *Necator americanus* being much less harmful than *Anchylostoma duodenale*.

The chief drugs which have been used by the Hookworm Campaign of the Rockefeller Foundation since its inception are thymol, oil of chenopodium, carbon tetrachloride and a mixture of carbon tetrachloride with oil of chenopodium. These four have succeeded one another in this order, which is that of their value against hookworms. Only oil of chenopodium and carbon tetrachloride and the combination of these two will be discussed here. Thymol, as well as other drugs such as β -naphthol, chloroform and eucalyptus which have been used and advocated, must now be recognized to be all inferior to the first two mentioned.

The two species of hookworms differ not only in pathogenic power, but also in their resistance to drugs. *Anchylostoma duodenale* which is the most harmful, is also the harder to eradicate. Carbon tetrachloride is highly efficient against *Necator americanus*, but less so against *Anchylostoma duodenale*.

Oil of chenopodium and other anthelmintics also remove *Necator americanus* more easily than they do *Anchylostoma duodenale*, but the difference is not so pronounced as with carbon tetrachloride. As against *Anchylostoma duodenale* carbon tetrachloride alone is probably not much, if at all, more effective than oil of chenopodium alone. Carbon tetrachloride tends to be selective against female hookworms, oil of chenopodium against male.

A saline purge after these drugs is always necessary; it should be large, thirty grammes (one ounce) of magnesium or sodium sulphate for an adult and it is advisable to ascertain whether it has acted and to repeat it at once if it has not done so within a few hours. The drugs are best given on an empty stomach. Preparation by fasting or light diet before the day of medication is not necessary. Neither is a preliminary purge the day before treatment imperative and it has been proved that its omission has little effect on the result obtained, especially with carbon tetrachloride. But it is often advisable to give it, especially when there is constipation, if only to insure that the purge which follows the drug, will be able to act quickly. Rest in bed on the day of treatment is very often omitted with little risk, although preferable when it can be secured. The patient may take food as soon as the bowels have acted well.

In practice it is found that the administration of these and other anthelmintics personally or under proper supervision yields far more satisfactory results than the mere giving of a prescription and directions.

Some further details concerning each of these three medicines in turn, will now be mentioned.

Carbon Tetrachloride.

Carbon tetrachloride is the best drug against necators; a single dose usually removes more than 90% of these worms. It is also efficient to a lesser degree against anchylostomes.

The dose for an adult is from two to three cubic centimetres (thirty-four to fifty-one minims). Three cubic centimetres are quite safe for a male adult

and much larger doses have often been recommended. But the general opinion at present is that it is safer not to exceed three cubic centimetres. The dose for children who stand the drug well, is 0.18 mil (three minims) per year of age. Pregnant women may safely be given carbon tetrachloride.

The drug is best given in the morning on an empty stomach. A preliminary purge the evening before is not necessary. The whole dose is usually given at once in hard gelatine capsules. On account of the volatility of the drug the capsules should be filled at the time they are to be taken. The drug which is not unpleasant, may also be swallowed quite easily in water (in which it sinks and does not mix) and may be given in this way to children. Two hours after the dose a large dose of magnesium sulphate or other purgative not of an oily nature should be given. Carbon tetrachloride has itself a slight laxative effect, but this alone cannot be relied on safely. In the case of carbon tetrachloride the salts may be given at the same time as or shortly before the anthelmintic, instead of afterwards, if it is more convenient, but with children and persons who may vomit a strong dose of salts, it is better not to give them at the same time as the vermifuge, as an unknown amount of the latter is then lost. On no account must any alcohol be permitted on the day of treatment.

The purity of the carbon tetrachloride is of the very utmost importance and many of the accidents have been attributed to impurities such as carbon bisulphide.

Carbon tetrachloride is one of the group of drugs, its relative chloroform being another, of which the toxic action falls mainly on the liver. Shortly after its administration there may be symptoms, usually slight and unimportant, consisting of dizziness and somnolence. The more serious and rarer symptoms are delayed and correspond to those of delayed chloroform poisoning. They are due to damage (necrosis of the central parts of the lobules) to the liver and sometimes to the kidneys. They usually appear on the second and third day; there may be nausea and vomiting, epigastric pain and tenderness of the liver; jaundice may appear and hæmaturia; there may or may not be rise of temperature. The contraindications to the prescription of carbon tetrachloride are liver and kidney disease, but above all alcoholism. Most of the cases of poisoning with moderate doses have either been due to an impure drug or have occurred in chronic alcoholics. It is good practice to prohibit all alcohol for several days before and after the treatment. In a recent circular of the International Health Board it has been pointed out that since the drug appears to have a selective action on the liver as well as on the kidneys, it is advisable to give the patient on the day preceding treatment a diet containing a considerable quantity of carbohydrates, especially sugar, because of their protective action on the liver.

Oil of Chenopodium.

Oil of chenopodium comes next to carbon tetrachloride in efficacy against hookworms in general

and has the advantage of being potent against ascaris as well, for which carbon tetrachloride is of little use. It should not be given to pregnant women. The drug is very unpleasant to take. It may be simply floated on water and swallowed, but is best given in hard gelatine capsules. To children it is often given on sugar. An adult should be given from one to one and a half cubic centimetres (seven to twenty-five minims) and a child 0.06 mil (one minim) per year of age.

The drug is more effective if given in two doses than if given all at once and division into three is better still. If 1.5 cubic centimetres (twenty-five minims) are given, they may be administered in three half cubic centimetre (eight minim) doses at intervals of one or two hours, beginning early in the morning. It should be given on an empty stomach and a purge the previous evening is advisable. The last dose should be followed in two or three hours by a large dose of a saline purgative. Castor oil, sometimes recommended, should not be used.

The toxic action of oil of chenopodium is confined to the nervous system. The symptoms of poisoning are dizziness, incoordination, tinnitus, disturbances of vision, formication and tingling of the soles and palms. Coma convulsions and death have been caused by overdoses. Some of the symptoms usually appear early in the rare cases in which any poisoning occurs. The treatment is to administer the purge immediately and of course to omit any portions of the divided dose which have not yet been taken.

Oil of chenopodium is of somewhat variable composition; it is a mixture of oils, some of which have no anthelmintic action. "Ascaridol" is the name which was given by Schimmel and Company who first isolated it, to that fraction of oil of chenopodium which contains the active body. It forms from 50% to 70% of the whole oil. As it is of more constant composition and potency than oil of chenopodium, it is to be preferred if available. Its toxicity as well as its anthelmintic action is higher than that of an equal volume of oil of chenopodium. The dose is half the dose of the whole oil.

A Mixture of Carbon Tetrachloride and Oil of Chenopodium.

Carbon tetrachloride and oil of chenopodium in combination seem to possess decided advantages over either given alone and to be the best medication for hookworm infection which has been fully tried up to date. The efficacy against both necators and anchylostomes is high and the effect on *Ascaris lumbricoides* is also good. It is true that carbon tetrachloride alone is just as good for pure necator infections, but one can usually only conjecture before treatment which species of worm is present or whether both are, since the predominant species of hookworm present cannot be determined readily by examination of the ova alone.

The toxicities for man of the two drugs are of quite different characters and do not reinforce each other. On the other hand their action on the worms is to some extent complementary. As the dose of

each in an effective mixture need not be as high as the effective dose of either given alone, the margin of safety is increased. A dose for an adult of 1.6 cubic centimetres (twenty-seven minims) of carbon tetrachloride with 0.8 cubic centimetre (fourteen minims) of oil of chenopodium or 0.4 cubic centimetre of "Ascaridol" possesses great efficacy with a large margin of safety and is recommended. For children the dose is 0.15 mil (two and a half minims) per year of age of a mixture of two parts of carbon tetrachloride with one part of oil of chenopodium or two minims per year of age of a mixture of four parts of carbon tetrachloride with one part of "Ascaridol." Larger doses have been advised and a full dose of both drugs may be given without undue risk in obstinate cases; for instance for a male adult, three cubic centimetres of carbon tetrachloride with one cubic centimetre of oil of chenopodium (half a cubic centimetre of "Ascaridol"). The mixture should be given in the morning, fasting and be followed in two hours by a full saline purge. Hard gelatine capsules may be used. It is important not to mix the drugs until they are to be used; they must not be kept mixed. Food may be taken as soon as the bowels have acted well.

None of the drugs for hookworms at present known can be relied on to remove every worm present in a single treatment, if only a moderate dose with a large safety margin be used. Such a single treatment usually removes over 90% of necators and the majority of the anchylostomes, but a few worms usually remain. The percentage of worms removed is usually higher in heavy infections than when only a few worms are harboured. It follows that to remove the last worm even by several treatments is often difficult. However it is not necessary in patients with hookworm disease to remove all the worms in order to remove all symptoms and effect a cure. As far as the patient's health is concerned a few worms are of little consequence; the number which is of no practical consequence, is smaller for anchylostomes than for necators. In general ten hookworms or less usually do little harm.

From a prophylactic standpoint it is of course desirable to remove every worm, but the difficulty of doing so is so great that the attempt has been abandoned by most hookworm campaigns. The question of interest to the clinician is how to decide when second or further treatments should be given. The degree of recovery from the anæmia and of disappearance of the other signs and symptoms gives some guidance. Sufficient time must be allowed for recuperation before a decision is made by clinical features alone that serious infection is still present. As regards other indications a count of worms removed by the treatment and determination of their species are very useful and methods of forming a very rough estimate of the number of worms still harboured by a count of eggs in the fæces are also of some value.

These procedures are troublesome, however, and it will be enough to state here that treatment should usually be continued until eggs are absent or scarce

in the fæces when examined by the ordinary Willis salt flotation method.

The fæces should not be examined for ova too soon after an anthelmintic has been given, because, although worms may have survived, they may have ceased temporarily to lay eggs after their unpleasant experience. According to one investigation dealing with this point the examination may safely be made after four days or more in the case of carbon tetrachloride and most other drugs, but in the case of oil of chenopodium the worms take longer to recover and the examination should be deferred for at least twelve days.

When a second treatment is required it may be given a fortnight or less after the first, if that consisted of oil of chenopodium; with carbon tetrachloride it is better to wait longer, several weeks, to avoid all risk of cumulative action. In anchylostome infections more than two treatments may be needed. When the combined treatment with carbon tetrachloride and oil of chenopodium is used, more than one treatment will least often be required.

Ascaris Lumbricoides.

Probably the most efficient treatment for the common round worm of man is the well known one with santonin. Oil of chenopodium however (or "Ascaridol") is also very good and is the most desirable method when other worms as well as *Ascaris lumbricoides* (hookworms or tapeworms) may possibly be present; the mode of administration and the dose are the same as for hookworms.

Santonin is given in doses varying from 0.03 gramme (half a grain) for a young child up to 0.3 gramme (five grains) for an adult. The patient should be prepared by restriction of diet and a preliminary purge. The drug may be given together with castor oil or calomel and a further purgative must be given some hours later.

The following prescription may be used, of which one dose for each year of age is given every night for three nights.

Santonin 0.01 gramme (one-sixth of a grain).
Calomel 0.01 gramme (one-sixth of a grain).
Sugar quantum sufficit.

Each dose is followed the next morning by a saline purge.

It is important to see that the purges act well, whatever drug is used for the treatment of *Ascaris lumbricoides*. Worms, poisoned but not killed, sometimes give rise to intestinal obstruction or other damage if not quickly removed, especially when many are present. Although ascaris infection often gives rise to no symptoms, it is credited with some times causing a variety of gastrointestinal or of nervous troubles. In spite of the variability and indefiniteness of such symptoms it seems beyond doubt that they are really caused by this and other worm infestations in some patients. Urticaria, of allergic nature, may occur.

The serious surgical complications which occasionally arise, are also well known; a great many have been reported and collected of recent years.

Pulmonary symptoms may be caused in children, exposed to heavy infection by the larvæ in the course of their migration through the lungs.

Enterobius Vermicularis (Oxyuris Vermicularis).

Familiar as we are with the common thread worm, all stages of its life history have not yet been fully observed. The worms live in the caecum and upper part of the large intestine, but the gravid females emerge from the anus before discharging their eggs which the host when he scratches carries off with his finger nails to reinfest himself or infect another person who may swallow them.

Diagnosis is made from the symptoms and by finding the worms in the fæces after a suitable enema. It should not be attempted by the examination of a small faecal sample for eggs, because these are laid for the most part outside the body and any present in the fæces are distributed quite unevenly.

It has been reported that microscopical examination for ova of the dirt under the finger nails of children is a fairly reliable means of diagnosis.

The therapeutic measures are well known, but cure may be very difficult, especially in adults. Measures to prevent reinfection are as important as those for the removal of the worms already present. Among the former are the wearing of strong cotton drawers and gloves at night, smearing the anus at night with a mercurial ointment and the paring of the finger nails and washing of the hands. The latter comprise vermifuges given by rectum or mouth. The adoption of strict diabetic diet is sometimes advisable.

Allusion may be made to "*Oxyuris incognita*." This was the name given to the unknown parent of certain large eggs which were found in human fæces in America and also by the Australian Hookworm Campaign. It has now been proved in America that these eggs do not proceed from any parasitic worm, but are eaten raw, such as radishes, celery and lettuce. At certain seasons these vegetables are often heavily parasitized by the widely distributed nematode worm *Heterodera radicolata*, the egg of which somewhat resembles a large oxyuris egg and contains a larva. These eggs pass unchanged through the gut of man and the eggs seen in the fæces contain still living larvæ. In Townsville radishes and carrots have been examined and in many of the roots the nodules formed by this worm were found abundantly and they contained numerous eggs which were found to be very resistant to digestive juices and to dilute mineral acids.

Trichuris Trichiura (Trichocephalus Dispar).

It is fortunate that infection with whip worms is not a serious matter, for no satisfactory means of removing them has been found. Some are often removed by oil of chenopodium given for hookworms.

Many weeks or even months outside the body may elapse before the embryo within the shell reaches a stage of development at which the egg is infective;

it can remain alive at this stage and infective for anyone who swallows it for as long as five years.

The infection rate with this worm shows a fairly close relation to the general sanitary standard.

Strongyloides Stercoralis (Strongyloides Intestinalis).

According to the findings of the Australian Hookworm Campaign *Strongyloides stercoralis* may be found occasionally in all the States of Australia.

The parasitic forms, parthenogenetic females, about 0.25 centimetre (a tenth of an inch) long, live usually in numbers in the submucous tissue of the small intestine. Infection is acquired in the same way as hookworm infection, by the penetration of the skin by larvæ in contaminated soil.

Diagnosis is made by finding the larvæ in the fæces; these have to be distinguished in the case of stale fæces from hookworm larvæ and from *Rhabditis hominis*, a free living worm which often contaminates fæces after they are passed, possibly through the agency of flies.

It is doubtful to what extent this infection is pathogenic. No satisfactory treatment is known, although oil of chenopodium is of some value.

Tapeworms (Cestodes).

The intestinal tapeworms are of less importance than the round worms. When they are met with, their treatment is often troublesome.

Three of the commoner tapeworms which inhabit man's intestine may be acquired in Australia, but none of them is very common. The three are *Hymenolepis nana*, *Tænia saginata* and *Tænia solium*. *Diphyllobothrium latum (Bothriocephalus latus)* is unlikely to be found in Australia except in immigrants from a country where raw fish is eaten such as Finland.

Hymenolepis Nana.

Hymenolepis nana is a very small tapeworm. It is the commonest tapeworm of man in warm climates in many parts of the world. It is the least rare of the intestinal tapeworms in Australia, where it is not confined to the tropical parts, although more often met with there. Of about two hundred thousand persons examined in Australia by the Hookworm Campaign this infection was found in 0.2%. Children are especially liable to be infected. The remarkable life history of this worm is of great interest. Certain questions concerning it have not yet been answered with certainty or at any rate with unanimity, for instance the question whether *Hymenolepis nana* of man and *Hymenolepis fraterna* of the rat are identical and whether man frequently acquires his infection from rats. There is little doubt, however, that the life history of the worm in man is the same as that of the rat tapeworm. This develops without any intermediate host, the larval (cysticercoid) stage occurring in the intestinal villi whence it is liberated into the lumen of the gut to become the adult worm. An important consequence of this mode of development is that autoinfection can occur and probably for this reason the number of worms present in an infected person may be large. Several hundreds are often present

and there may be thousands. Infection is acquired by swallowing the eggs of the worm which occur in the fæces of infected persons (and possibly by swallowing the eggs from rat fæces).

As a rule there are no symptoms, but sometimes there are those of chronic intestinal catarrh. Various nervous symptoms have also been described as in so many other worm infestations.

Filix mas, the best drug against many tapeworms, expels this worm too, but seems to be inferior to oil of chenopodium or thymol. It is often difficult to remove all the worms.

The patient should be kept in bed during the treatment if possible and must be prepared by restriction of diet for one or two days followed by a purge on the afternoon of the day before the drug is given. Next morning oil of chenopodium should be given, divided into two or three doses and followed by a saline purge, the manner of administration and the dose being just the same as has already been described for hookworms.

After about three weeks the fæces should be examined for ova and the treatment repeated if they are present. The combination of oil of chenopodium with carbon tetrachloride as recommended for hookworms may also be tried.

As the ripe segments of this worm when they become detached are partly digested and the ova liberated, diagnosis can be made by examination of a small faecal sample for eggs in the ordinary way used for most intestinal worms.

Tænia Solium and Tænia Saginata.

Tænia solium and *Tænia saginata* are both best treated by *Filix mas*. The same treatment should also be used for *Bothriocephalus latus*.

Tænia solium, acquired by eating infected pork incompletely cooked, is rather rare in Australia. If it is met with, the patient should always be thoroughly treated on account of the possibility of his becoming infected (by swallowing eggs passed by himself) with the larval form, *Cysticercus cellulosa*. When this form invades man's tissues the brain is sometimes the organ involved.

Tænia saginata, acquired by eating insufficiently cooked beef infected with *Cysticercus bovis*, is also not common in Australia, but is commoner than *Tænia solium*. In the two hundred thousand persons examined in Australia by the Hookworm Campaign, only forty-two infections with one or other of these tapeworms were found. However the method of faecal examination suitable for detecting hookworm eggs misses many cases of infestation with these tapeworms, because the ripe segments usually retain most of their eggs until they have emerged from the body.

Invasion of the tissues of man by the larval form, *Cysticercus bovis*, is very rare, more so than infection with *Cysticercus cellulosa*. The removal of these tapeworms is not always easy and requires to be carried out with care and under properly controlled conditions. The patient must be confined to bed, preferably in a hospital. *Filix mas* is the most effective drug. It varies in quality and care should be taken to get a reliable preparation.

The ethereal extract, *extractum filicis liquidum*, is usually used; it should be freshly prepared. It is essential that the patient be carefully prepared by starvation and purging so as to empty the bowel completely.

The following are the details of procedure recommended by Lane and Low ("The Practice of Medicine in the Tropics," Byam and Archibald):

Place the patient on liquid diet for two days. On the afternoon of the second day a dose of calomel or salts is given and some clear soup or milk in the evening. Next morning, (the third day) a cup of black coffee may be taken and then three capsules, each containing thirty minims (two cubic centimetres) of the liquid extract are administered at intervals of half an hour, say at 9 a.m., 9.30 a.m., and 10 a.m. To prevent vomiting, one drachm of brandy, to which fifteen minims (one cubic centimetre) of chloroform have been added, may be given with the first dose. Two hours later a saline aperient (Epsom salts, Carlsbad salts or sodium sulphate) is administered, to purge the patient and wash out the worm.

Jalap may be used as the purgative instead of salts, but castor oil should not be given. A total dose of eight cubic centimetres (two drachms) should never be exceeded. Symptoms of poisoning consist in mild cases of jaundice; in more severe cases violent vomiting, abdominal pain, a feeling of feebleness, syncope, somnolence and occasionally amblyopia occur; in very severe cases cerebro-spinal paralysis and death result.

All stools should be kept and examined carefully to determine whether the head is present or not. The first motion should be passed into a vessel of warm water as this diminishes the likelihood of the worm breaking. It must be remembered that more than one worm, of either of these two species, may be present (*solium* is a misnomer). If the head survives, segments will reappear in the faeces in about two or three months. Should the head not be found in the stool following the dose of salts, an immediate dose of two cubic centimetres (thirty minims) of oil of turpentine in an emulsion or of a chloroform-eucalyptus mixture, may bring success. This mixture consists of eucalyptus two cubic centimetres (thirty minims), chloroform three cubic centimetres (forty-five minims), castor oil forty cubic centimetres (ten drachms). If the head is not found, a second treatment may be given after an interval of ten days. It is better, however, to wait three months and repeat the treatment only if segments reappear. *Extractum filicis liquidum* has a very horrible taste. For those who cannot take capsules, it may be administered in a mucilaginous emulsion such as *mistura amygdala*. The dose for children is from two to four cubic centimetres (half to one drachm).

Among other drugs which may be tried in special cases or when *Filix mas* fails, oil of chenopodium and thymol may be mentioned. Oil of chenopodium should be given in the same manner as for hook-worms, but the preparation of the patient by starvation and purging should be carried out in full just as with *Filix mas*. Carbon tetrachloride is said to anaesthetize the worms temporarily and must be

immediately followed by a massive saline aperient to remove them. A mixture of carbon tetrachloride and oil of chenopodium as recommended for hook-worms is worth trying when *Filix mas* fails; it is less nauseous and quite safe.

RADIOTHERAPY AS AN AID TO OTO-RHINO-LARYNGOLOGY.¹

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TONIGHT I propose to put before you the present state of the art of radiography as an aid to the diagnosis of conditions met with in your practice as specialists in ear, nose and throat surgery.

A specialist has been described as "one who knows everything about his own subject and nothing about anything else." Perhaps, if you will accept this definition, you will forgive me for the very little I know about your speciality.

Now skiagrams are but shadow pictures; when X rays pass through a region, we have reproduced on the film a record of the densities of the various structures through which they pass. Ordinary bone stops a great number of X rays while the air-filled spaces of the face allow a greater number to pass and thus produce greater photographic effects on the sensitized film. If one of these spaces is filled by an effusion of fairly high specific gravity, a great number of the traversing X rays fail to reach the film; therefore we have a light area on the negative where we would expect a dark one and so we are able to demonstrate departures from the normal and draw various conclusions.

The first essential in radiographic work is a good negative. With modern machinery and technique this should be insisted upon. Distortion must be avoided in sinus skiagrams, especially as we are dependent in this class of work almost entirely on our ability to compare the two sides and note variations in their density.

The X ray examination should be looked upon as an additional clinical method and should be considered in conjunction with the other signs present and should never be looked upon as a short cut to diagnosis.

Usual routine examinations should be made and then the patient should be referred to the radiologist for confirmation of the findings or possibly for the demonstration of some unsuspected abnormality.

In reporting on skiagrams, the radiologist should state what variations he notes from the normal and what variations in translucency are noticeable on comparison of the two sides. Then and only then should he give his interpretation stating what pathological conditions would give these radiographic

¹ Read at a meeting of the Section of Oto-Rhino-Laryngology of the New South Wales Branch of the British Medical Association on November 30, 1925.

appearances. Perhaps, as in the American special clinics, greater liberty may be allowed where surgeon and radiologist are constantly working together; but it is not good practice for a radiologist to advise as to operation or to suggest treatment.

We will now pass on to consider various regional lesions as met with in an average practice.

Anterior Head Sinuses.

The best position for radiography is with the patient lying prone, with the chin resting on the table and the nose elevated about 1.25 centimetre (half an inch) above the chin level. The central ray passes through the vertex, striking the film at right angles. Upper dental plates should be removed before examination, otherwise the floor of the antrum will be obscured. The actual exposure possibly does not interest you, but we use ten milliamperes of current at a 13.75 centimetres (five and a half inches) gap for ten seconds using the Potter Bucky diaphragm, duplitzed films and double intensifying screens. This picture will include both frontal and ethmoidal sinuses and both antra. The picture on the screen shows the correct position with the antra and the frontal sinuses well displayed (each slightly enlarged in the skiagram) and the ethmoid cells are seen to either side of the nasal cavity. If the tube is centred too far back or if the nose is lowered to the chin level we get obliteration of the antral shadows by the massive petrous temporal bones. Deviations of the septum and enlargement of the turbinate bones can also be demonstrated, but as such lesions are demonstrable by your ordinary examination, it is rarely commented upon by the radiologist.

An effusion into any of these air spaces causes absorption of the X rays and consequently less light effect on the film, giving a lighter area on the affected side which we call a comparative dulness. Now this dulness may be due to pus, to polypoid material, to thickened membrane, new growth or to a simple inflammatory effusion; the latter is common in influenzal infection and if an examination is made after a week or ten days, in many cases it will have disappeared.

A peculiar rounded shadow is frequently seen projecting above the antral floor. This gives dulness to ordinary transillumination and is due to the presence of a mucous cyst and it would be missed in an ordinary antral puncture through the nose. Simple bone cysts and dentigerous cysts in the maxilla are frequent sources of pain similar to antral pain. They are benign and evacuation with curettage leads to cure. The upper premolar and molar alveolar processes should always be examined in antral cases, as unsuspected periapical foci are frequently found in these regions. The skiagrams I show you demonstrate how closely dental structures are related to the antral floor.

The frontal sinuses vary greatly in size, shape and position and frequently the septum is to one side of the mid line. I will show you examples of frontal abnormalities and of the appearances seen

in disease. We must always remember that frontal sinuses are rarely demonstrable before eight years of age while absence of one frontal sinus is by no means uncommon.

When the inflammatory conditions in these sinuses extend to the bone, they produce a haziness and loss of bone detail as is usual in osteomyelitis generally.

Ethmoidal cells are difficult problems and unless a very definite unilateral infection exists, it is rarely possible to state whether disease is present or absent.

Sphenoidal cells are radiographed with the plate under the chin and the central ray passing vertically downwards in a plane about 2.5 centimetres (one inch) anterior to the external auditory meatus and casting the shadow of these cells in the horse-shoe loop of the mandible. Deviation of the medium septum may be demonstrated and frequently dulness of the air cells. A method of localizing the various cells which is often of great help is to pass a probe into what is considered any particular set of cells and then skiagraphing the part; it is surprising how often the specialist is at fault in his estimation of distances when working among these cell spaces.

Mastoids.

The generally adopted position for radiography of the mastoid cells is to place the patient prone with the head turned to the side, with cheek and ear resting on the film (the pinna being turned forward) and with the mastoid process centred over the middle of the film. The central rays are then directed to the centre of the film through a point five centimetres (two inches) above and five centimetres behind the external auditory meatus the tube being tilted 10° downwards and 10° forwards. The mastoid cells manifest no cellular development before three years of age and usually not until the fifth year and so mastoid examination of patients under five years of age is unsatisfactory.

Two types of mastoid cell are recognizable: (i.) the noncellular and (ii.) the pneumatic or cellular types. The first type is practically indistinguishable from sclerosed conditions, but a bilateral skiagram will allow of a differentiation as the two mastoids are generally symmetrical. In the pneumatic type the cells are distinctly visible and the fine cellular and trabeculated structure can be seen.

The most important finding is a loss of definition in trabeculation meaning that an inflammatory exudate is present or if the loss of definition is very great, that there is destruction of bone substance with breaking down of the cell walls. Necrotic bone shows as a darker shadow in the skiagram owing to the greater translucency of necrotic areas. Necrosis, cholesteatoma and bone cysts all give similar radiographic appearances, that is the appearances of bone absorption. Mastoids with large antral cells allow of better drainage than the small celled type and such mastoids are more likely to improve without operation. Mastoids which do not heal after operation will often be found to manifest