

Original Articles.

OBSERVATIONS ON THE CAMPAIGN AGAINST UNCINARIASIS IN PORTO RICO.*

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Gentlemen, It would be wasteful of your time should we review the history, the older and now discarded theories of the pathogenesis of this disease, its fairly well-known symptomatology, its method of diagnosis and the long list of more or less worthless drugs which, from their fancied effect on the parasitic worm or upon the course of the anemia, have been from time to time recommended to supplant those whose efficacy is believed to outweigh any objections thus far brought against them.

We purpose bringing before you some hitherto unpublished data in connection with the work of the commission against uncinariasis and some which may be of interest in connection with the very practical question, "How can the ravages of this disease in Porto Rico be controlled?"

The data here reported were collected conjointly by the three members of the Commission of 1906-7, the absence of Dr. Pedro Gutierrez, the chairman of the commission, preventing him from taking an active part in the preparation of this paper.

We will first invite your attention to what is, to us, of paramount importance in the control of a disease which has for years decimated that otherwise healthful and rich island, impoverishing its laboring classes and rolling up an unprecedented mortality from a rapidly curable and preventable scourge. We refer to the usual mode of invasion of *Necator Americanus*.

Uncinariasis in Porto Rico is not only an interesting medical question but an all-absorbing social and economic one whose effect reaches out in every fiber of the social and industrial life of the people. We base our statement on a careful study of the endemic in that island, an experience extending over a period of several years, and including thousands of cases from practically all parts of Porto Rico.

We estimate that about 750,000 of the inhabitants are infected and that 70% are suffering in some degree, greater or less, from the effects of such infection. By a long series of cases, now considerably more than the 600 blood examinations reported in 1904, we have established the fact that the average hemoglobin of those complaining of symptoms is from 40% to 45%. From 5,000 to 7,000 persons, at least, have succumbed annually to this terrible affection, thus increasing by from 20% to 25% the total mortality for the island from all causes.

Variously attributed in times, luckily past, to malaria, starvation, climatic influences, habits

of life, etc., to-day rich and poor, educated and unschooled, are learning that this anemia which from all time has claimed so large a share of the public attention is the outward manifestation of an infectious disease in epidemic form, an epidemic of such unheard-of proportions and fatality as to astonish those who have heretofore considered it to be a comparatively benign affection, as far as a menace to life is concerned. The mode by which the parasite invades the human body is clear, however strange it may appear, and has been reduced to concrete facts:

The larvæ from ova deposited upon the earth in the feces of the host, developing under proper conditions of shade, moisture and temperature, penetrate the unbroken skin of the feet of unshod laborers. These larvæ enter the veins, are swept to the right heart and from thence to the pulmonary artery, to finally become arrested in the smaller vessels through which they are unable to proceed owing to their size. At this juncture they break through into the alveoli of the lung, ascend the bronchial tubes, descend the esophagus, pass the stomach and eventually find a resting place in their preferred feeding ground, the upper part of the jejunum.

Not only have we been able to experimentally corroborate skin infection but we feel justified in saying that this is practically the only way the worm enters the body. We have never found a case which was clearly due to ingestion of the larvæ. The inhalation of infected dust does not merit consideration, as drying almost instantly kills them. On the other hand we have seen that 96% of 18,865 patients have acknowledged to having had an affection known the length and breadth of Porto Rico as a special and peculiar condition, not confounded with any other by those exposed to it, always acquired from contact of the bare but healthy skin with mud or muddy water, "mazamorra" or "ground itch." The word, "mazamorra" is not employed in Spain with this meaning. It is a common expression in Porto Rico, employed just as our laity here refer to urticaria as hives, and it is really uncinariar dermatitis. A very short time, from some minutes to a half hour, after standing, with bare feet in infected places, itching begins; in a day the part is covered with papules which later may become vesicles and, if conditions are favorable, but not necessarily as a distinctive part of the process, pustules and even ulceration may appear, the latter, of course, being due to concomitant infection by pus-producing organisms. This mazamorra and the anemia of Porto Rico are always found together, and both are seen in exaggerated degree where the most perfect conditions for the development of the larva from the egg and its subsequent desiderata, constant moisture and shade, are found,—the coffee plantation. On the other hand, both mazamorra and anemia are generally conspicuously absent among those who wear shoes.

The following experiment brings out in this connection a very interesting point and also demonstrates that we have in the guinea pig an

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animal capable of being infected by *Necator Americanus*, a fact likely to be of value in future experimental work.

On the 1st of March, 1906, the feces of a newly-acquired servant of the commission, heavily laden with eggs of *uncinaria*, was mixed in a Petri dish with such quantity of sterile sandy earth as to remove much of the offensive odor, a proportion of about one part of feces to two of earth. Water in sufficient quantity to give the consistency of mud was added, the dish covered and set away in the shade.

On the 4th of March larvæ were very plentiful to every field of a No. 3 Leitz objective. Some were moving lazily but the majority were apparently dead and lying fully straightened out. The immersion in excess of water of those which were before active brought all movement to a standstill. This effect was noted in about fifteen to thirty minutes.

On the 5th of March the dish having been slightly tilted overnight and about two table-spoonfuls of water added, all larvæ in the water which had collected at the lowest level of the dish, were motionless and straight, while those in the damp mud above this level were exceedingly active and encapsuled.

March 8 we found changes in the larvæ in the water which showed us that they were dead. Those in the damp earth were just as lively as before.

We took a four-day-old guinea pig, reared under conditions where infection by *uncinaria* was practically impossible, clipped the hair from its back without subsequently shaving the area, made a mud poultice in cheese cloth about the size of a silver dollar from the upper part of the contents of the Petri dish in which the larvæ were found so active and bound it gently on the animal's back, the pig being held for a half hour by the feet and head to avoid contact of its mouth with the mud. At the end of that time the spot was appropriately cleansed, rubbed well with absolute alcohol and the animal returned to its cage.

The behavior of the pig after the first five or ten minutes was remarkably suggestive as he squealed and squirmed with unmistakable desire to scratch. March 9 the same procedure was repeated, the gentleman who had stocked the culture officiating as guard over the animal's feet. The same struggling took place in about the same time, and the man remarked with an appreciative grin that the pig was suffering with *mazamorra*.

On March 10 the same application was made. The pig seemed well. *Absolutely no uncinariæ dermatitis had developed in these three days.* That night the pig died; the jibaro said that he had noticed him about six hours before and that he had a very blue nose and seemed *triste* (sad).

Necropsy. — No edema; skin at site of infection, stomach, intestines, peritoneum normal. The kidneys and the liver were violently congested, but showed no larvæ. On opening the chest the cause of death was seen: the lungs were

hemorrhagic. One lung was solid with blood and the other filled with dark red, almost black, spots. One of these spots was excised, crushed between two slides and examined with a No. 3 Leitz objective. *Ten encapsuled larvæ were found, all very active, wriggling with an exceedingly violent movement.* They seemed to overcome by their enormous strength all obstacles, breaking up lung tissue wherever it opposed them.

The larvæ seemed to be in the alveoli and are prone to seek little pools of blood.

The heart's blood was examined without result. Nothing else was found to be abnormal.

A very interesting deduction, among others more important and quite obvious, without any special attention being drawn to them in this paper, is that the so-called "natural cure," to us, a rather trying process with so sure and rapid a remedy as thymol, is possible in a heavily infected country, provided that stout shoes are worn and further *uncinariæ dermatitis* avoided. The fact that the ova of *uncinaria* never develop into larvæ in the intestine of the host, coupled with the fact that we have not seen infection to occur save by the skin, not only explains why patients sick of anemia in the mountains gradually get well on taking up their abode in the cities of the island where the mud of streets, even though subject to occasional contamination, is subjected to drying fatal to the life of the larvæ. It explains why the soldiers of the Porto Rican regiment, almost universally infected on presenting themselves for their first enlistment, but not to an extent to be noticeable and thus to incapacitate them from acceptance in the physical examination for the service, are such perfect specimens of manhood after a few years, even in less time, from the day they were compelled to wear shoes and received the ample food and solicitous care bestowed upon them by their officers. Their alertness and physique are commented upon wherever they go, and they furnish excellent examples of what can be done by the redemption of the Porto Rican jibaro.

The pathogenesis of uncinariasis. — Those who have seen much of the disease in its more advanced stages, and especially those who have made a series of necropsies, are apt to feel that the most probable cause of the anemia is hemolysis. Those who believe that the reduction in red cells and hemoglobin results from hemorrhage should take seriously into account the fact that the appearance of a bloody stool is truly a rare occurrence in Porto Rico. Of the thousands upon thousands of specimens of feces personally examined by the members of the commission working in their own dispensary, under conditions where every visit of the patient called for a microscopic examination of feces, we can freely say that not more than 0.5 per thousand contained the slightest trace of blood that could be detected by macroscopic inspection. They usually showed nothing whatever that could be regarded as peculiar to the condition. A slightly greater proportion, but not over one per thousand, was found on microscopic examination to contain

red blood corpuscles in appreciable numbers. We exclude, of course, cases of bilharziosis and amebic dysentery.

As to occult blood, there seemed to be no special reason to examine for it. Knowing the condition of affairs in the jejunum, we were satisfied that tests would reveal it. Should we prove this by the report of a series of cases we should not be able to claim that it was even a potent cause of the anemia. And all this is irrespective of the fact that, as a result of numerous other causes, occult blood can be detected in the extremely small amount which it is reasonable to suppose would be lost by the minute wound inflicted by so small a parasite. In our twelve necropsies of this year and those of the last, we have only once seen the rose-red ecchymoses described in the older works as occurring in the jejunum. In all save this one it would have been very difficult indeed to have found the point of attachment of a worm, after it had become detached.

In the case we were able to see the little red points, which were very small and only noticeable by holding the cleansed intestine against a good light and looking through it, the patient had not received any specific treatment. This case was the only one in this year's series in which no anthelmintic had been administered. Had we not held the intestine up to the light we probably would not have noticed these spots. A number of them were removed and were found to present very minute and superficial erosions with no invasion of the submucous tissue.

The point we wish to emphasize is that there is nothing distinctive about the stool of an uncinaria patient, at least as far as the presence of blood is concerned and as regards the gross appearance. This is not alone our experience but that of others, for the occurrence of bloody stools is denied by many Porto Rican physicians who are working on this disease, and we have yet to hear one state that he had found it a distinctive feature.

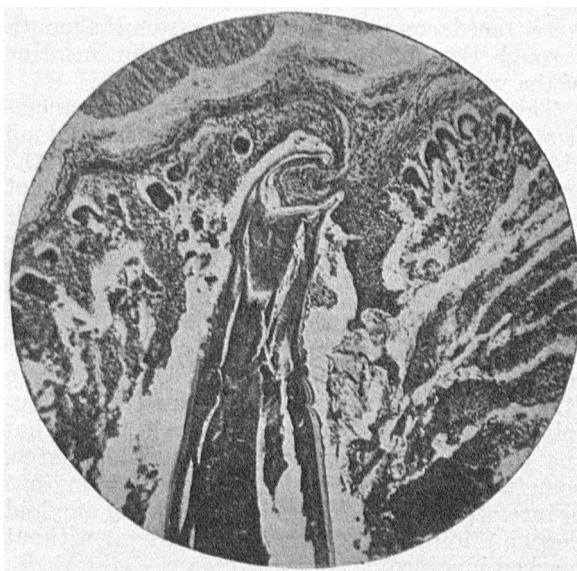
It is certainly a great error to designate this worm a blood sucker, for by using this expression we imply that not only is blood his normal food but that he abstracts a sufficient quantity to bring about in part the pronounced anemia of uncinariasis. That he does swallow, and even suck very small quantities of blood in feeding on so vascular a substance as the intestinal mucosa, we do not deny. Nor is there any doubt that an exceedingly small quantity of blood does reach the intestinal canal of his host and that it can be demonstrated as occult blood in the feces. In the rare instances, cited by various authors, of the loss of considerable amounts of blood, the animal probably punctured a large vessel.

We do not believe it possible that any degree of anemia could be produced by the loss of the small amount of blood ingested by these minute creatures.

The food of uncinaria is shown when we come to examine the beautiful, almost diagrammatic

photograph of the worm *in situ*. This is a photograph of one of a number of uncinariae which we removed from the cadaver, while the parasite was still alive and feeding, with a portion of the intestine to which they were attached. They were dropped immediately into alcohol. These specimens were imbedded and sectioned very skillfully by Dr. W. M. Gray at the Army Medical Museum and the accompanying photographs were also made by him, as were all others we take pleasure in being able to show you.

There are, at least, two valuable lessons to be learned from a careful inspection of these photographs of the worm *in situ*:



Photographed by Dr. W. M. Gray.

FIG. 1. *Necator Americanus* attached to the human jejunum. x 55 diameters.

(1) The lesion is practically confined to the mucosa. (2) Although the animal had drawn into his mouth the submucosa which has become completely denuded of epithelium, among the contents of the intestine of the parasite the conspicuous objects are epithelial cells, not red blood cells.

The picture here shown corresponds in every particular with a previous description and photograph published by Loos in "The Anatomy and Life History of *Ancylostoma duodenale*," *Records of the Egyptian Government School of Medicine*, vol. iii, Cairo, 1905.

We feel obliged to conclude that the epithelium lining the intestinal canal of the host furnishes the normal food supply of *Necator Americanus*, just as he previously describes it to be that of *ancylostoma duodenale*.

In conclusion we wish to note that in the immense majority of about 80,000 uncinariae counted personally by us in the stools of our patients after the administration of the anthelmintic, as well as in those attached worms found in the intestines at necropsy, the worms did not appear to contain blood but were generally grayish white. In fact this peculiarity was made use of in the device adopted for their recovery

from the stools, which were washed slowly down a trough painted black, the stool having first been filtered through gauze. In a report on ankylostomiasis by Löbker and Bruns, 1906, we find the following:

"The views of Loos were substantiated by Schaudinn, after a careful re-examination of a large number of Leichtenstern's sections, when the intestinal contents of the ankylostoma were microscopically examined. Among 300 worms selected at random, he found 196 whose intestines contained cell fragments other than blood cells. In the remainder he found either nothing or else blood cells to a greater or lesser amount. Repeatedly long strips of intestinal membrane were traced, completely extending from the mouth through the alimentary canal into the intestine of the worm."

This is important information when we remember that Leichtenstern was the observer of all observers who was most identified with the teaching that ankylostoma duodenale was not only a blood sucker but was so prodigal of his food that he consumed blood entire to appropriate only the serum, evacuating blood cells practically unchanged. For this the noted authority dubbed the worm, "the luxurious parasite."

The urine in uncinariasis before and after treatment.—In the first report of the Porto Rico Anemia Commission it is stated that albumin is rarely found, although note is made that the kidneys may be very pale and slightly fatty, sometimes being the seat of parenchymatous or interstitial inflammation, sometimes of amyloid degeneration but, generally speaking, without marked involvement of these organs.

We would like to considerably modify our former opinion. It was based on the examination of a series of cases but was not made, as was the blood, a matter of special study, inasmuch as Heller's nitric acid test and the absence of clinical evidence gave us no clew to the real condition. It is significant that writers on uncinariasis make practically the same statement. As a matter of fact, the condition of the kidney in a well-marked case of uncinariasis is of the greatest importance, as will be shown. We noted the irritant effect of the anthelmintic drugs employed upon the digestive tract and found albuminuria after their administration, in accord with the experience of Loebker and Bruns, Calmette, Siccardi, and others with thymol and male fern.

Our plan for 1905, among other things, was to make a careful study of the therapy of uncinariasis and to that end a series of cases was studied in which the uncinariae expelled were counted after each anthelmintic dose. This, together with manifold other duties, consumed about all the time available from the actual administration of so large a work as the treatment of some 25,000 persons.

From the first, however, our attention was attracted by one case to the immediate and imperative duty of more carefully investigating the urine. This was one in which nephritis occurred during treatment. Naturally, the first

thought was, "Has the new anthelmintic, betanaphthol, said to be at times a renal irritant, anything to do with this condition?" The second, "Is there a latent renal lesion present in the disease?" To determine these facts an additional series of cases were taken and our results follow with conclusions; but before considering these tables a few explanatory remarks should be made:

It was manifestly out of the question, for lack of time, to make complete quantitative urinalyses as we desired. The day was so split up by other work and other investigation that it was decided to elicit certain facts only, and these with great care, so that a definite conclusion could be reached.

It was evident that an examination of the urinary sediment, as well as a determination of the presence or absence of albumin, should be made. In order to offer a series of cases carried far enough to furnish evidence that would be satisfactory, the continued presence of the patients in hospital was necessary, and this was precisely the most difficult part of the problem, as when they felt better they clamored to go back to work and stood not on the order of their going but frequently went, spoiling for us many hours of toil. The original number of such cases is, therefore, reduced to twenty-four. The practical impossibility of obtaining the twenty-four hours' urine and the numerous time-consuming details to which we were obliged to attend personally, prevented us from making urea estimations. One of the occasions at which the urinary examination was needed was that at which purges had to be administered, and with the small force at our disposal collection of all the urine was impracticable. The invariable custom was to examine the urine on the day before and the morning of the day of treatment, before the anthelmintic was given; then the afternoon urine on the day of the specific drug and the morning after. Thus there were two examinations before and two after each administration of the anthelmintic and the samples were faithfully taken at the same time by our trustworthy nurses in the field hospital.

Albumin.—Three tests were always used at each analysis:

(1) The boiling of urine with a drop of two or acetic acid to six parts urine and one part saturated salt solution, the test tube nearly full and the upper half boiled to compare with the un-boiled lower half in a good light against a dark background. We were aware that a very faint clouding could be thus obtained in many normal urines. (2) The ferro-cyanide of potash test. (3) Heller's nitric acid test. When the first was faintly positive and the last negative, a slight trace was noted; when the latter was positive in a faint but characteristic ring, not disappearing on heating, a trace was noted. Only a very few times was albumin found in considerable amount. Ordinarily the amount was so small that its percentage could not have been determined by the Esbach albuminometer. The sediment was collected after

standing some hours in conical test glasses and the urine was not centrifugalized. The casts were generally of the smaller varieties, hyaline and finely granular forms predominating. Blood casts were not seen in this series and epithelial casts were uncommon. Fatty casts were quite often noted. The presence of polymorphonuclear leucocytes was at times discovered before the administration of the anthelmintic, and there was a tendency for them to appear, sometimes in fair numbers, afterwards. Renal cells were not a very marked feature and were almost always scarce.

Urobilin was almost always present, fluorescence by the zinc chloride test being elicited, but it was often remarkably slight.

Peptones in traces were found to be inconstant but often demonstrable.

Indican in abundance, as Siccardi recently states, was a very constant and persistent phenomenon.

Bile pigment was relatively rarely found.

A most interesting fact was the invariable absence of the *dialysis-reaction*, save immediately after the administration of beta-naphthol, in 1- or 2-gm. doses, *when it never failed*. Its presence was demonstrable three to four hours after the dose and its effect lasted five or six hours. The next day it was always absent. When it was present it was beautifully pronounced and was an unfailing evidence of whether or not the drug had been taken. The *color* of the urine was frequently some shade of olive after thymol, a color developing or deepening on standing in the open air. Apparently, beta-naphthol did not affect the color of the urine. The *reaction* was practically always acid, rarely alkaline or neutral, as Calmette found in his cases.

The *specific gravity* tended to be low but almost always increased under medication. *Sugar* was not found to be present.

From the tabulation of the twenty-four cases in which successive urinalyses were made the following condensed statement embraces the essential facts: 18 were males, 6 were females. Seven under fifteen years of age; 12 were between fifteen and thirty; 5 were over thirty. One case expelled no uncinariae, had no symptoms of the disease but expelled 418 oxyurides in two doses of beta-naphthol (all she harbored). Two of the remaining 23 were suffering from a very light form of uncinariasis; 3 from a light grade; 4, moderate; 10, intense; 4, very intense. Thymol was the only drug employed in 10 cases; thymol and male fern in one case; beta-naphthol alone in 13. The total number of doses of thymol was 45 and of beta-naphthol, 62. The dose of thymol was 2 gm. in children, and from 3 gm. to 4 gm. in adults; that of beta-naphthol 1 gm. in children, and from 1 gm. to 2 gm. in adults. These doses were always preceded the night before by sodium sulphate and followed in two hours by the same drug. The anthelmintics were always administered by dividing the dose above mentioned into two equal parts, one given at 8 and the other at 10 A.M. Male fern was given

but twice in this series. These two doses were given successively to the same patient, 2½ and 4 gm. respectively, and resulted in the expulsion of only two uncinariae. The alcoholic extract was used in each instance and it was presumably fresh as it was employed immediately after it arrived by mail from one of the best known pharmaceutical firms in the United States. This was not the only occasion upon which we used male fern, and its failure to expel *Necator Americanus* was observed in several other trials where the preparations of other firms were used. In this particular case this observation was especially interesting as one week after the fruitless administration of male fern only 3 gm. of thymol were given and by this one dose 3,686 uncinariae were expelled from the same patient.

Of the 23 who expelled uncinariae, in 1 case the worms were not counted. In the rest, 9 expelled less than 300 and of these 2 had no



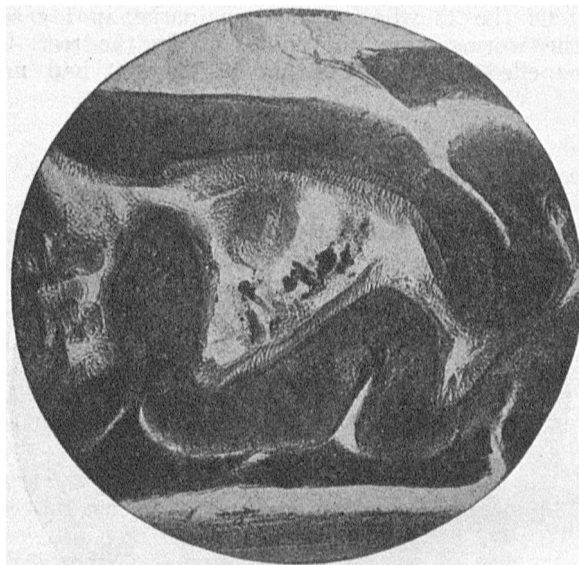
Photographed by Dr. W. M. Gray.

FIG. 2. *Necator Americanus* attached to the human jejunum. x 200 diameters.

albumin in their urine before the administration of the anthelmintic; 5 had a slight trace; 1 a trace; 1 a considerable amount. Eight expelled between 300 and 1,000 uncinariae and of these 1 showed no albumin before treatment; 6, a slight trace; 1 a considerable amount. Three expelled between 1,000 and 2,000 and of these 2 showed a slight trace and 1 a trace of albumin before the drug. Those who expelled more than 2,000 uncinariae (one 2,749; the other 4,397, the largest number expelled in our series of worm counts) gave only slight traces of albumin before treatment, demonstrable solely by boiling.

Of the total of 24 cases, 20, or 83.3%, are seen to have had albumin in the urine before the administration of anthelmintics. One of these cases was not one of uncinariasis and had no albumin nor casts, but developed a very slight trace of albumin under treatment. In 18 of these 20 cases, or 75%, casts were also demonstrated. Generally the casts were very few in

number; in only 6 of the 18 were they at all abundant. The average hemoglobin in those persons showing albumin before the administration of the anthelmintic was 46.1%; that of the 4 who had no albumin before the dose was 80.5%. Sixteen of the 20 cases showing albumin before taking the specific drugs had but a slight trace; 1 a trace; 3 a fairly abundant amount. Albumin increased in amount under treatment in 15 cases and appeared for the first time after the anthelmintic in 4, a total of 19. Albumin did not increase under treatment in 5 cases, although it existed at the beginning. Finally, of the 220 urine records here recited, 118, or 53.63%, showed but a slight trace of albumin; 34, or 15.45%, a trace; 19, or 8.63%, a moderate amount;



Photographed by Dr. W. M. Gray.

FIG. 3. Contents of the intestine of the same worm. $\times 200$ diameters.

and 22, or 10%, much albumin. Twenty-seven, or 12.27%, showed no albumin. Hyaline casts were demonstrated in 133 of these examinations, in 100 of which they were few in number; granular casts in 103, in 71 of which there were few; epithelial casts in 21; fatty casts in 23. Of the 41 records of moderate or much albumin, about two thirds occurred after the administration of anthelmintic drugs.

Conclusions.—Our conclusions are not based alone upon this series of cases, but embrace a much larger number of observations, too scattered to place in tabular form. It is believed that the data contained in the series of 24 cases represent what is generally found before and after the administration of thymol and beta-naphthol.

1. Albuminuria with tube-casts is a very common phenomenon in uncinariasis.

2. It may be present in light or severe cases, more constant in the latter.

3. Albumin is present generally in very slight traces, not discernable by the Heller nitric acid test, but is usually accompanied by a few casts.

4. The casts are generally hyaline, finely granular and fatty; rarely epithelial unless the epithelial cells are very fatty when they are classed as fatty casts. Blood casts are very rare.

5. Albumin may be present in light and heavy infections.

6. Albuminuria with casts in uncinariasis should be regarded as the evidence of a degenerative process in the kidney, not as an inflammation or, more specifically, a nephritis.

7. Both thymol and beta-naphthol can act as renal irritants, especially in the presence of this condition of the kidney.

8. While ordinarily these drugs cause an increase in albuminuria and often bring it about where before it was absent, their effect is temporary, causes no symptoms in the vast majority of cases and is rarely of importance.

9. There is almost always an absence of inflammatory elements after the above-mentioned increase in albumin.

10. Very rarely they may set up a severe nephritis.

11. The cases herein cited show that both drugs seem to have an equal power to increase in albuminuria with tube casts, but our experience over a large number of cases demonstrates to us that, all things considered, beta-naphthol has a very much less favorable action on the kidney and that it is not as safe as thymol for this reason, although its depressant effect is not so marked. Thymol has not, in our experience, caused fatal collapse.

12. Albuminuria does not always seem to depend upon the grade of anemia.

13. Albuminuria and the changes found in the kidney after death may be due to a specific toxin elaborated by uncinariae, but where severe anemia exists such an explanation for the condition is hardly needed.

14. Uremia in Porto Rico is not uncommon, but is rarely seen by a physician and is confused by the jibaros with "nervous attacks" of all kinds, particularly with the very common hysteria major. Epilepsy is not uncommon and we are persuaded that sometimes this diagnosis would suffer a change on examination of the urine. We know of several instances where there was good ground for believing that the attacks were uremic in character.

15. Emphasis must be laid on the fact that the albuminuria of uncinariasis is extremely irregular, coming and going without the slightest apparent reason.

16. Renal accidents from the use of the anthelmintics under consideration are not generally serious and are still more rarely fatal. The great severity of the present epidemic and the high mortality should make us disregard the remote danger to the patient from the use of thymol.

17. The use of beta-naphthol should be restricted to very few doses and its administration should be limited to patients in extreme grades of the disease, on account of its less depressing

effect on the vital centers, until enough uncinariæ are expelled to create a favorable reaction and enable us to use thymol. However employed, a dose of 2 gm. should not be exceeded and no more than three successive doses given, one each week.

In concluding this paper we desire to call attention to the possibilities for scientific investigation in the work which the Porto Rico Anemia Commission is now accomplishing.

The insular government is doing all in its power to conquer the reigning disease of its working classes but for some time this campaign must be vigorously pushed to restore health and to save life. Face to face with an enormous number of sick it would be manifestly impossible to divert funds for the further investigation of the diseases of the island in a well-equipped laboratory, yet such an institution is urgently needed, as none realize more fully than the commission itself. To the honor of the physicians of Porto Rico let it be said that they have equipped themselves with microscopes and a few of the more necessary clinical laboratory instruments, from their own personal resources. This is not confined to one or two but is general among the large number who see the necessity for recourse to so valuable an aid to diagnosis. This fact more than all others demonstrates the active and intelligent interest in medical progress in Porto Rico and bespeaks a spirit which merits support.

There is an aged physician in one of the small towns, all his life a scientist, who has secured a modern microscope from Germany a year ago at great personal sacrifice, that he might keep abreast of the advance of medical knowledge. This physician is now pursuing original investigation under conditions which would infallibly paralyze the ambition of the majority of young men and is setting an example to be emulated by all who bear the title of Doctor of Medicine in this country. The example is followed, however, and there are many who are making splendid use of the microscope in towns of the interior where one would least expect to find an instrument too commonly regarded as only fit for the laboratory.

Were a laboratory for research provided, it would be of incalculable value to the many who to-day have no adequate place where such scientific work can be done; the commission would receive a powerful weapon to advance its ever-widening sphere of action; and perhaps the foundation could be laid for a school of hygiene which would be valuable to American as well as to Porto Rican physicians, which may some day contribute to the knowledge of diseases affecting countries beyond its shores.

When we reflect on the real state of affairs, when we ask ourselves the question, "Where did ninety-nine of a hundred physicians practicing in the tropics receive their medical education?" we begin to see where the difficulty lies. Whether a man is an American or a Spaniard he has usually studied his profession in northern climates. The diseases seen in his clinical course

were those of temperate zones and he is apt to explain the phenomena of disease according to the light he received.

There should be some way of acquainting American and Porto Rican physicians with special features of preventable disease in that island where such efforts are being made to carry the principles of the science of medicine into practice.

As it is, men who are not satisfied to trust to tradition to solve the problem arising in their professional life grope aimlessly about for some center where they may work out for themselves, or have worked out, those facts which alone can be resolved in a well-appointed laboratory.

Such a center, by interesting all physicians who come in contact with the poor on the one hand and local officials on the other, would be able to carry the authority derived from facts and figures into their great task of sanitary reform.

THE EFFECT OF INDUSTRY ON HEALTH.*

BY WILLIAM C. HANSON, M.D., CAMBRIDGE.

THE recent investigation of health conditions of industrial life by the State Board of Health of Massachusetts is the first definite step in the development in America of industrial hygiene. For this step credit belongs to the promoters of the necessary legislation, to the legislatures of 1904 and 1905, to our efficient State Board of Health, but most of all to the secretary of the board.

No legal provision was made requiring the employment of scientific men for the investigation, but Dr. Charles Harrington, realizing the importance of preventive medicine and, therefore, of encouraging specialization in sanitary work, saw that just as an expert may trace typhoid fever to a polluted water supply of a workshop, so one versed in medicine and hygiene may trace chronic lead poisoning to improper devices for the removal of lead fumes from furnaces containing kettles of molten lead. In fact, Dr. Harrington even went so far as to announce to one of his classes in hygiene in the Harvard Medical School that only graduates of medicine or those receiving degrees on Commencement Day would be eligible for the work.

Moreover, no legal provision was made for the careful consideration of conditions from a commercial point of view in connection with the hygienic investigation, yet one of the points insisted upon by the secretary of the board was that no injustice should be done to employers.

In short, an attempt has been made to establish the factory inspection work on a scientific basis. In order to do this, it has seemed clear to the State Board of Health that special pains should be taken to assure the employers that the work is not only free from anything underhanded, but that it is of such a nature as to enlist their hearty co-operation.

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