PHRYNODERMA : A CONDITION DUE TO VITAMIN DEFICIENCY

By LUCIUS NICHOLLS, M.D., B.C., B.A. (Cantab.)
Director of Pasteur and Bacteriological Institutes, Ceylon

THE symptoms, pathology, course and complications of such deficiency diseases as pellagra, beriberi, and scurvy are well defined, even if the final details of their ætiologies have not been decided. But these are conditions which are familiar to many medical men who work among the indigent classes of the tropics and to which they refer by such indefinite terms as marasmus, malnutrition, deficiency dermatoses, diarrhœa and dysentery due to bad food.

Many years ago in East Africa I was concerned medically with gangs of African labourers working on the construction of the Magadi Railway and the Magadi Soda Factory. These labourers were recruited from their villages, more or less as indentured labour, for a period usually of three months. The healthy only were recruited. They arrived with healthy shining skins. They worked hard for long hours building embankments, etc. The majority of them were fed on maize meal only, it was called *poocho*, and there were few, if any, means by which they could augment this diet.

(*Continued from previous page*)

descending part of the duodenum. The right testis hangs a quarter of an inch lower than the left.

We have not found any antero-posterior transposition of the viscera. Such a specimen showing general transposition of the viscera with a tricoelian heart described by Adrian Stokes, of Trinity College, Dublin, in the *Journal of Anatomy and Physiology*, 1909, page 301, is of particular interest. A newly born, well-developed male child lived only for a few minutes and died in spite of artificial aid. On post-mortem examination, it was found that in addition to the general transposition of the viscera in the lateral plane, there was also antero-posterior transposition only with regard to the ascending aorta and the stem of the pulmonary artery, so that the ascending aorta was situated in front and to the left of the pulmonary artery. The heart showed only three chambers, two auricles and a common ventricle. The common ventricle was divided by an incomplete septum into two unequal parts, a large right and a small left. Both the aorta and the pulmonary artery opened into the left part of the ventricle, whereas the right part communicated with the pulmonary (right) auricle through the auriculo-ventricular orifice. The pulmonary (right) auricle communicated with the systemic (left) auricle through the foramen ovale and the systemic auricle had no direct communication with the common ventricle.

Within a few weeks their skins lost the natural gloss, and a close inspection showed dry goose skin due to enlargement of the sebaceous glands. They became emaciated, the papules of the skin enlarged, and the epidermis became dry and furfuraceous, a mild form of neuritis was common among them, diarrhœa set in and in many cases was soon followed by death. A similar disease was prevalent among the porters of the Carrier Corps during the war in East Africa. Such a term as marasmus, general debility or dysentery was considered a sufficient description of the cause of death.

I think this picture will be familiar to others who have had experience of gangs of improperly-fed native labourers.

Recently I inspected a jail with a population of over 1,500 prisoners where there was an outbreak of a skin eruption, often accompanied by signs of neuritis, xerophthalmia or keratomalacia, and diarrhœa or dysentery.

There were 87 patients in the prison hospital and the majority of them had papular dry skins. There were 19 in the advanced stages of this, all had diarrhœa or dysentery, and neuritis in a mild or advanced form, and 11 of them showed signs of keratomalacia.

The medical officer stated that the patients did not usually recover from this advanced condition, and that it was customary to consider that death was due to dysentery.

This preliminary inspection indicated the necessity for detailed enquiry into the conditions existing in the prison. The prison authorities kindly supplied the following table of statistics:

TABLE I

*Death rate and sick rate in the prison**

	Daily average sick		Daily average number of prisoners in jail		Deaths in prison hospital	
	Prison hospital	Prison dispensary	Convicted	Unconvicted	Dysentery	Other diseases
1931 ..	75.92	92.4	1,220.4	37	26	28
1932 ..	97.8	120.4	1,463.8	47	40	21

* Needless to state executions are not included in the above statistics (table I).

The sick rate is high and this is reflected in the death rate of 43 per 1,000 for 1931 and 40 per 1,000 for 1932.

The true death rates are higher than these figures indicate, because prisoners who are suffering from incurable diseases and are considered likely to die are sometimes pardoned and discharged to their homes. During 1932 nineteen prisoners were medically boarded for this purpose and recommended for discharge, but, before

effect could be given to this, six died; the remaining 13 were discharged. Furthermore, the aged and infirm are not retained at this prison, but are sent to a small prison at Negombo.

The death rate in Ceylon for the ten years 1921—1930 was 26.2 per 1,000. But the death rate for the Western Province, in which the prison is situated and where malaria is not prevalent, has always been less than this, and in 1932 it was 16.8 per 1,000.

The death rate of a general population is largely determined by infant mortality and the deaths of the aged; both these factors are absent from this prison, and therefore the death rate should not be more than half that of the surrounding population. Thus the death rate in the prison is at least 5 times as high as it should be.

The enquiry was especially directed to skin diseases, neuritis, eye diseases, diarrhœa and dysentery. The medical officer supplied the following table showing the number of prisoners who were treated for these symptoms in 1931 and 1932 :—

Table II

		1931	1932
Dysentery.			
Prison hospital.	Amœbic	38	41
	Bacillary	248	476
	Others	288	246
Dysentery and diarrhœa.			
Welikada jail. ..		8,359	15,874
Eye diseases.			
Prison hospital. .. (Keratitis and corneal ulcer.)		79	99
Welikada jail. .. (Eye diseases.)		1,837	5,866
Skin diseases.			
Prison hospital. ..		237	151
Welikada jail. ..		1,928	7,261
Neuritis.			
Prison hospital. ..		5	41
Welikada jail. ..		1,872	2,397

Although these statistics show the surprising incidence of these conditions, they are even more prevalent than these figures indicate because the diagnosis is given on the predominant symptoms only. For instance the patients in hospital with advanced dry skin, neuritis, keratomalacia and dysentery are considered to be suffering from dysentery and the other symptoms do not appear in the returns. Twenty-one patients being treated for marked keratomalacia were examined, and every one showed signs of papular dry skin.

Examination of working prisoners for papular dry skin and keratomalacia

The method of examination was to line up the prisoners and examine each one and call out the result which was written down by the apothecary of the prison hospital. The prisoner then passed to the apothecary who noted down the date when he entered prison; in this way all bias from a knowledge of the length of time each person had been in prison was avoided. Some of those of the first gangs which were examined complained of burning sensations in the hands and of numbness, tingling and weakness in the legs; others complained of dimness of sight and other symptoms referable to the eyes. But an enquiry into the subjective symptoms of prisoners is an arduous procedure pregnant with error, therefore it was avoided.

The various gangs of prisoners examined were, (*a*) in the remand jail where they sometimes remain for several months; (*b*) working in the coir fibre sheds; (*c*) working in the carpentry shops; (*d*) working in the laundry.

In the following table (table III) the patients are placed in one of four categories :—

Category I includes those who have been in the prison for less than one month.

Category II includes those who have been in the prison for more than one month and less than one year.

Category III includes those who have been in the prison for one year to 1½ years.

Category IV includes those who have been in the prison for more than 1½ years.

Table III

	Total examined	Papular dry skin	Papular dry skin and keratomalacia	Keratomalacia only	Skin and eyes more or less healthy	Percentage showing papular dry skin and/or keratomalacia
Category I	138	10	*Nil*	*Nil*	128	7.2
„ II	189	100	11	*Nil*	78	58.7
„ III	38	22	2	2	12	68.4
„ IV	111	32	11	2	66	34.6

Prison dietary

Unconvicted prisoners are placed in the remand jail, and their daily diet is as follows :—

Rice, 22 ounces.
Fresh fish, 2½ ounces, 1¼ ounces when cooked.
Or Dried fish equivalent in weight of fresh fish.
Plantain, 2 ounces.
Vegetables, 2 ounces.
Sugar, ½ ounce.
Coconut, ½ ounce.
Lime, ½.
Onions, ½ ounce.
Chillies, 2.
Pepper, 1/10 ounce.
Salt, ¾ ounce.

A prisoner after conviction is placed upon a diet known as penal no. 1 for the first 14 days of his imprisonment. Penal no. 2 is served to him for the next 14 days. Thereafter for 11 months he receives ordinary no. 1. After he has served for one year he receives ordinary no. 2 for the remaining period of his sentence.

The following are the diets :—

Penal no. 1

Bread, 4 ozs.
Rice, 18 ozs.
Vegetables, 4 ozs.
Coconut, ½.
Lime, ½.
Pepper, 1/10 oz.
Salt, ½ oz.

Penal no. 2

Bread, 4 ozs.
Rice, 18 ozs.
Plantain, 2 ozs.
Vegetables, 2 ozs.
Dhall, 2 ozs.
* Jaggery, ½ oz.
Coconut, ½.
Lime, ½.
Onions, ½ oz.
Chillies, 2.
Pepper, 1/10 oz.
Salt, ¾ oz.

Ordinary no. 1

Bread, 4 ozs.
Rice, 18 ozs.
Fish, 2½ ozs.
Plantain, 2 ozs.
Vegetables, 2 ozs.
Dhall, 2 ozs.
* Jaggery, ½.
Coconut, ½.
Lime, ½.
Onions, ½ oz.
Chillies, 2.
Pepper, 1/10 oz.
Salt, ¾ oz.

Ordinary no. 2

Bread, 4 ozs.
Rice, 18 ozs.
Beef or liver, 2 ozs.
Fish, 2 ozs.
Plantain, 2 ozs.
Vegetables, 2 ozs.
Dhall, 2 ozs.
* Jaggery, ½ oz.
Coconut, ½.
Lime, ½.
Onions, ½ oz.
Chillies, 2.
Pepper, 1/10 oz.
Salt, ¾ oz.

* Palm sugar.

The following table gives the constituents of the three meals a day for the four diets :—

Meal	*Penal no.* 1	*Penal no.* 2	*Ordinary no.* 1	*Ordinary no.* 2
Early morning ..	Bread and cunjee, 4 ozs. (Rice gruel).	Bread and cunjee, 4 ozs. Jaggery.	Bread and cunjee, 4 ozs. Jaggery.	Bread and cunjee, 6 ozs. Jaggery.
Mid-day ..	Rice and vegetables.	Rice and vegetables.	Rice and vegetables.	Rice and vegetables. Beef, 1¼ ozs.
Evening ..	Pepper water which is made by boiling pepper, salt and tamarind in water.	Rice and vegetables, 8 ozs.	Rice and vegetables, 8 ozs. Fish, 2 ozs.	Rice and vegetables, 6 ozs. Fish, 2 ozs.

The monotony of these diets is somewhat varied in practice, as follows :—

Ordinary no. 1

Mondays—2 ounces of red onions, no fish.
Tuesdays—2½ ounces of fresh fish.
Wednesdays—2 ounces potatoes.
Thursdays—dried fish.
Fridays—2½ ounces of fresh fish.
Saturdays—dried fish.
Sundays—2 ounces potatoes, no fish.

Ordinary no. 2

This is the same as the above, but 1½ ounces of cooked meat is given every day except Friday.

The vegetables consist principally of the following :—One of three varieties of pumpkin is supplied twice a week, and a variety of the following is supplied, according to which are in season, on the other five days :—cucumber, brinjals, snake gourds, jack fruit, bread fruit, bandakka, or drum sticks. Cabbages, tomatoes, spinach and beans have been supplied very occasionally, about once in three months, according to the cooks' statements.

The quantity and quality of the vegetables is such that the diet cannot contain much fat-soluble vitamin. It is probable that there is also a deficiency in B_2.

The penal diets nos. 1 and 2 are particularly deficient. One green plantain weighs between 3½ to 6 ounces and when skinned weighs 2 to 4 ounces. Therefore the amount of vegetables served to each prisoner daily is about the equivalent of one plantain or less.

Most of the prisoners come from the indigent classes, among whom papular dry skin and keratomalacia is not uncommon; therefore it is not surprising, when after conviction they are placed on these diets, that they soon show signs of vitamin deficiency, for the reserves of vitamins in their bodies cannot be high.

Ordinary diet no. 1 differs from the penal diets principally by the addition of a small amount of fish. White fish is usually supplied and this contains very little vitamin A or D (McCarrison, 1921).

The prisoners who have been in prison more than 18 months are less affected than those who have been imprisoned for a shorter period. Probably the addition of the beef which is supplied in ordinary diet no. 2 accounts for this. And this diet may be sufficient to maintain a

person in a fair state of health provided he is not given very hard work.

Overcrowding.—The cells and corridors were built to accommodate fewer prisoners than are in the jail at present. There is some overcrowding of the floor space at night, but this is mitigated by the great height of most of the corridors.

THE SYMPTOMS

Papular dry skin.—This commences with the appearance of minute, hard papules, and the surface of the skin becomes dry and loses its natural gloss. The eruption may be irritable and the patients rub and scratch the skin. The papules may occur on any part of the body, but they are particularly liable to occur on the thighs, the extensor surfaces of the arms near the elbows, the abdomen and across the shoulders. They are less common on the face, neck and anterior surface of the chest.

The papules enlarge and many of them become very dark in colour. When examined with a lens the apex of a papule is seen to have a small crater-like opening often with minutely fissured sides. When a papule is squeezed with forceps a dense somewhat-translucent sebaceous material exudes; in some cases this material cannot be squeezed out without incising the papule.

In the later stages the natural fissures of the skin increase in depth and width, and still later the whole skin of the body becomes very dry and furfuraceous, and the papules stand out with dark pigmented areas around them.

The papules do not tend to suppurate, but a dry form of skin sepsis may take place, when hard dry thin scabs form over and around the papules. Removal of a scab leaves a very superficial excoriation of the skin.

The papules are enlarged sebaceous glands plugged with altered sebum. The papules in some cases appear to spread laterally, producing sub-angular, slightly-raised flattened areas of smooth epidermis, contrasting with the surrounding accentuated fissures of the skin; the centres of the areas show the openings of the gland ducts, possibly this is a process of recovery.

In some cases the furfuraceous dry skin is more marked than the eruption of papules, but the latter can always be seen by a close inspection.

The diagnosis of the papular dry skin must be made from scabies and acne.

It is liable to be mistaken for scabies in those patients where there is itching. The distribution of the two conditions is different, scabies occurs between the fingers, on the front of the elbows, around the nipples and on the buttocks; it is seldom so widely spread as the condition of papular dry skin. Scabies is at first vesicular, and later becomes pustular, and the eruptions due to the sepsis and scratching are not as dry as in papular dry skin.

In acne the itching is more or less absent, and the material squeezed from an acne papule is white, opaque, and caseous in contrast to the somewhat translucent material of papular dry skin. Well-developed acne sooner or later becomes papular, and the sepsis often spreads around the base of the affected gland and forms a small abscess. But this I have not seen in papular dry skin.

Some of the prisoners had pyosis, that is a septic condition of the hair follicles, its commonest site is on the extensor surface of the legs below the knee. It cannot be mistaken for papular dry skin.

The photographs reproduced here are from two early cases and one later case. Many of the papules were darker than these photographs indicate.

Keratomalacia, due to vitamin-A deficiency, is well known in Ceylon. It has been described from India, Africa, and other countries, and I read in the limited references available that it usually starts as a xerophthalmia.

The course of the disease in the prison appears to be as follows :—It starts by injection of the vessels running from the inner and outer canthi of the eye to the cornea; and the redness of the vessels stands out in marked contrast to the whiteness of the sclerotics; at the same time yellowish thickenings occur where the vessels disappear at the corneal-sclerotic junction.

The next change is the appearance of pinpoint opacities in the cornea; these increase in size and may become two or three millimetres in diameter. Then the opaque areas ulcerate, and if the ulcers do not heal they become extensive and hypopyon develops, and finally the anterior chamber and cornea become disorganized and permanent blindness follows.

Before the opacities of the cornea have appeared many of the prisoners complain of dimness of vision and even of blindness. The visual symptoms must be due to the deficiency affecting other parts of the eye than the cornea.

Neuritis.—Table II shows that the diagnosis of neuritis was made in the cases of 41 patients admitted to the prison hospital (apart from those with dysentery and neuritis) and 2,397 patients attending the prison dispensary in 1932.

All the patients in the hospital who had advanced papular dry skin, wasting, diarrhœa and dysentery showed signs of neuritis, and in several cases it was so advanced that the patients were unable to stand. But many of the dispensary patients have subjective symptoms only, namely a burning sensation of the hands, and weakness, numbness and tingling of the legs. The more advanced cases showed absence of knee jerks.

Photographs taken from prisoners who were working

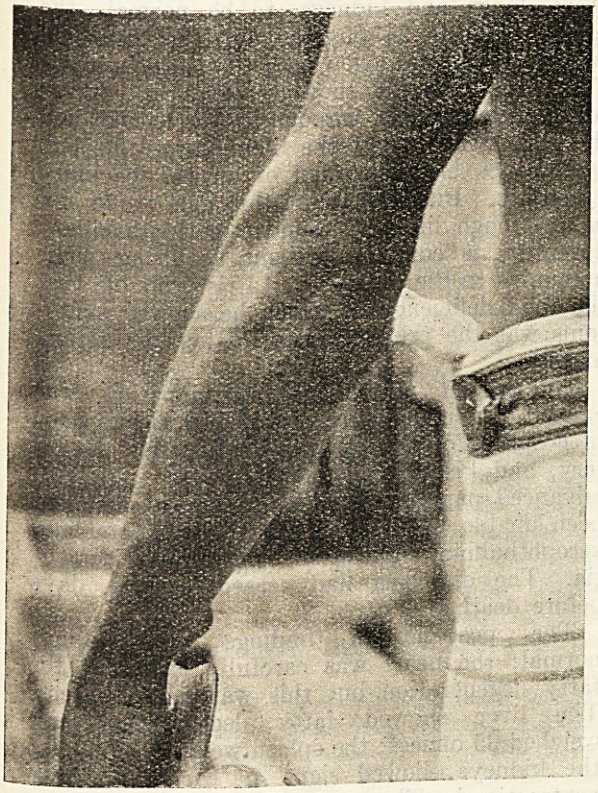

Fig. 1
Earliest stage

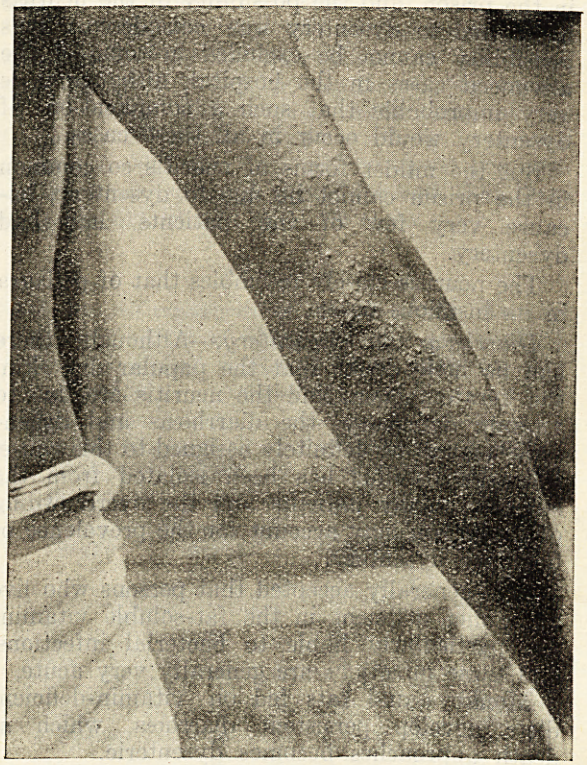

Fig. 2
Early stage

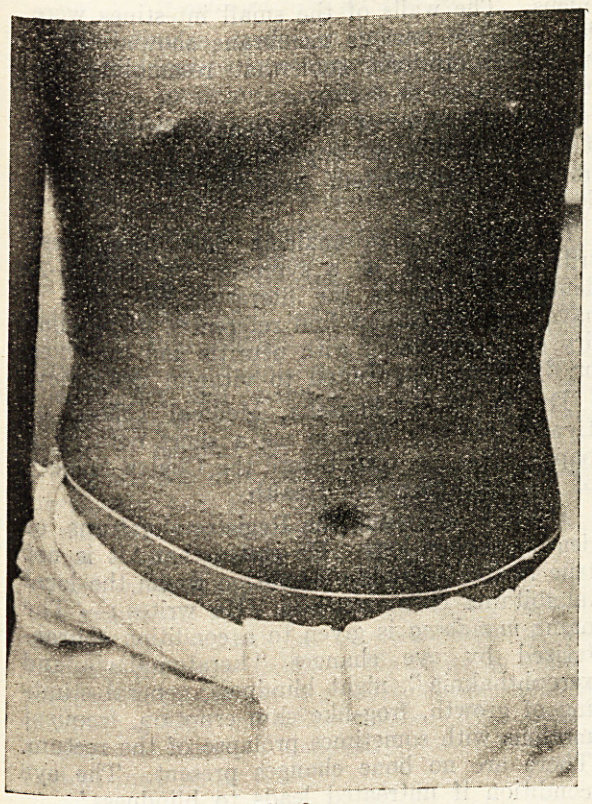

Fig. 3
Later stage

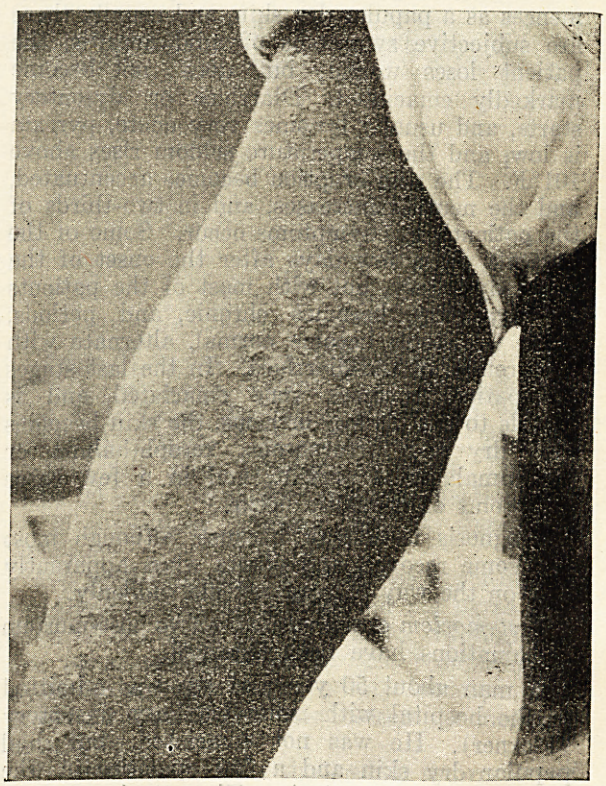

Fig. 4
Later stage. (Inner aspect of thigh)

Bacillary dysentery is a prevalent infection in the prison, and the possibility of the neuritis being due to dysentery was considered. This possibility cannot be excluded in some of the advanced cases in the hospital, although it is very improbable that such a complication of dysentery would occur in all these cases.

But the milder forms of neuritis so common in the prison cannot be due to dysentery, because very few of the patients had had dysentery.

The neuritis closely resembles that of pellagra in its insidious onset.

Diarrhœa and dysentery.—Although there can be little doubt that the papular dry skin, the keratomalacia, and the neuritis are due to vitamin deficiency, the diarrhœas and dysenteries cannot be definitely assigned to this cause. Flexner's bacillus has been isolated from the stools of many patients and the overcrowding of the prison may account for the prevalence of bacillary dysentery.

It is generally accepted that persons who live on a diet deficient in the fat-soluble vitamins are particularly liable to bacterial infections, and these infections are generally very acute.

Monkeys and rats fed on vitamin-deficient diets develop persistent diarrhœa, which as death approaches becomes dysenteric.

One of the three cardinal signs of pellagra is diarrhœa.

The course of the disease.—The disease commences as a papular dry skin, and usually there are subjective symptoms of mild neuritis, the patient loses weight, but does not become markedly emaciated. Diarrhœa or dysentery starts, and usually becomes very acute, pyrexia is low, and the temperature seldom rises above 101°F. The skin eruption becomes accentuated, and the neuritis increases, and in two-thirds of the patient's eye symptoms occur. Some of the patients die a few days after the onset of the acute dysentery, but with most of the patients the dysentery becomes chronic, and periods, when the stools become normal, alternate with recurrences of the diarrhœa. In the last stages the patient becomes very emaciated, and is unable to use his legs or arms, the skin becomes very dry and furfuraceous, xerophthalmia or keratomalacia is present, and in a few cases symptoms of dementia occur.

Prognosis is difficult because, although most die, some recover, and others when apparently well on the way to recovery die suddenly.

Post-mortem examinations.—Two post-mortem examinations have been obtained.

A man about 50 years of age was admitted to the hospital with acute bacillary dysentery (Flexner). He was not emaciated, but had papular dry skin and a few opacities in the eyes from keratomalacia. The attack was fulminating and he died in five days.

The post-mortem examination showed the heart, lungs and kidneys to be normal, the spleen weighed 3¼ ounces and the liver 40 ounces, the latter showing fatty degeneration. The large intestine showed advanced diffuse coagulative necrosis throughout its length, and the last two feet of the ileum was affected. Obviously this man died of acute bacillary dysentery. But a man of this age would not pass through life in a country where bacillary dysentery is common without acquiring some immunity to the disease, and it is probable that the food deficiency of which he showed symptoms was the primary cause of his loss of immunity.

The second post-mortem examination was carried out on the body of a man who had been in hospital for six weeks. He had had dysentery, and his later symptoms were diarrhœa, advanced papular dry skin, neuritis—he had been unable to stand or feed himself, and had xerophthalmia, emaciation, and signs of dementia. The diarrhœa had ceased several days before death.

The post-mortem findings were :—lungs normal; the heart was carefully examined for fatty degeneration but this was not apparent. The liver showed fatty degeneration and weighed 35 ounces; the spleen weighed 3 ounces; the kidneys showed signs of early 'granular contraction'. There were areas in the large intestine where dysenteric ulcers had healed, but the rectum contained formed fæces free of mucus. The walls of the small intestines were thin and the mucous membrane showed slight superficial erosions, somewhat resembling the condition seen in pellagra.

Had the history of the patient been unknown, it would have been impossible to have stated from the post-mortem findings the cause of death.

Discussion.—Keratomalacia has been described frequently as a symptom of vitamin-A deficiency. But in the literature to which I have access I cannot find references to papular dry skin, associated with neuritis and diarrhœa or dysentery, attributed to vitamin deficiency.

Dr. D. C. de Fonseka, Medical Officer of Health, recently sent to me a short note on a paper which he read before the Ceylon Society of Medical Officers of Health.

He was discussing the Registrars' returns of deaths from rickets. He states that 'it is not true rickets', but is a condition which the local inhabitants call *mandama*. He writes :—'The name *mandama* is given to a condition characterized by eye changes "keratomalacia and xerophthalmia", night blindness, general stunting of growth, frog-like skin eruption, frequent motions with sometimes prolapse of the rectum. There are no bone changes present. The eye condition if untreated leads to blindness'.

(Continued at foot of opposite page)

A NOTE ON THE VALUE OF THE ASCITIC FLUID FOR THE WASSERMANN REACTION AND AGGLUTINATION TESTS WITH DYSENTERY ORGANISMS*

By M. V. RADHAKRISHNA RAO, M.B., B.S.
Research Fellow, Andhra University
(*From the Department of Pathology and Bacteriology, Medical College, Vizagapatam*)

THE material in this paper was collected during an investigation into the causation of ascites (Radhakrishna Rao, 1932) and subsequently during a study on decompensated portal cirrhosis, in the medical wards of the King George Hospital, Vizagapatam.

In all the patients who were admitted with ascites into the medical wards of the King George Hospital, Vizagapatam, the Wassermann reactions and the agglutination tests (with dysentery organisms), of the blood and ascitic fluid, were done as a routine, in addition to the other investigations. This short note is based on a study to find out how far the results obtained with ascitic fluid are valuable in these tests, as compared with those obtained from the blood serum.

The results are summarized in tables I and II. In most of the cases specimens of the blood and the ascitic (aseptically drawn) were taken for examination at the same time; while in the others, there was only a short interval between the examination of the blood and the ascitic fluid.

It will be seen that out of the 60 cases, in which the Wassermann reactions of the blood and the ascitic fluid are compared, the results of the latter tally exactly with those of the former in 37 cases. However, if the ++ and + results and the (±) and —ive results, respectively, are grouped, it will be seen that there is agreement in 51 out of 60 cases.

TABLE I

Showing the comparative results of the Wassermann reaction of the blood and ascitic fluid. [++ = *strong positive;* + = *positive;* (±) = *doubtful;* — = *negative*]

BLOOD WASSERMANN RESULTS IN GROUPS		ASCITIC FLUID RESULTS OF EACH GROUP	
Result	Number of cases in group	Result	Numbers in group
++	31	++	19
		+	7
		(±)	1
		—	4
+	12	++	5
		+	6
		(±)	1
		—	0
(±)	3	++	1
		(±)	1
		—	1
—ive	14	++	1
		+	1
		(±)	1
		—ive	11
TOTAL	60	..	60

Table II, given below, shows that out of the 53 cases in which the results of the agglutination tests (with dysentery organisms) of the blood and ascitic fluid are compared, 22 cases showed the same reaction in both. Out of these 22 cases, 16 showed negative reaction both to *B. dysenteriæ* (Shiga) and *B. dysenteriæ* (Flexner).

Out of the 31 cases in which the agglutination reactions of the ascitic fluid did not agree with those of the blood, 5 gave a higher reaction than the blood serum, while in the remaining 26 cases the reaction was in a very low titre compared to that of the blood serum, or negative altogether.

It will thus be seen that, while the results of the Wassermann reactions of the ascitic fluid compare favourably with those of the blood

(*Continued from previous page*)

The disease occurs in young children, and although neuritis is not mentioned it is probably the same condition as occurs in the prison.

It appears to me that some name is required for this disease. The name *mandama* (pronounced märndärmär) is almost synonymous with marasmus and therefore is unsuitable.

Dr. Fonseka's mention of a 'frog-like skin eruption' at first puzzled me, because a frog's skin is soft and smooth. Apparently it is a native description of the eruption, and in translating it into English, he has used the word frog, when it should be toad. The skin of a toad is dry and 'papular', and the feel and appearance of it are very similar to the later stages of papular dry skin.

The disease may have been definitely named previously, but, if it has not, I propose to call it phrynoderma (φρυνη a toad), and to define it as :—'A papular dry skin eruption frequently accompanied by a mild neuritis and (or) eye symptoms such as night blindness, dimness of sight, xerophthalmia, or keratomalacia; the patients are very liable to diarrhœa or dysentery, when this occurs the neuritis becomes more marked; a high mortality results. The disease is due to vitamin-A deficiency, but other food factors may be at fault'.

*Rearranged by Editor.