NOTES, COMMENTS AND ABSTRACTS

FOOTPRINTS AND FEET OF NATIVES OF THE SOLOMON ISLANDS

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THE footprint of a savage in the sand has always been a thing of interest, from our earliest reading up to present-day study of orthopædics. Lack of roads in two of the islands where I have worked has made the beach the main highway; and material for the investigation of footprints has been plentiful.

The ones studied in this paper are mostly those of natives of the island of Malaita, a virile, wild, and aggressive type of Melanesian who rarely goes far without his big knife, axe, or club. The group is unselected and consists of normal average natives—e.g., visitors, passers-by, convalescents from minor troubles, labourers, and so on. The method of taking the prints was to seat the subject on the edge of the table and to paint his soles liberally with black paint. Supported by each arm, he stepped cleanly down on to a sheet of paper. Standing there, he was told to make as big a print as possible. This he did by bending his knees and giving a jab downwards on to the paper. This manœuvre encouraged relaxation of his muscles and voluntary depression of the arches of his feet, if depressible. He was lifted back on to the table, and the paint was removed with kerosene.

In considering these footprints, I must state first of all that among the population generally there is neither foot-gear nor flat-foot. My work in these regions extends over ten years.

The footprint of a native is often as characteristic of the man as is his face. Not only is his foot, untrammelled by shoes, put down in its own way, but also the depredations of yaws, tropical phagædenic ulcer—both universal—and fungus infections of the sole make it further characteristic by loss of a toe or by contractures and deformities following ulcers.

COMPARISON OF EUROPEAN AND NATIVE FOOTPRINTS AND FEET

The *longitudinal arch* exists in both European and native races and is a definite fixed part of the anatomy. Although it can easily be increased by pushing down the anterior part of the foot, it cannot be depressed either voluntarily or passively, with the foot and leg in complete relaxation even under an anæsthetic, by manipulation with the hands.

D1, a normal native, selected only because of his willingness to coöperate, was given an anæsthetic. When he was deeply under, a print was taken of his flaccid left foot. A similar print was taken of his right foot, pressure being applied with all the force that I could exert, but the arch remained as before (fig. 1, D1 (normal) and N4 (under anæsthesia) and fig. 2).

The tuberosity of the navicular bone varies little, whether the foot is merely resting relaxed on the ground or the whole of the body-weight is pressing on it, the other foot being raised from the ground.

This finding is opposed to the view that there is no fixed arch in "primitive races who have never worn boots or shoes," and "the arch of the foot . . . is a contracture deformity almost universally acquired by civilised people as the result of cramping their feet in boots and shoes" (Bankart 1935), and that "it is the fixation of the arch . . . that we regard as unnatural," and "it is the mobility of the arches which is of most importance" (Bankart 1938). Likewise Wiles (1938) expresses the opinion that the normal foot "can relax into the 'flat' position." On the other hand, it is in agreement with Bruce and Walmsley (1938), who, from examinations of fœtal feet, conclude that "the human foot possesses a well-defined structural longitudinal arch." They could not agree that the mobility of the foot, as mentioned above, is the all-important factor.

Some differences between the feet of Europeans and natives.—A native's foot is more massive and broader, especially in the male, and lacks the "elegance" (usually pathological) of a European's foot. The sole is well padded, and the skin is thick where contact is made with the ground. (Under the arch the skin is not thickened.)

The toes of a native are straight, lie parallel with the ground, and are spread out so that the inner and outer borders of the feet are two straight lines. In fact, all the toes lie in lines radiating from the centre of the heel. Occasionally the great toe is abducted, so that the inner border of the foot is concave medially and the other foot has to "step over" the great toe. The differences are evident in fig. 3, where the footprint of a normal shod European is superimposed upon that of a native.

On wet slippery ground, where a European's foot would meet with disaster, a native's foot remains firm. The footprint shows deep toe-prints where the toes have been pushed into the ground to get a good hold. Even on the beach the toeprint is deep, because a native uses his toes in walking more than a European does. The final push-off is from the toes. His powers of flexion resist any effort of mine to straighten his toes.

When the prints are superimposed (fig. 3), the outer border of the heel and the prominent base of the fifth metatarsal being taken as a base line, it will be seen that the anterior part of the native's foot is swung inwards—adducted—with a hinge mid-tarsally. This is confirmed by measurements:—

(1) A line from the middle point of the heel posteriorly to the front of the print of the ball of the great toe is shorter in a native's foot when compared with a line from the heel to the ball of the little toe than is the corresponding line of a European's foot similarly compared.

(2) A line drawn across the foot from the front of the ball of the great toe to a similar place in front of the ball of the little toe, when joining the line along the lateral border of the foot, makes a smaller angle in a native's foot than in a European's foot.

(3) In the hollow of the footprint a transverse line, drawn behind the ball of the great toe and meeting a line drawn from the heel along the inner border of the footprint, makes a smaller angle in a native's foot than in a European's foot. (This angle can be drawn accurately only in some feet.) However, in a European's foot this inner border of the print tends to be a wide curve rather than the angle seen in so many footprints of natives (see fig. 4).

(4) The increased prominence of the base of the fifth metatarsal (fig. 1) in so many footprints of natives is partly due to this medial swing of the fore part of the foot.

The most obvious difference between the two footprints as seen on the beach is that the European's foot is always turned out to various degrees when walking. If a European places his footprints in alignment with those of a native he feels that he is

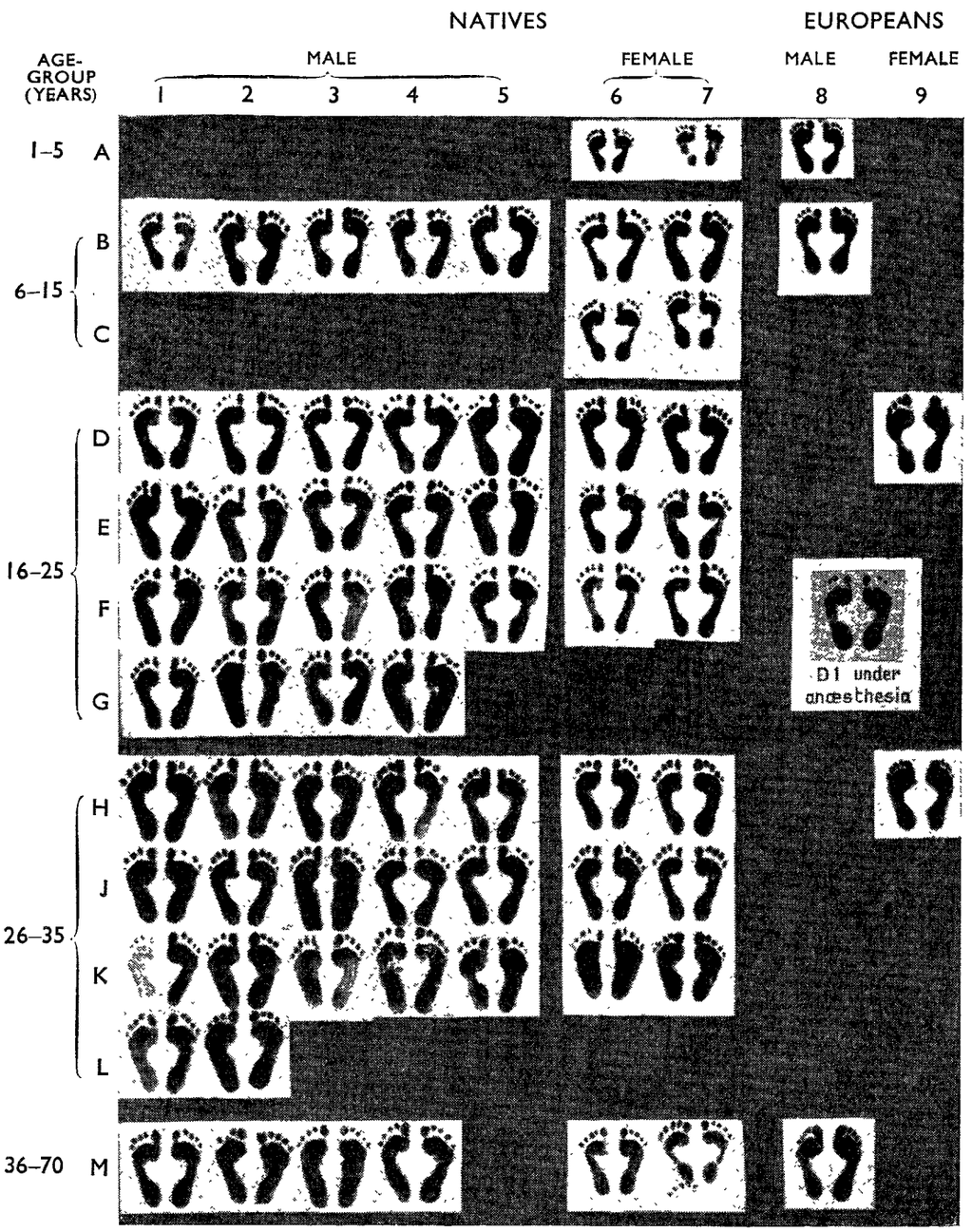

FIG. 1—Footprints of 65 natives of the Solomon Islands and 5 Europeans, arranged according to sex and age. D1's footprints under anæsthesia are seen on the right. Under full anæsthesia the left footprint was taken by bending the knee and placing the blackened foot on paper. The same was done with the right foot and a strong force was applied in an attempt, which failed, to obliterate the longitudinal arch.

FIG. 2—Feet of D1 (see fig. 1). The arch and general contour of the feet are shown. The strong toes of the right foot are flexed and gripping the table.

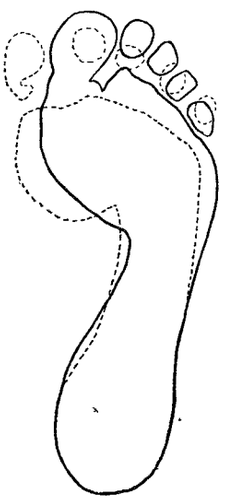

FIG. 3—Footprint of a normal shod European (M8 in fig. 1), shown by continuous line, superimposed on that of a native (D1 in fig. 1), shown by interrupted line. The swing medially of the fore part of the foot and the wide spread of the toes, each lying in the line of its metatarsal bone, are obvious in D1.

walking very "pigeon-toed." A native's foot has its inner border pointing straight ahead, with slight variations one way or the other.

Where a European's footprint shows a "waist," the outer border of a native's foot often shows a projection. This is at the prominent base of the fifth metatarsal. In a European's foot there is a slight bony arch laterally (Bruce and Walmsley 1938), whereas in a native's foot there is none. This corresponds to the fact that the tuberosity of the navicular on the inner side of the foot is lower by ½ in. than in a European's foot as measured by Bruce and Walmsley.

Further points in the examination of the foot itself.—The female foot, being less massive than the male, is the more easily examined. Its mobility and pliability are most noticeable; in fact, the only fixed thing is the longitudinal arch. All the other joints can be moved separately. The line of the heads of the metatarsals, where the presence of an arch has been disproved by Bruce and Walmsley (1938), can be freely bent transversely either convexly up or down to an equal degree. This part of the foot in a young woman aged 19 could be increased ¾ in. in width merely by gentle digital traction of the heads of the first and fifth metatarsals. Further evidence of this pliability is the way in which the foot spreads out over the ground when the body-weight is put on to it. Also, though the sole is usually thick, some prints (fig. 1, E3 and M7) show evidence of two lines of flexure in the sole, one behind the metatarsal heads and one in front of the heel. This flexibility makes the foot very adaptable. Whatever the nature of the ground, the native walks with ease—e.g., a European treading on a pebble with a diameter a third of the width of the foot

treads only on the pebble, whereas a native's foot "flows" all over and round the pebble and adapts itself to it unconsciously and without discomfort, the sole making contact with the ground behind and on the sides, and the toes in front.

At rest—e.g., with the legs hanging over the side of a bed—there is plantar flexion of the foot as a whole, dropping of the anterior part of the foot, with increase of the longitudinal arch, some dorsiflexion of the toes, and inversion of the foot. The normal foot of a European would take up this position were it as flexible as a native's foot.

In fig. 1 there are five footprints in which the black area extends almost to the inner border of the foot—e.g., K6—as though there might be flattening of the arch. This was not so, however, and the tuberosity of the navicular was the same distance from the ground as in other feet with a normal footprint. The fullness of the sole was made up of soft tissues, especially muscles. As soon as the foot touched the ground, the abductor hallucis muscle came into action and pulled the great toe medially and with it the forepart of the foot, which was more adducted than usual (fig. 5). At rest the great toe was normal in position. The interest of this case lies in the fact that the woman was stout and heavy, and this action of the muscles of the foot in bringing more toes and metatarsals to the help of the first metatarsal and so to support the arch seemed to be compensatory.

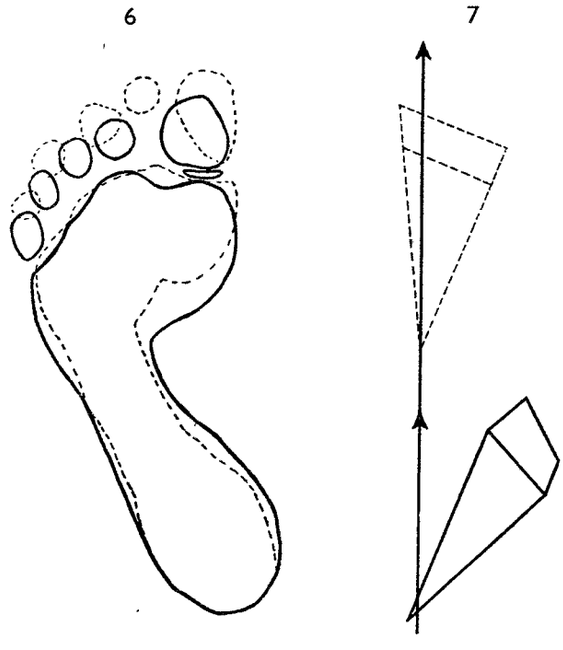

FIG. 6—Footprint (continuous line) of a European (A8 in fig. 1), aged 5½, who had never worn shoes, superimposed on that (interrupted line) of a native (B1 in fig. 1), aged 7. Except for the rather shorter toes of the European, there is a striking similarity between the two footprints.

FIG. 7—Triangles of the feet in relation to the direction of travelling: (*a*) of a native (fig. 1, D1); (*b*) of a European (fig. 1, M8). In the native's foot the toes form a strong additional base to the triangle; all the metatarsals help in propulsion; and the body-weight passes straight over the arch in the line of its strength. In the European's foot (turned out at an angle of 22½°) the toes form a weak and contracted second base; the first metatarsal takes most of the strain of propulsion; and the body-weight passes diagonally over the arch, the strain being on the side of the pillars and tending to push still further out the fore part of the foot and the great toe.

Comparison of an unshod European's foot with that of a native.—A European, aged 5½, had never worn foot-gear (except wide sandals for a short time). Fig. 6 shows his footprint superimposed on that of a native aged 7 (B1). The similarity is striking when compared with fig. 3, the shod foot of a European. The inner border is straight and the fore part of the foot adducted, and in walking the foot turns very slightly in, as does a native's foot. Another European, aged 9½, also has been unshod for the most part, though the period in wide shoes or sandals was longer (fig. 1, B8). Unfortunately there is not a footprint similar in size and sex with which to compare his. However, the adduction is evident, the inner border is straight, and he walks with the feet turned very slightly out—i.e., within the limits of a native. Both have strong active toes with strong flexion. The measurements of the inner and outer lines of the foot bear the same ratio to each other as do those of a native's foot. (The foot of B8 is narrower than that of a native, possibly owing to a syndactylism of the second and third toes of each foot.)

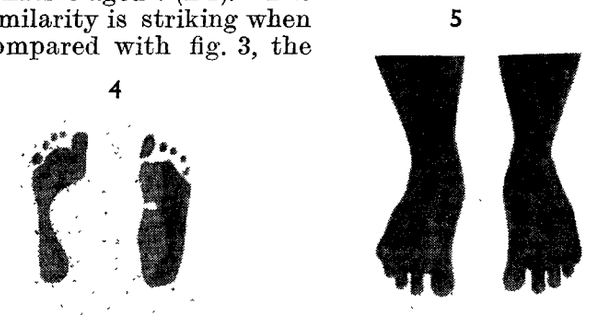

FIG. 4—Footprints of a normal and of a flat-foot (Thomson, Miles, and Wilkie, Manual of Surgery).

FIG. 5—Feet of K6, whose footprints (see fig. 1) suggest flat-foot. The arch is the same height above ground as that of J7 (fig. 1). The fullness of the soles is due to soft tissue, especially the abductor hallucis muscle, which pulls the great toe medially. The fore part of each foot is well adducted.

COMPARISON OF THE MECHANICS OF EUROPEAN AND NATIVE FEET

The feet of both Europeans and natives possess an arch, and the posterior pillar of each is the same. The anterior pillar, however, varies very greatly. In a native the adduction of the fore part of the foot strengthens the anterior pillar by bringing in more of his metatarsals to take the strain, whereas a European's foot depends almost entirely on the first metatarsal to take the whole weight. The active and strong toes of a native also take some of the strain, especially at the moment of pushing off; in fact, the depth of the footprint on the beach, as we have seen, shows that the toes give the final push in walking. The toes of a European, on the contrary, remain more or less passive in the shoe, and barefoot the toeprint is faint. A native's toes are in a line each with its metatarsal, and, as the body-weight comes on to the forepart of the foot, each toe lies in the optimal position to help with the load, whereas a European's toes, especially the strong great toe, are pushed away from the line of stress and so can help much less. The contractions of the strong flexor muscles of the toes and of the small muscles of the foot, coming, as they do, at the time of great strain on the arch, act as the string of a bow and keep the arch from spreading. Lambrinudi (1938) emphasises this point. A European lacks this

assistance to the support of the arch in proportion to the non-use of the flexors.

A native, by keeping his feet straight in the direction in which he is walking, carries his body-weight straight over the arch and its pillars, with the result that the weight is borne by the strongest parts and in the best direction. The same weight in a European's foot, turned out to various degrees, goes over the arch by climbing up the outside of the posterior pillar, going over the summit diagonally, from the back, and then going down over the opposite side of the anterior pillar. No arch is made to take a strain on the sides of the pillars. The foot therefore gives, and the anterior pillar is pushed outwards. The joints, muscles, tendons, and ligaments have to work "off the square," and symptoms develop (see fig. 7).

Shoes compress the foot and interfere with the blood-supply of the muscles, structures become shortened, and the foot loses its pliability, and becomes less resilient and so less able to adapt itself to varying strains and positions. A native's foot, free to spread out, maintains its pliability and can meet these changing circumstances without effort.

CONCLUSIONS

The facts that these natives, while possessing an arch, are free from flat-foot, and that the unshod European's foot, at least in childhood, differs little from that of a native suggest that the cause of flat-foot lies not so much in the formation of our foot as in our ill-treatment of it.

The arch, a normal structure, is not meant to take the weight of the body unassisted and unsupported nor yet to propel us without help. The boots of a European deprive the arch of all its assistants—namely, (1) the metatarsals other than the first, by abducting the fore part of the foot, (2) the toes, (3) the small muscles of the foot, and (4) some of the power of the longer muscles.

Turning out the feet to form an angle of 45 degrees (as the army manual instructs us) is another factor in pushing the foot "off the plumb."

Manipulation which aims at breaking down the arch, while wrong in theory, may secure its success in practice by its effect on structures other than the arch—e.g., adhesions in the joints.

The *prevention* of flattening of the feet must lie in bringing back to our longitudinal arches all the supports that modern foot-gear has knocked away and giving to our feet, especially the toes and anterior part of the foot, some of the freedom enjoyed by those of a native. This done, exercises to strengthen the muscles controlling the foot and supporting the arch will bring the foot back to something near its natural form, and flat-foot will slowly disappear. Sayle Creer's (1938) specifications for a good shoe seem to fit these factors—namely, ample room in the fore part of the shoe, while the heel is gripped firmly by the shoe and the instep is held firmly by a strap.

Although we cannot discard foot-gear altogether, it seems useless, from the point of view of the foot, to do drill and exercises in any kind of foot-gear, even in socks. The feet should be bare and the toes allowed free movement.

The standing position with the inner borders of the feet together, or even with the fore parts touching and the heels slightly separated, should be adopted in place of the 45 degrees position. This position alone is often associated with some elevation of the arch, and a lessening of the strain on the first metatarsal can be felt by anyone who tries it.

The toes should point straight to the front in walking.

Between periods of exercise or standing, the weight should be taken off our arches by sitting down. A native will seldom stand for any length of time. If he cannot find a log or a flat stone, he will squat on his heels.

Diet seems to play a much smaller part than the factors already mentioned. B3, B6, C6, E3, J7, and M4 were thin and ill-nourished, but their footprints show a normal arch. However, the diet of these Melanesians is poor, consisting of taro, potato, yam, and small amounts of paw-paw and banana, the two latter eaten unripe and cooked. The food is badly chewed, is bolted, and is eaten almost all at one meal, much too large, in the evening. During the rest of the day they usually nibble at any bit of food that they can pick up or they have none at all. Their gardens are at the mercy of the elements, and after bad weather food is often scarce. The poor diet is responsible for much of the septic conditions which are so prevalent among them.

SUMMARY

The feet and footprints of 65 unselected, average, and normal natives of the Solomon Islands, of primitive and virile type, who suffer from neither flat-foot nor foot-gear, show a fixed longitudinal arch, depressible neither voluntarily nor by force under an anæsthetic. There is no anterior transverse arch.

The feet show (1) a straight inner border; (2) adduction of the fore part of the foot, which brings in the other metatarsals to the support of the first; (3) strong active toes, straight, and each in the line of its metatarsal, the toes forming an additional base of support for the anterior pillar, and giving the final "push off" in walking, while their tendons, with the small muscles of the foot, act as a bow-string, preventing spreading of the arch when the body-weight is put on it; (4) a standing position with the inner borders parallel or turned in a little; and (5) when travelling, an inner border pointing straight ahead, with the result that the body-weight is conducted over the arch in the line of its strength. In proportion to the amount of padding of the sole, the feet are delightfully pliable, the joints mobile, and the whole structure adaptable to any stress.

Some footprints suggesting flattening of the arch show active small muscles in the sole, which, contracting, fill up the hollow of the sole. The arch is normal in height.

The feet of two unshod Europeans show characteristics similar to those of a native—i.e., a straight inner border pointing straight ahead, adduction anteriorly, and strong active toes.

The foot of a European is essentially the same as that of a native, but his foot-gear has robbed it of the above-mentioned supports of its arch, which thus becomes loaded beyond its capacity.

The prevention of flat-foot must be to allow the foot to develop normally by the adoption of suitable foot-gear, which, while it holds the posterior part of the foot firmly, allows plenty of room for the free movement of the toes and the forepart of the foot—i.e., to approach as closely as possible the conditions under which a native's foot works.

Exercises in bare feet, a proper standing and walking position of the feet, and rests between periods of exercise or work are essential.

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— (1938) *Ibid*, **2**, 746.
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Creer, W. S. (1938) *Ibid*, p. 1482.
Lambrinudi, C. (1938) *Ibid*, p. 1480.
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SUPPLIES OF COD-LIVER OIL

THE price of cod-liver oil has been more than doubled since the war began and the upward tendency is still in evidence. One of the reasons for the reduced supplies of oil expressed from the livers of cod fish caught off the north-east coast of England is that most of the trawlers engaged in the fisheries have been commandeered by the Admiralty. In consequence we have become more dependent on imported oil. The main source of imports is Norway, and according to advice from the chief centre of the industry there ample supplies of Norwegian cod-liver oil are available for shipment. It is true that the prices quoted by Norwegian shippers have advanced substantially owing to the depreciation of sterling in terms of Norwegian currency and other causes, but there is still a large margin between the price quoted in Norway and the price which has to be paid when the barrels are landed at British ports. The duty chargeable on imports plays no part in the advance in the London price. It is true that there are other charges, but it is questionable whether these are sufficient to justify the remarkably high prices which wholesale drug houses have to pay for this essential commodity. It may be that the big margin is capable of satisfactory explanation, but an inquiry by the Ministry of Health or the Ministry of Supply would do no harm.

CHINA'S NEW HIGHWAYS

AN informal collection of letters from a red-cross doctor in China to his friend in this country have been published under this title.[1] They tell us casually of day-to-day difficulties such as impossible gradients, clogged feed-pipes, and bandits which are to be met against a background of cholera and air-raids on the little-known roads through which all China's trade with the west must pass now that Japan has gained control of the sea coast. The doctor is in charge of the distribution of medical supplies from the railhead at Yunnan—lately an unimportant townlet, which today shelters nine universities and twenty-two large banks, and where three further railways are being built in haste. In China, petrol is scarce and dear (sometimes 8*s*. a gallon), and some of the medical supplies are carried in ambulance lorries specially designed to run on anthracite or charcoal. The motto of the doctor's fleet is "the slowest driving but the fastest transportation," and he finds time to "pep up the health stations and quarantine stations" en route. Some of the earlier letters describe a pleasant trip along the new Burma-Yunnan road already described in our columns (July 8, 1939 p. 108), which was only slightly marred by an accident to the lorry which carried the doctor's cherished bicycle. "A bishop was driving it, and that is not ideal." The doctor was impressed by the spirit of enterprise which built the road. "It was nearly all done by farmers who were assigned certain bits to do; certain sections of mountain to be cut out were appointed to certain villages and districts." In this way 600 miles were built in nine months. Eleven photographs help us to share his admiration.

A WEARSIDE SURGEON

THOSE in search of an antidote to blackout boredom might do worse than turn to an unpretentious little volume of reminiscences written by a general-practitioner-surgeon of the old school. ("Sidelights on the Life of a Wearside Surgeon." By William Robinson. Gateshead-on-Tyne: Northumberland Press Limited. 1939. Pp. 153. 5*s*.) William Robinson was born at Stanhope, Weardale, where he practised for many years. As a young man in country practice he contrived to prepare himself for, and to pass, the English F.R.C.S. examination; no mean feat. Later he moved to Sunderland and became first physician and then surgeon to the infirmary there. Many years of sound and thorough work followed, and in 1934 the University of Durham conferred on him the honorary degree of doctor of surgery. After 57 years of practice he is still active and able to enjoy life. In this record of quiet and solid endeavour enlivened with numerous anecdotes about colleagues and patients, their foibles, follies and infinite variety, Dr. Robinson does not hesitate to poke fun at human vanity and pomposity, but his comments are singularly free from malice. His excellent little book might have been even better had it included an occasional joke against himself.

1. Obtainable from the secretary of the British Fund for Relief of Distress in China, 108, Barton Road, Cambridge. Pp. 27. 6*d*.

INFECTIOUS DISEASE

IN ENGLAND AND WALES DURING THE WEEK ENDED DEC. 9, 1939

Notifications.—The following cases of infectious disease were notified during the week: Smallpox, 0; scarlet fever, 1233; whooping-cough, 1189; diphtheria, 994; enteric fever, 29; measles, 2225; pneumonia (primary or influenzal), 440; puerperal pyrexia, 130; cerebrospinal fever, 27; poliomyelitis, 4; polio-encephalitis, 2; encephalitis lethargica, 2; dysentery, 50; ophthalmia neonatorum, 86. No case of cholera, plague or typhus fever was notified during the week.

Deaths.—In 126 great towns, including London, there were no deaths from smallpox or measles, 1 (0) from enteric fever, 2 (0) from scarlet fever, 2 (0) from whooping-cough, 26 (3) from diphtheria, 29 (3) from diarrhœa and enteritis under 2 years, and 23 (3) from influenza. The figures in parentheses are those for London itself.

Brighton reported the only death from typhoid. Fatal cases of diphtheria were scattered over 19 great towns, Liverpool reporting 4 deaths, South Shields and Plymouth each 2. Birmingham had 6 deaths from diarrhœa, Manchester 4.

Vacancies

Barnsley Beckett Hosp.—H.P., £150.

Birmingham, Romsley Hill Sanatorium.—Res. asst. M.O., at rate of £240.

Guildford, Royal Surrey County Hosp.—H.P. and cas. O., also H.S., each £150.

Halifax Royal Infirmary.—First H.S., at rate of £200.

*Hampstead General Hosp., Hampstead, N.W.*3.—Res. cas. M.O. for out-patient dept., at rate of £100.

*Hospital for Consumption and Diseases of the Chest, S.W.*3.—H.P., £50.

*King Edward Memorial Hosp., Mattock Lane, Ealing, W.*13.—Res. M.O., at rate of £275.

Leeds Jewish Hosp.—R.M.O., £200.

Lincoln County Hosp.—Jun. H.S., at rate of £150.

Liverpool, Mill Road Infirmary.—Sen. res. asst. M.O., £350.

Manchester, Baguley Sanatorium.—Dep. med. supt., £500.

Manchester, Booth Hall Hospital for Children.—R.S.O., £400.

*Mildmay Mission Hosp., Austin Street, Bethnal Green, E.*2.—Asst. cas. O., at rate of £140.

Reading, Royal Berkshire Hosp.—Res. H.S.'s, each at rate of £150.

Rochdale County Borough.—Jun. res. M.O. for Birch Hill Hosp. at rate of £225.

*Royal Free Hosp., Gray's Inn Road, W.C.*1.—Hon. asst. surgeon to orthopædic dept., hon. asst. surgeon to ophth. dept., two res. cas. O.'s, each at rate of £150, also dist. obstet. asst., at rate of £100.

Staffordshire County Council.—Asst. M.O. for maternity and child welfare, £600.

Stockport County Borough.—Deputy M.O.H., £750.

Taunton, Taunton and Somerset Hosp.—H.P. and H.S., each £125.

Worcester County and City Mental Hosp., Powick.—Asst. M.O., £350. Also locum tenens M.O., £7 7*s*. per week.

The Chief Inspector of Factories announces a vacancy for an examining surgeon at Lincoln.

Appointments

Examining Surgeons under the Factories Act, 1937: Dr. H. STEWART (Littlehampton district. Sussex).

SMITH, N. THOMSON, B.Sc., L.D.S., school dental surgeon to the Kent education committee.