soft tissues of the ulnar side of the hand and of the webs between the fingers, but none on the thenar side. The emphysema thus appeared to be confined mainly to the palmar space and its lumbrical extensions.

He was treated by local heat, sling immobilization, and a prophylactic course of sulphadiazine, 1 g. by mouth every four hours. Next day the hand remained swollen but was less painful. There were slight pyrexia (99°F. ; 37.2°C.) and some redness around the puncture wound. Sulphadiazine and immobilization were therefore continued. The following day the swelling had completely subsided; there was full function and no pain. A further x-ray examination showed a normal soft-tissue shadow, and he returned to work six days after the accident.

Discussion

The air compressor responsible for this accident is one used for blowing the metal filings and chips away from the metal being cut, so that the field of work is not obscured. It is similar to the familiar automatic pump used in garages for inflating tyres, and pumps air at a pressure of 75–90 lb. per sq. in. (5–6 kg. per sq. cm.). When directed on to the unabraded skin it causes no discomfort but is sufficient to make a deep indentation in the tissues. Whitwell (1944) published a somewhat similar case, in which subcutaneous emphysema occurred in the middle finger from an identical cause, but he was able to elicit the typical crepitus of surgical emphysema. In his case the condition subsided without sepsis. Another use of compressed air is as a method of cooling when using a lathe, etc. A third, and more extensive, use is in compressed-air tools such as pneumatic drills, riveters, etc. Parker (1937) records a case of extensive emphysema of the whole hand in which a workman, having a deep wound, accidentally pressed his palm over the exhaust opening of a pneumatic drill. In this case, too, the emphysema subsided without complications.

The present case is of interest for two reasons. First, in spite of the extremely small wound, a large quantity of air penetrated even to the deep subfascial tissues; secondly, the extraordinary manner in which the air inflated the palmar space. It will be remembered that this space is bounded by the intermediate palmar septum laterally, and that this septum lies between the flexor tendons of the index finger and the second lumbrical muscle. The skiagram showed that the air in the tissues reached exactly to this point and did not encroach on the thenar space. It will also be remembered that the palmar space communicates distally with the subcutaneous tissues at the webs between the fingers along the lumbrical muscles. The air was well shown in these extensions in the x-ray picture. The palmar boundary of the space is the dense palmar fascia and the common flexor synovial sheath. This adequately explains why crepitus was not elicited. The dorsal confines of the space are the third, fourth, and fifth metacarpal bones, the fascia covering the interosseous muscles of the third and fourth spaces, and the fascia covering the medial part of the transverse head of the adductor pollicis. These would prevent extension of air into the dorsum of the hand. Medially the boundary of the space is the medial palmar septum, lying close to the lateral side of the opponens minimi digiti and passing deeply to be attached to the anterior surface of the fifth metacarpal bone. The septum extends distally to become continuous with the fibrous tendon sheath of the little finger on its ulnar side. Proximally it reaches the hook of the hamate and the pisohamate ligament and is pierced by the deep branches of the ulnar nerve and artery. This may possibly explain the presence of air in the subcutaneous tissues around the ulnar styloid process and in the subcutaneous tissues on the medial aspect of the base of the little finger in the x ray. However, there appeared to be some more superficial air in the hypo-

thenar region, and it is probable that it penetrated the subcutaneous tissues here before the larger quantity entered the palmar space.

These accidents are well known in industrial medicine, and no record of any untoward results could be found in the literature. However, should infection occur, it is conceivable, if not probable, that the consequences might be more serious to the patient. Whether the accident could occur in an already infected wound, walled off by tissue reaction, it is impossible to say, but, if so, a spread of infection would be practically inevitable. It would appear to be of utmost importance that the condition be recognized early and prophylactic treatment undertaken. Furthermore, the workmen should be warned of the possibility of the occurrence. Not one workman at the small metal milling factory at which this incident occurred was aware of these dangers.

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DIGITAL FOREIGN BODIES IN SPOT-WELDERS

BY

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Of the countless varieties of injuries sustained by the human body in this industrial age the hand receives perhaps more than its fair share. An unusual type of lesion has come to our notice lately. This is an industrial injury to the hand and fingers sustained by those engaged on the job of spot-welding.

Resistance welding, or spot-welding as it is more popularly called, is a process by which two or more pieces of metal are joined together by a combination of mechanical pressure and the heat which is generated in the metal by the passage of an electric current. The pieces to be welded are held under pressure between two copper electrodes and a current is caused to flow. As an example of this, when spot-welding two thicknesses of mild steel sheet each 0.04 in. (1 mm.)

FIG. 1.—Girl using spot-welding machine; showing the use of the right hand to position the part to be welded and how this brings her fingers in close proximity to the electrodes, whence the sparks emanate.

FIG. 2.—Man using spot-welding gun; showing that his hands are well away from the electrodes.

thick the welding conditions are: diameter of tip surface of electrodes, 0.25 in. (0.63 cm.); welding pressure on electrode-tip surface, 10,000 lb./sq. in. (700 kg./sq. cm.); welding current, 8,000 amperes; voltage across the electrodes, less than 1 volt; welding time 0.2 second.

In practice, spot-welding is applied either by means of a stationary "machine" (Fig. 1) or by means of a mobile "gun" (Fig. 2). The machine is used when small objects are being welded, and the gun is used on a large job. When using the machine the small object is held between the electrodes by hand, a pedal switch is depressed, and this causes the electrodes to approximate and squeeze the metal parts together and the current to flow. In the case of the gun, which is portable, when its electrodes are brought into position one hand is used to steady it, the other to switch on the current; thus both hands are necessarily far away from the area to be welded. In each type, as the current is flowing and the weld is being made, there may be a spraying outwards of sparks of red-hot metallic particles. For the most part this "splashing" of sparks is absent or negligible in amount, but in some instances, for a variety of reasons, a much heavier "splash" occurs.

This discharge of sparks can be seen wherever spot-welding is being done. They collide with various parts of the worker and his clothing, but it is the common finding of industrial medical officers that on the whole they do little or no damage. A spot-welding operator usually shows evidences of his occupation by the presence of minute superficial burns of his hands and arms caused by contact

with the flying red-hot particles, but these burns are regarded as a trivial and transitory annoyance and produce no disability. Occasionally injury to the eye occurs, but that is outside the scope of the present article.

Six months ago we noticed in the factory a case (Case 1) in which the sparks had penetrated the fingers of a worker, and since that time we have been on the look-out for such cases. Eleven more have presented themselves. These cases have all occurred in the factory in which one of us (W. A. B. R.) is medical officer, and have all been referred for surgical treatment to this unit.

Reports of 12 Cases

Case 1.—C. M., a female spot-welder aged 18. While spot-welding small steel brackets on Nov. 13, 1945, she received a jet of sparks from the welding machine into the tip of her right forefinger. She felt a stabbing pain and rapidly the finger became white at the tip, painful, and began to swell. The wound of entry was so minute as to be almost invisible after the event. The pulp felt and looked hard. On Nov. 20 she reported the injury at the works hospital. Treatment was instituted, and kaolin poultices were applied daily for a week. At the end of that time a small metallic foreign body was picked out with an eye-spud, and temporarily the condition settled. On Jan. 1, 1946, the finger became painful again; another piece of metal was removed and a small pinhead abscess evacuated. By Feb. 25 the acute pain, swelling, and tenderness had subsided, but she complained of a pricking sensation in the finger when handling small objects, and tenderness to the slightest touch. Her disability had necessitated a change of job to one in which fine finger movements were not essential.

On examination a very hard tender scar at the finger-tip had resulted from the injury and the sepsis that followed. There was no acute inflammation and no axillary adenitis. The fingers and hand were mobile and otherwise normal. A skiagram showed multiple M.F.B.s lying in the pulp of the digit parallel to the terminal phalanx. No evidence of bone injury or disease was seen. *Surgical Treatment.*—On March 11 a lateral incision was made, extending into the cornified entry wound at the finger-tip, and a minute superficial cavity containing necrotic material was opened up. There was no frank pus. Deep and proximal to this cavity the M.F.B.s were located and as many as possible extracted by the point of the knife. The wound healed by first intention, and when seen again recently the patient had no complaint. She had returned to her old job of spot-welding on April 8.

Case 2.—T. C., a male spot-welder aged 42, while welding on Jan. 26, 1946, received a spray of sparks from the machine into the dorsum of the terminal phalanx of his right middle finger. It quickly became swollen and painful. He went to the works hospital and was treated by a sterile dressing and, later, kaolin poultices. During the next two months small pieces of metal were extracted on two occasions from suppurating sinuses at the site of injury. On March 19 he complained of tenderness and a throbbing pain in the finger. On examination a hard, blackened, and calloused spot was seen at the wound of entry on the dorsum of the terminal phalanx of the middle finger and a similar lesion was noted on the dorsum of the ring-finger. Both areas were tender to pressure. There was no acute inflammation noted, no lymphangitis or axillary adenitis. He thought the ring-finger lesion had occurred earlier in January; but he wasn't sure, and it did not give him trouble. A skiagram showed multiple M.F.B.s in ring- and middle fingers, but no evidence of bone injury or disease. *Treatment.*—By March 25, when he attended for surgical treatment, a small spot of pus was visible at the entry wound on the middle finger and the axillary glands were enlarged and tender. The superficial abscess on the middle finger was incised and two pieces of metal which lay loose in the cavity were removed and the incision left open for drainage. From the ring-finger numerous small M.F.B.s were extracted and primary suture was carried out. By April 9 both wounds were well healed and painless, and he had resumed work as a spot-welder.

Case 3.—W. K., a male spot-welder aged 39. On Nov. 10, 1945, while spot-welding, a jet of sparks entered the pulp of

the left little finger and the dorsal surface of the terminal phalanx of the right ring-finger. Both wounds were fomented daily, and a week later pieces of metal were picked out with a needle from each wound. The little finger healed quickly thereafter, but the ring-finger discharged pus for ten days before healing. When seen in March, 1946, he complained only of a pricking sensation on pressure. There was no evidence of infection. A skiagram showed a spray of M.F.B.s in each of the affected fingers. As the patient considered his symptoms to be trivial he was not keen to submit to operation, and nothing further was done. He has continued to work as a spot-welder and is without disability.

Case 4.—A.M., a male welding charge-hand aged 36, on April 22, 1946, sustained a jet of sparks into the pulp of the terminal phalanx of the right index finger. Immediately it became very painful and swollen, and remained so for a few days, after which the condition settled down without treatment and without complications. After a week the small entry wound became hard and cornified. The resultant scar was lumpy and tender to pressure. There was no throbbing or pain. By May 29 the finger had become inflamed, swollen, and painful. At the site of injury there was a small black cornified spot with a surrounding yellow area and a slight sero-purulent exudation. A skiagram showed multiple M.F.B.s but no bone lesion. **Treatment.**—A lateral incision was made on May 31 and inspissated pus was evacuated from the superficial aspect of the wound and most of the M.F.B.s extracted with the aid of an electro-magnet. The wound was left unsutured. A post-operative skiagram showed that most of the M.F.B.s had been extracted. The wound healed quickly and well. He was still at work in his pre-accident job.

Case 5.—A.T., a male spot-welder aged 52. While spot-welding on May 30, 1946, he received a spurt of sparks from the machine into the pulp of his left index finger. He was seen within two hours of the accident. At the site of injury there was the erythema of a thermal burn with a few small black marks in its centre. A few hours later the finger became swollen and gave much pain overnight. Next day a small blister appeared at the wound site. A skiagram showed multiple M.F.B.s but no bone or joint involvement. A lateral incision was made and the pus drained from the blister, the main mass of underlying M.F.B.s extracted, and the wound left unsutured. A post-operative skiagram showed that only a few dust-like particles remained. He resumed work as a spot-welder two days later, and was without disability on Sept. 10.

Case 6.—G.S., a male spot-welder aged 25. On Aug. 13, 1946, he was welding parts of a motor chassis, using the spot-welding machine, when sparks penetrated his right thumb. He felt a sharp stab of pain, the site of the wound went white, and after a few hours the thumb was quite swollen. He did not

FIG. 4.—Enlargement of the thumb of Case 6, showing the wound of entry.

attend the works hospital until next day. For three weeks the wound periodically healed and broke down again, with discharge of pus and metallic particles. The interphalangeal joint became progressively stiff and painful on movement. On examination on Sept. 3 there was a small hard lump consisting of a central black spot with a white halo and a peripheral area of erythema on the lateral aspect of the right thumb opposite the interphalangeal joint. In addition the marks of his trade were very apparent. There were two black spots on the flexor aspects of his right index and little fingers (Figs. 3 and 4).

On the front of the wrist were fresh superficial burns, minute scars of old burns, and abrasions and linear scratches due to flying particles of steel. He had been welding steel sheets of extra thickness, and although his hands were relatively far away from the electrodes the spark output was heavier. Skiagrams (Figs. 5 and 6) showed numerous opaque foreign bodies close to but not in the interphalangeal joint. Flexion of the joint was limited to half its normal range. By means of an electro-magnet most of the metallic particles were extracted and the wound was left open for drainage. He resumed work as a spot-welder on Sept. 16, and on Nov. 12 was without disability.

Case 7.—E. P., a male assembler and temporary spot-welder aged 38, received a spurt of sparks from the spot-welding machine into his left index finger on Aug. 13, 1946. He said the injury almost paralysed the finger. It was very painful and began to swell soon

FIG. 3.—Photograph of the hand of Case 6, showing a number of the relatively unimportant superficial burns commonly sustained by spot-welders. Also seen, on the thumb, is the wound of entry of M.F.B.s.

FIG. 5.—Case 6: Skiagram showing the digital lesion.

FIG. 6.—Skiagram of Case 6 taken after operation.

afterwards. He reported to the works hospital two days after the event and kaolin poultices were applied. The wound healed quickly, but thereafter broke down every few days with discharge of pus. On examination on Sept. 13 a typical lesion was seen on the flexor aspect of the middle of the terminal phalanx of the left index finger. It was tender to pressure and dry. There was no joint or tendon involvement. A skiagram showed M.F.B.s in the pulp of the left index finger, but no bone or joint lesion. The metallic particles were excised, and he resumed work as a spot-welder on Sept. 13; when seen on Nov. 12 he had no disability.

Case 8.—R.S., a male, aged 56, while spot-welding small brackets on a machine on Aug. 27, 1946, and wearing cotton gloves, sustained a jet of sparks into the pulp of the left thumb. Inflammation, swelling, and pain resulted, and kaolin poultices were applied daily. On Sept. 3 two pieces of steel were removed from a pin-head abscess at the site of injury by probing only and without incision. On the 12th a dark, rough, cornified area appeared at the site of entry. There was no inflammation or oedema. Slight pricking on pressure was the only symptom, and this gave so little trouble that surgical intervention was unnecessary.

Case 9.—E.I., a female spot-welder aged 23. On Sept. 2, 1946, while welding small brackets on the spot-welding machine a splash of sparks entered her left index finger. No pain was felt at first, but some hours later the finger began to swell and throb. She reported for treatment next day. Kaolin poultices gave ease, but the wound discharged moisture for ten days before it healed. Examination on Sept. 13 showed a lesion situated on the flexor aspect of the left index finger over the distal interphalangeal crease; it was dry and tender to pressure. Joint movements were of full range, without tendon involvement. A skiagram showed M.F.B.s situated in soft tissue of the middle flexor aspect of the middle phalanx. No bone or joint was involved. The foreign bodies were excised, and next day she resumed work as a spot-welder. When seen on Nov. 12 she was without disability.

Case 10.—W.E., a male jig hand aged 27, sustained a splash of sparks into the lateral aspect of the terminal phalanx of the left ring-finger while spot-welding on Aug. 23, 1946. An x-ray film disclosed numerous M.F.B.s, but no bone lesion. The affected area was inflamed and tender and in the centre was a minute dark entry wound. An occlusive dressing was applied. On Aug. 30 there was still some inflammation but no pus and no oedema. On Sept. 9 the only disability was very slight pricking on pressure; but this is not often felt, as the lesion is situated laterally. Surgical intervention was not required.

Case 11.—A.P., a male aged 35, was using the spot-welding machine on Sept. 13, 1946, when sparks penetrated his left thumb; he reported this fact soon afterwards to the works hospital. Apart from the initial stab of pain the lesion did not cause discomfort, but the immediate vicinity of the entry wound became blanched and tense. At the radial side of the base of the left thumb there was a small collapsed blister with a surrounding area of erythema. At the centre could be seen a hard black core, from which exuded a pin-point of serum on pressure. A skiagram showed the presence of multiple M.F.B.s close to but not actually in the first metacarpo-phalangeal joint. Surgical treatment was carried out within six hours. The area of the lesion was completely excised and primary suture performed. Healing was by first intention, and he returned to his job on Sept. 23. When seen on Nov. 12 there was no disability.

Case 12.—N.S., a male spot-welder aged 35. On July 20, 1946, a splash of sparks from the machine penetrated his right index finger. He felt a burning sensation at the time of injury and had little discomfort afterwards. About four days later the finger began to throb and swell. He first came for treatment on Sept. 27, when the findings were as follows. Right index finger: raised pus-filled blister on the radial aspect of the interphalangeal joint. Joint movements were limited owing to inflammatory oedema surrounding the lesion. An x-ray film showed multiple metallic foreign bodies. The M.F.B.s were removed by excision the same day, and the opening was drained. The patient resumed work as a spot-welder on Oct. 5, and when seen on Nov. 12 was without disability.

Comment on the Cases

From the foregoing it will be seen that the lesion consists of a superficial burn, minute entrance wounds, and underlying foreign bodies. The red-hot sparks are sterile, but dirt and bacteria may be carried in from the skin surface. In addition the heat coagulates and devitalizes an area surrounding the particles, thus producing a field particularly prone to the onset of infection. The symptoms are primarily those of a burn and, later, those of retained foreign bodies with chronic inflammation. In our cases the metallic particles had lodged in the pulp and cellular tissues of the fingers, but if the more specialized anatomical structures—joint, nerve, tendon, bone—should be involved, a more serious outcome might be expected. Even in the form described above, in which the finger-pulp is affected, involvement of nerve fibrils in the finger-tips can lead to much tenderness and disability. These workers depend for their livelihood upon the exact and full function of their fingers, and if to pick up an object causes severe pricking pain they are seriously handicapped.

Treatment

First Aid.—This calls for a sterile occlusive dressing, a sling, the injection of antitetanus serum, and a sedative for the relief of pain. Preparation should then be made for the patient to receive surgical treatment.

Early Surgical Treatment.—If seen within eight to twelve hours of injury the procedure indicated is wound toilet, excision of dead tissue, extraction of metallic particles, and primary suture. The operation is carried out with all the usual theatre facilities. Either regional "novocain" block of the digital nerves or general anaesthesia is satisfactory, and a bloodless field is obtained by means of a rubber catheter tied round the proximal end of the finger. Incisions are placed laterally and enclose the wound of entry if possible. If the lesion is more centrally situated the incision is still made laterally and the entry wound excised separately. Although most of the metallic particles can be seen and removed by the point of the knife the procedure is facilitated by the use of an electro-magnet: the foreign bodies are magnetic, and even dust-like particles can be withdrawn. The operation is completed by the insufflation of penicillin powder and primary suture.

Late Surgical Treatment.—Cases which arrive for treatment later than twelve hours require immediate surgery only if infection is present. Even if no infection occurs, tenderness, irritation, lumpiness, or loss of fine sensation may be present, and these are indications for removal of the metallic foreign bodies. In certain cases, even in the absence of symptoms, excision is indicated, as the presence in the tissues of multiple M.F.B.s remains a source of danger. Chronic suppuration and sinus formation necessitate incision and drainage, with removal of the causative foreign bodies.

Prevention

It will be noted that all the above cases occurred in workers engaged in the use of a spot-welding "machine" as opposed to a "gun." The reason for this is that the process of welding small parts on a machine may entail the positioning of the part with the fingers close to the electrode as the weld is being made: the fingers are therefore exposed to the splash of sparks close to their origin and at their point of maximum velocity. In the case of a gun operator, on the other hand, the hands are both employed in holding the gun and operating the switch, and are therefore out of harm's way.

There are many technical causes of an increase in the amount of sparking produced in the process of welding.

Among these may be included foreign matter on the surface of the metal, inaccurate placing of the weld on the edge of the sheet of metal, maladjustment of the machine, etc. But even under ideal conditions sparking will occur in a certain number of cases. Such being the case, the problem of prevention is to devise a means of protecting the hands of the worker from these sparks. This might be achieved by one of three methods:

(a) By applying to the machine a guard which would protect the operator's hands or prevent them from being brought close enough to the welding point to be in danger. This would be the ideal method—being permanent and foolproof, and in no way demanding the co-operation of the worker. Unfortunately, no such guard yet conceived will permit of the welding machine being used.

(b) By the use of a jig for positioning the parts to be welded and thus removing the necessity for the operator's fingers to be close to the welding point. This is possible in many cases, but in some is technically impracticable. Also, in practice there is the very real danger that the operator will place ease before safety and discontinue the use of the jig.

(c) By the provision of tongs or protective gloves. This is analogous to the provision of goggles for the protection of the eyes, and possesses the same disadvantages—namely, that through laziness or carelessness on the part of individual operators they will be temporarily or permanently left off. As is well known by all industrial medical officers, protective clothing can easily be devised and provided, but it is most difficult to persuade operators constantly to use it.

It has been found that neither industrial cotton nor leather gloves afford sufficient protection, and we have experimented with various other materials. Those most satisfactory to date are cotton gloves coated with "neoprene" and asbestos fabric finger-stalls worn under the usual cotton gloves. We now have both of these in use, but are continuing our search for the ideal material.

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SYMMETRICAL GANGRENE IN THE AFRICAN

BY

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Gangrene in the extremities can generally be attributed to diabetes, arteriosclerosis, or thrombo-angiitis obliterans. Ergot poisoning is a relatively rare cause. Arteritis resulting in gangrene is described in acute infections, such as typhus and typhoid fevers and malaria. Gangrene has been noted in pellagra or the vitamin B deficiency state (Page, 1946). It is also seen in those cases where the arteries are suddenly occluded by an embolus, subacute infective endocarditis being a typical instance. Occasionally, in Raynaud's phenomenon, there are trophic changes in the tips of the fingers. Traumatic cases, forming a separate group, are also seen. Trench foot and the immersion-foot syndrome following exposure to cold constitute another class of cases in which gangrene of varying extent is the most important feature.

I have encountered gangrene in an extremity in the elderly African, presumably due to arteriosclerosis, and unilateral gangrene, which might have been attributed to syphilis. There appears to be very little written on Buerger's disease in the African. I have not encountered a case in the native. Ferro-Luzzi (1942) reports on 20

cases of Buerger's disease in European males living in Eritrea, but he failed to find the condition among the indigenous population. Goetz (personal communication), however, has seen a case in the African.

During the past four years I have seen six cases of symmetrical gangrene in the African, running a peculiar but nevertheless more or less constant course. In each the course and history were similar. (1) The onset occurred in a person who previously enjoyed more or less good health. (2) The disease was seen only in males. (3) It occurred usually between the ages of 20 and 35—one patient, however, was over 50. (4) The first sign was oedema of both feet; this was followed by pain. (5) The gangrene occurred simultaneously on each side. (6) No obvious cause common to each case could be found for the disease.

In four cases the gangrene was limited to the tips and pads of all the digits. In one the gangrene ascended to the mid-tarsal joints, being exactly symmetrical on both sides. In the sixth case the whole of both feet and up to 3 in. (7.6 cm.) above the ankle-joint on each leg was affected.

All the cases came from Mashonaland, but from widely separated regions. They were seen at different periods over the four years. In none was there anything to suggest that other cases with gangrene had occurred in the villages from where they originated. The patients denied having received any treatment from a witch-doctor or of having consumed any native drugs prior to the onset of the disease. They all stated that they had previously been well. In two of the six cases the Wassermann reaction was positive. In one of them the disease was immediately preceded by cerebral malaria, but in no other case was acute malaria found. No sugar was found in the urine of any of the patients. The blood pressure was normal in each. The clinical features of the two cases in which extensive gangrene occurred were as follows.

Case 1

An African man aged about 30 first became ill on June 11, 1945, with general malaise and shivering. He vomited twice on the first day of the illness. During the night he developed severe headache and passed into coma. He was admitted to the Salisbury Native Hospital from Norton (about 25 miles away) on June 14. The coma continued for two days, after which he gradually regained consciousness (June 15).

On admission the blood smears were positive for *Plasmodium falciparum*, and quinine was given by injection 10 gr. (0.65 g.) twice daily for two days. The cerebrospinal fluid was clear. There was nothing abnormal in his legs. On June 16, the day after his recovery from the comatose state and acute malarial condition, the patient first complained that his legs were heavy to lift. It was noticed that his feet, ankles, and the distal halves of his legs were swollen and showed pitting oedema, but there was no pain. A day or two later his legs and feet were very painful to touch. Several days later it was noticed that the skin of both feet was hard and cold up to 3 in. (7.6 cm.) above each ankle-joint. The feet were discoloured black, this being most clearly seen on the soles and the pads of the toes. Three distinct zones were noted on each limb: The most distal one, from the toe-tips to past the mid-tarsal joints, was pitch-black, due to total gangrene. The middle zone, which reached to about 3 in. above the ankle-joints, was cold and swollen. Above this was a narrow zone, which was warm and faded gradually into the normal temperature of the leg. All the toes were affected by dry gangrene. No pulse could be felt in the anterior and posterior tibial arteries, but that in the popliteal and femoral region was easily palpated and was of equal force in each limb.

The patient was thin. There was no oedema in any part of the body until it appeared in the legs. Jaundice was not detected. The conjunctivae were pale, as was the tongue. The gums were slightly spongy. There were signs of a pellagroid rash