may well be staged, in some convenient place, a selection of protective industrial clothing. A miner, after all, wears a hat, a lamp, and sometimes knee-pads; but few students know exactly why, and still less do they realize that these represent elementary steps in preventive medicine.

Staffing the Department

I have dealt to some extent with what this department has to do, and now can outline briefly the staff needed to undertake the task. In the early stages of the bedside work full clinical responsibility should be borne by the departmental head; but later, as the work increases and plans mature, a competent clinician capable, if necessary, of bearing the full load must be employed. He should, moreover, have another interest in some investigation of his own. Under him would come two junior assistants, spending part of their time on clinical work and part on fundamental research, and part again in helping with the routine departmental teaching. These men or women will be at the stage of deciding whether, or how, they intend to advance themselves, and, if so, in which of the branches of activity displayed before them in the department; and one of them will join the social worker as a small combined team of two. Finally will come a house-physician of some previous medical experience who may one day become an assistant in his turn.

On the laboratory side it is most necessary to have a man who combines a knowledge of statistics with a social or biological outlook and who will perhaps in time develop a small subdepartment of his own; there are needed, too, a physicist or engineer who can plan and make machinery to study our problems of design, and a non-medical but biological assistant to use this machinery as a tool to answer the questions posed. Occasionally, but very rarely, one man can do both of these; but usually the purer type of scientist has difficulty in dealing with the variability of response of human beings, and, vice versa, few biologists have the necessary technical knowledge to design the apparatus used. Finally there must be, of course, ample help in computation and secretarial work, because otherwise much time will be wasted.

The "foreign policy" of a department such as this should be to maintain the closest contact with both employer and employed, to eschew politics and compensation questions like the plague, and to avoid the role of expert witness. It should, moreover, work in close connexion with the local department of public health, and with the sister—perhaps one should say the elder sister—Nuffield Department of Child Health.

Conclusion

To summarize the story, it can perhaps be said that an organization such as this should have five main duties: (1) to its patients, which it must treat as persons as well as members of an industrial or social group; (2) to its subject, which it may advance a little, chiefly by affording a seed-bed for the germination of potential workers in this field; (3) to the students, by reorientating their medical horizon; (4) to its college, by concentrating mostly upon research, and only slightly upon teaching; and (5) to employer and employed by maintaining a tactful, fair, and independent attitude in its outside work.

May I now conclude with some words of John Dryden's which do, I think, foreshadow this new spirit in preventive medicine?

"Better to hunt in fields for health unbought,
Than fee the doctor for a nauseous draught,
The wise, for cure, on exercise depend;
God never made his work for man to mend."

SURGICAL EMPHYSEMA DUE TO COMPRESSED AIR

BY

A. M. DESMOND, F.R.C.S.

In the last twenty years compressed air has been employed in industry on an increasing scale, and the hazards associated with its careless use are now well recognized. Emphasis has been placed particularly on injuries of the rectum and colon, and Wyllys Andrews (1911) and others have given excellent surveys of this aspect of the subject. One feels, however, that the occurrence of tissue emphysema in the presence of even the smallest wounds has not been sufficiently brought to notice, and for this reason the following case is considered worth recording.

Case Report

A metal miller aged 16 years was working on the "miller," and a small piece of metal shaving (referred to in the trade as "swarf") punctured the ulnar side of the palm of his left hand about 1 in. (2.5 cm.) proximally to the base of the little finger. He removed it, and the minute pin-point wound bled a little. He then, in an attempt to remove the remainder of the "swarf," directed the nozzle of a powerful air compressor pump on to his hand, which instantaneously became ballooned and painful. He was examined within two hours, and complained only of the swelling and pain.

The ulnar side of the palm was diffusely swollen and tender, the swelling roughly conforming to the size and shape of the palmar space, with ballooning of the webs between index, middle, ring, and little fingers (see Fig.). The palmar creases

Showing the ballooning of the palmar tissues. The puncture wound is indicated by arrows.

over the area involved were almost obliterated. No crepitus was elicited. The remainder of the hand, the fingers, and the forearm were normal; there was no swelling of the dorsum. There was a pin-point puncture wound in the position described above, and scattered over the surface of the hand were multiple cuticular abrasions. An x-ray photograph showed air in the

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

W. A. B. REYNARD, M.B., Ch.B.

Principal Medical Officer, Pressed Steel Co., Ltd.
Cowley, Oxford

AND

FREDERICK SMITH, M.B., Ch.B., F.R.C.S.Ed.

Assistant, Accident Service, Radcliffe Infirmary, Oxford

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.