logical characteristics indicated that it was at least subacute in type. Two weeks later a general enlargement of lymph glands was noted, both liver and spleen were palpable, and a diffuse purpuric eruption appeared. The white cell count rose to 147,000 per c.mm. and the blood lead to 485 microgrammes per 100 c.cm., and death occurred on March 25, 1940.

At necropsy the findings were typical of an advanced leukaemic process with marrow hyperplasia, glandular, splenic, and hepatic enlargement, and histological evidence of leukaemic infiltration of the viscera. This change was most pronounced in the myocardium, liver, and kidneys. In the last, almost the entire renal substance had been destroyed.

Discussion

Although the patient had been exposed to an undue amount of lead for many years, the reason for the development of lead-poisoning was at first uncertain. The onset had been acute after a period of less rather than greater exposure, and after 10 weeks' freedom from further absorption symptoms were very much more severe. During his stay in hospital, on a diet conducive rather to storage than to mobilization of lead, the concentration of lead in the blood rose to 485 microgrammes per 100 c.cm., and death occurred with generalized flaccid paralysis. In this case exposure might have been much in excess of the patient's suspicions, but the progressive rise in blood values appeared to indicate an undue addition to the circulation at a time when storage might have been expected. Some rarefying bone disease was a possible cause, and when the leukaemia developed it seemed probable that the hyperplastic marrow might be responsible for the liberation of lead stored in the trabeculae. The occurrence of trabecular absorption was confirmed at necropsy.

While it is true that the blood changes followed rather than preceded the appearance of poisoning, it is highly probable that marrow changes occurred some time before the blood picture altered. Acute and subacute leukaemia usually show marked marrow hyperplasia with a normal or even subnormal white cell count. Abnormal cells may fail to appear in the circulation for some weeks, and a rise in the count is usually a terminal phase. It is therefore possible that marrow hyperplasia, preceding a blood change, precipitated lead-poisoning by causing trabecular absorption in an individual who had been storing relatively large amounts of the metal in the skeleton over a period of 12 years.

Post-mortem examination of the skeleton for lead by the method of Tompsett (1939) showed abnormally high values for the femur. In Table II these results are compared with values obtained from normal persons by Tompsett and Anderson (1935) and Tompsett (1936).

TABLE II.—Lead Content in mg. per kg. Fresh Tissue

	Present Case	Tompsett and Anderson (1935)		Tompsett (1936)	
		Mean	Maximum	Mean	Maximum
Brain ..	0.52	0.50	0.72	—	—
Liver ..	1.29	1.73	4.63	—	—
Kidney ..	0.66	1.35	3.55	—	—
Vertebra ..	16.40	7.10	14.70	8.40	12.6
Rib ..	18.40	8.55	12.90	9.75	17.5
Femur ..	293.00	—	—	48.00	108.0

The values for the soft tissues are normal, and the amounts of lead in the ribs and vertebrae are only slightly if at all increased. It is possible that those low values resulted from previous mobilization of lead owing to trabecular absorption. In the final stage of the illness impaired renal function may have contributed to the high blood levels.

When this patient was under observation the possibility of lead-poisoning due to mobilization of the metal in this manner had not been considered. The chance of investigating another such patient was so remote that some other approach to the problem had to be sought. Accordingly an investigation of blood-lead levels was undertaken in individuals exposed to a domestic lead hazard and suffering from rarefying processes affecting the skeleton (Brown, 1946). This investigation has revealed that, even without undue exposure to lead, osteolytic processes may result in high blood-lead concentration. It is to be expected, therefore, that where exposure has been excessive rarefying lesions in bone may result in lead-poisoning.

Summary

The case has been described of a compositor in whom lead-poisoning was caused by mobilization of lead from the bones by leukaemic marrow hyperplasia.

Lead-poisoning in a lead-worker may not indicate immediate exogenous lead intoxication.

Marrow hyperplasia in a lead-worker may precipitate lead-poisoning.

Anaemia in a lead-worker may be the cause, and not the result, of lead-poisoning.

We are indebted to Dr. David Smith for permission to study the patient in his care, and to Dr. A. B. Anderson for helpful criticism and advice.

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A CASE OF CHRONIC UNDERMINING ULCERATION TREATED WITH PENICILLIN

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While the American literature contains many descriptions of this type of ulceration, no papers on the subject could be found in the English medical press. Though rare, the condition deserves wider recognition.

Case History

A soldier in the Pioneer Corps, aged 32, while serving in North Africa was given an injection of T.A.B. in the left upper arm on Oct. 23, 1943. Four days later his arm rapidly became very painful, red, and swollen, and his temperature rose to 103°. A diagnosis of cellulitis was made, and he was treated with chemotherapy and fomentations. On Nov. 7 his arm was incised and much pus evacuated, relieving his pain. An aerobic haemolytic streptococcus was grown from the pus. The incision continued to discharge freely, but the infection spread subcutaneously, producing a large pocket of pus, which was opened more widely on Dec. 10, and again on Jan. 19 and Feb. 29, 1944. During this time the arm became more painful, especially around the edges of the inflammatory process, which gradually but inexorably spread down to the elbow.

By April 3, when he had been evacuated to England, there was a large ulcer 8 in. by 3 in., extending from the deltoid region to the back of the elbow. There was moderate pain in the region of the ulcer and the whole area was extremely tender. The temperature varied, rising to 100°, and the pulse rate was slightly raised. The base of the ulcer consisted of pale unhealthy granulations, and most of the edge was undermined, with up to an inch of overhang. In a few places the edge was adherent to the floor of the ulcer and its appearance suggested that epithelization was beginning. The undermined edge was bluish, shading outwards into a slightly raised red area, outside which was normal skin. There was no zone of cutaneous gangrene. In the floor of the ulcer were two sinuses about 1½ in. deep. The humerus showed mild periostitis. There was no lymphadenitis.

In the differential diagnosis, syphilitic, tuberculous, diphtheritic, and amoebic ulceration were considered, but no evidence of any of these diseases could be found.

On April 28, at Friern Hospital, the edges of the ulcer were excised with a knife, and the sinuses opened up to give a flat surface. A gauze dressing was applied and the limb immobilized in a plaster spica. The plaster was left on for a month, during which time there was little pain from the ulcer and the patient's general condition improved, but when the plaster was removed the ulcer had extended downwards to just beyond the point of the elbow, though lateral spread had stopped. A biopsy of the active edge showed non-specific inflammatory changes extending outwards beneath the intact epidermis. Numerous Gram-positive diplococci and occasional Gram-positive bacilli were seen in the floor of the ulcer.

Next, a great variety of antiseptic and bacteriostatic dressings were tried, including sulphanilamide powder and proflavine powder as well as more old-fashioned remedies, but none produced any significant improvement. Zinc peroxide could not be obtained.

On June 6 a swab from the edge of the ulcer gave a profuse growth of an aerobic haemolytic streptococcus, with moderate numbers of *Staphylococcus aureus* and *Pseudomonas pyocyanea*. The first two organisms were sensitive to penicillin *in vitro*, and on

June 12 local penicillin treatment was begun, using a solution containing 100 units per c.cm. Rubber tubes were introduced into the sinuses and along the most undermined and painful parts of the edge, and penicillin injected through the tubes to keep the dressing wet.

After 24 hours of penicillin treatment a swab grew only a few streptococci, and after 48 hours all penicillin-sensitive organisms had disappeared. After five days the appearance of the ulcer had enormously improved; there was no pain, little tenderness, and epithelization had begun. Infection with *Ps. pyocyanea* persisted, but seemed to be diminished by 1% acetic acid dressings.

Epithelization progressed rapidly from the edges and from two islands of epithelium which appeared in the floor of the ulcer. In addition the size of the ulcer diminished considerably, owing to contraction of its fibrous base. The sinuses did not heal until early

Chronic undermining ulcer of arm.

September, and at that time epithelization stopped. The remaining skin defect, about 3½ in. by 2½ in., was covered by a Thiersch graft, which was 80% successful. Healing was complete by Nov. 7, and on Jan. 15, 1945, the patient was discharged, with a stable scar and a good range of elbow movement. The only residual disability was some weakness of the triceps.

Discussion

Spreading, undermining, burrowing infections of this kind have been described at length by Meleney and his colleagues (1935, 1937, 1939) and by other American surgeons (Pennoyer, 1937; Rhoads, 1937). Dermatologists have described in the American and French press an apparently identical condition, under the name of phagedaenic ulcer or phagedaena geometrica. Greenbaum (1941) gives a full review of the dermatological papers on this subject.

Meleney has found constantly associated with these lesions a haemolytic streptococcus which is a facultative aerobe, but which, when obtained from the undermined edge of the ulcer or from the depths of the sinuses, grows best under anaerobic conditions, and grows in pure culture. Meleney therefore classifies it as a micro-aerophilic organism, and believes that it is an aerobic streptococcus which becomes adapted to thrive in anaerobic or micro-aerobic conditions, as in the depths of sinuses or under overhanging skin edges. *Staphylococcus aureus* was also found in most of the recorded cases.

The process may start as an infection of a surgical incision or of a traumatic wound, or as a lymphadenitis, and at first resembles an ordinary cellulitis or adenitis; but suppuration, instead of becoming localized, progresses. On the trunk and limbs the process spreads mainly beneath the skin, producing the typical ulcer with undermined edges; while in the axilla, perineum, or groin the infection also burrows deeply, producing extensive sinuses. Daughter ulcers may appear, with undermined skin bridges separating them from the main ulcer. The infection slowly progresses over months or even years, and

amyloid disease may develop, or death may follow the erosion of deep vessels.

To be distinguished from this type of ulceration is the well-recognized condition chronic progressive post-operative cutaneous gangrene, which has been described, under a variety of equally clumsy names, by numerous authors, including Brewer and Meleney (1926), Nightingale and Bowden (1934-5), Stewart-Wallace (1934-5), and Willard (1936). After operations for infective processes in the chest or abdomen a chronic spreading infection may develop in the region of the wound, commonly starting round a tension suture, and spreading in two to six weeks to produce a large ulcer 6 in. or more in diameter. The advancing edge shows a peripheral red or purple zone and a raised irregular margin, inside which is a wide or narrow zone of gangrenous skin. The muscles are unaffected. A non-haemolytic streptococcus is found in pure culture in the advancing edge, and this organism grows best under anaerobic conditions, though aerobic growth also occurs. *Staphylococcus aureus* is found in the gangrenous zone, and the process is regarded as a symbiotic infection.

The case described, although the organism always grew readily under aerobic conditions, appears to belong to Meleney's group of chronic undermining ulcers.

Treatment

Meleney has obtained good results by treating these chronic undermining ulcers with a suspension of zinc peroxide in water. This liberates oxygen in an active form over a period of several hours. It was found that, unfortunately, only one of the commercial manufacturers of zinc peroxide (the Du Pont Company) could provide a material which gave consistently satisfactory results (Meleney and Johnson, 1937). The suspension was used as a wet dressing and introduced into the depths of the lesion by rubber catheters. Incisions and trimming of edges were often necessary to permit the peroxide to reach the area of active spread.

The only successful recorded treatment of progressive post-operative cutaneous gangrene is wide excision of the advancing edge with knife or cautery. This has been successful whether or not zinc peroxide was subsequently used.

In the case described above the response to penicillin was much more rapid than could have been expected from the use of zinc peroxide, and suggests that local penicillin may become the treatment of choice for this rare condition.

Summary

A case of chronic undermining ulceration is described. The condition responded dramatically to local penicillin treatment. The aetiology of the condition is discussed, and it is distinguished from chronic progressive post-operative cutaneous gangrene.

I would like to thank Mr. Reginald Vick for permission to publish this case.

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War-time nurses with good nursing experience who satisfy certain conditions will, if they decide to make nursing their peacetime career, be allowed six months' remission in their training for State Registration. This concession, agreed to in principle by the General Nursing Councils for England and Wales and for Scotland, will apply to all those who have had suitable nursing experience in the Forces, or as nursing auxiliary members of the Civil Nursing Reserve, British Red Cross Society, the St. John Ambulance Brigade, or the St. Andrew's Ambulance Association. Formal rules to give effect to the scheme are being prepared by the two General Nursing Councils for submission to Mr. Aneurin Bevan, Minister of Health, and Mr. Joseph Westwood, Secretary of State for Scotland. But meanwhile the two Ministers, in view of the urgency of attracting recruits to nursing, have written to the authorities concerned asking them to bring the scheme to the notice of all who may qualify for the concession.