Cerebral infarction is similarly due to a discrepancy between cerebral supply and demand for oxygen. Under adequate general anaesthesia, oxygen demands of the brain are so reduced (to less than half their normal value), that, unless gross anoxia such as that due to delay in treatment of cardiac arrest occurs, the oxygen supply is likely to be adequate. The brain is in a relatively protected state. Of the three patients in the current series whose cerebral infarcts occurred in the first week (on the day of operation and the first post-operative day), two had operations under local and one under spinal anaesthesia, so that this protection was lacking. Later in the post-operative course, continued narcotic administration, without the artificially augmented respiration of the operating-room, may cause respiratory depression and cerebral anoxia. Unfortunately it is the garrulous and wakeful patient with cerebral arteriosclerosis and a reversal of the normal sleep rhythm who is particularly likely to receive heavy nocturnal sedation. The high incidence of cerebrovascular accidents after cataract surgery and skeletal trauma is well known. The balance between the supply and demand of cerebral oxygen is so delicate that only a minor further mishap is needed to tip the scales. Anoxia follows, and need only be unrelieved for five minutes for the cerebral damage to be permanent.

Summary

A review of 30 patients who experienced cardiac or cerebral infarction during the 30 days following operation or accidental trauma suggests a biological difference between these two processes. Of the cardiac infarctions, 63% occurred during the operation or within the first three days after operation or injury. All but 23% occurred within the first week. To the contrary, the cerebrovascular accidents occurred without apparent predilection of time.

A period of hypotension was known to be associated with operation in 53% of the patients. Hypotension is known to result in a reduction in coronary flow. In the arteriosclerotic patient, whose coronary arteries are unable to dilate appreciably, the reduction in flow following hypotension is probably a major factor in the progression of ischaemia.

The complications could not be related to the anaesthetic agents used; indeed, eight followed the use of local analgesia. One patient received no anaesthesia (fractured humerus).

The increased oxygen requirements of the burdened heart, associated with the decreased coronary flow of hypotension, predispose it to an immediate oxygen deficiency. General anaesthesia reduces the oxygen demands of the brain so that an absolute oxygen deficit is as likely to be post-operative (atelectasis, narcotic respiratory depression, postural changes) as operative.

An urgent need is the rejection of the surgeon's concept that most of these complications are inevitable. Application and extension of the recognized principles of avoidance of anoxia, hypotension, and increased cardiac work in arteriosclerotic patients should prevent many of the myocardial infarctions. The biological and clinical factors underlying cerebrovascular accidents differ in not being specifically related to the period of trauma; attempted prevention necessitates the empirical application of such measures as adequate oxygenation, inhalation of carbon dioxide, and the avoidance of undue sedation in arteriosclerotic patients.

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TRENCH-FOOT IN PEACETIME ENGLAND

BY

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Severe injury from cold is seen in three main forms. Frostbite occurs if the temperature is low enough to cause actual freezing of tissues, while more prolonged exposure to a cold but non-freezing environment results in a trench-foot type of injury. Although this derives its name from its prevalence during the trench warfare of 1914–18, the occurrence of trench-foot among Napoleon's troops during the retreat from Moscow was described by Larrey (1812), and practically every military campaign fought in cold climates since that time has produced further cases. Similar to trench-foot in many respects is immersion foot, numerous examples of which were observed among shipwreck survivors in the 1939–45 war (Ungley and Blackwood, 1942; Webster, Woolhouse, and Johnston, 1942; White, 1943), while it has been suggested (Greene, 1941) that shelter foot is another type of local cold injury. It seems possible, however, that mechanical obstruction to the venous return, coupled with some deficiency of vitamin C, is more important than cold in the production of this last-named condition. Frostbite is a result of cold which may occur in time of war or peace (Brahdy, 1935; Kleitsch and Connors, 1954; Butler, 1957). Prolonged exposure to a low but non-freezing temperature is, however, very unlikely to occur under normal conditions of peace, and trench-foot is primarily a hazard of war.

The occurrence of two cases in peacetime England is rare enough to warrant this report. We have, in fact, been unable to find any record of similar cases occurring in this country, although the circumstances under which our patients sustained their injuries cannot be unique.

Case 1

A vagrant aged 54 first took to the roads in 1937. Apart from service with the Army from 1939 to 1945 he had had nothing but casual employment during that time, and had

been unemployed since December, 1955. During this most recent spell of unemployment he lived a precarious existence in the West End of London, and 16 days before admission he made his headquarters on a bombed site near Old Street Station. It was 10 weeks since he had taken off his shoes and socks, and while on the bombed site he became progressively less inclined to exert himself. Three days before admission his shoes fell apart and he remained relatively immobile. His feet were painful, but not excessively so. On March 20, 1956, he was too feeble to move, but his cries were heard by passers-by, and he was brought to St. Bartholomew's Hospital. Weather conditions during the period of exposure were average for the time of year. Recordings made at Regent's Park (see Table), which is approximately

Weather Conditions at Regent's Park (Case 1) and at Sprowston (Case 2)

Regent's Park

	March, 1956							
	13	14	15	16	17	18	19	20
Maximum temperature of day (°F.)	39	46	40	48	57	59	54	57
Minimum temperature of day (°F.)	32	31	31	29	31	38	35	37
Relative humidity at 9 a.m. G.M.T. (%)	70	79	80	89	84	83	91	92
Rainfall for 24 hours ending at 9 a.m. next day (in.)	0·0	Trace	0·0	0·0	0·0	0·0	Trace	0·10
Mean wind speed for day (m.p.h.) (Kingsway)	8	7	5	3	3	8	9	9

Sprowston

	December, 1953							
	16	17	18	19	20	21	22	23
Maximum temperature of day (°F.)	50	49	47	48	46	45	50	47
Minimum temperature of day (°F.)	34	48	41	42	42	31	34	41
Relative humidity at 9 a.m. G.M.T. (%)	93	94	97	88	81	92	100	100
Rainfall for 24 hours ending at 9 a.m. next day (in.)	0·0	0·0	0·40	Trace	0·0	Trace	0·02	0·01
Wind at 9 a.m. (speed m.p.h.)	4–7	4–7	1–3	19–24	4–7	4–7	4–7	4–7
	Soft (muddy) wet ground							

three miles (2.7 km.) from Old Street Station, showed a minimum temperature of 29° F. (−1.7° C.) on March 16 with a maximum of 59° F. (15° C.) two days later.

On examination he was unkempt and bearded, but coherent and not complaining of pain. His nutrition was good and there was no obvious dehydration. The blood pressure was 80/60, pulse rate 100, pulse regular, temperature 100° F. (37.8° C.), and respirations 16. His pupils reacted to light and accommodation, the fundi were normal, and his tongue was furred. His hands were warm and showed no evidence of injury from cold, while the heart, lungs, and abdomen were healthy. His feet and lower legs (Fig. 1) were oedematous. The toes were cold and pale, the feet cold and cyanosed, while the ankles and lower legs were hyperaemic. Active movements of the feet and toes were possible, and the knee- and ankle-jerks were present and equal. All sensation below the ankles was lost. The femoral and popliteal pulses were strong, but the peripheral pulses were not felt, although oscillometry showed good arterial pulsation below the knees and above the ankles. The neurological system was normal, apart from the sensory changes in the legs.

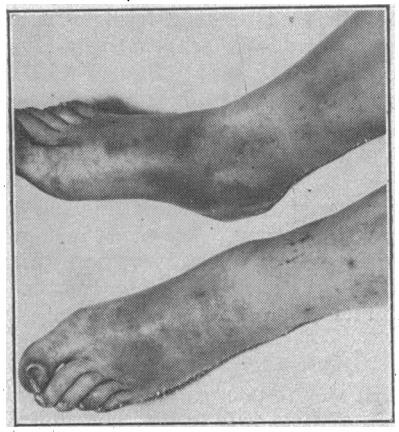

FIG. 1.—Case 1, on admission.

Investigations.—Examination of the blood showed: Hb, 70% (Haldane); white cells, 10,000/c.mm. (polymorphs 82%, lymphocytes 12%, monocytes 6%); E.S.R., 25 mm. in the first hour (Westergren); W.R. and Kahn, negative; plasma protein, albumin 3.7 g./100 ml., globulin 2.8 g./100 ml. *X*-ray examination of the chest showed nothing abnormal, while that of the legs gave no evidence of arterial calcification. The urine had a specific gravity of 1020 and contained no albumin or sugar.

Treatment and Progress.—He was put to bed at normal room temperature with the feet elevated and exposed to the air. His general condition rapidly improved on a normal diet and fluid intake, his blood pressure rising to 120/80, but an intermittent pyrexia continued and transient albuminuria occurred 24 hours after admission. He was given 2 pints (1,140 ml.) of fresh blood, A.T.S., and penicillin, while a course of anticoagulant therapy was begun with phenindione ("dindevan"). On the day after admission a right temporary lumbar sympathetic block was performed with no noticeable effect, and thereafter he was given brandy, 1 oz. (28 ml.) twelve-hourly. After one week the swelling had largely subsided and the toes were becoming black. The distal parts of the feet were mauve, the proximal regions red, and large blisters had appeared. At this stage 10 ml. of 5% fluorescein was given intravenously and the feet were viewed under ultra-violet light. Fluorescence was observed throughout the feet and toes, although less well marked in the blackened areas, indicating that a good circulation was still in being. Five weeks after admission the skin over the feet, proximally, was blackened, while the gangrene affecting the toes was spreading proximally. The fluorescein test was repeated and good fluorescence was again observed in the feet distally and the toes. Despite this apparently favourable prognostic sign the general trend was gradually downhill. Although sensory perception spread to below the ankle and some new skin grew slowly downwards, the gangrene became more extensive (Fig. 2), until 12 weeks after admission bilateral below-knee amputations were performed.

FIG. 2.—Case 1, twelve weeks after admission.

Case 2

A Norwich youth aged 20 arrived home late on the evening of December 16, 1953, to find the doors locked and his parents in bed. Rather than risk their anger by awakening them he repaired to Mousehold Heath and slept under a bush. There he apparently remained for seven days, until December 23, when his cries attracted the attention of a passer-by and he was taken to the Norfolk and Norwich Hospital. Apart from some evidence of recent psychological maladjustment there was no relevant past or family history.

Weather conditions at the time of exposure were mild for the time of year. Recordings made at Sprowston (see Table), 1½ miles (1.4 km.) from where the boy was lying, showed a minimum temperature of 31° F. (−0.6° C.) on December 21 and a maximum temperature of 50° F. (10° C.) on the following day.

On examination he was conscious and coherent, but shocked, dehydrated, and very dirty. His pulse rate was 120, pulse regular, temperature 95° F. (35° C.), respirations 20, while the blood pressure was unrecordable. His eyes were sunken, but his pupils reacted to light and accommodation and the fundi were normal. His tongue was furred and there was surgical emphysema over the left pectoral and axillary regions, but the heart, lungs, and abdomen were otherwise normal. His hands were cold but showed no evidence of injury through cold. His feet and lower legs were grossly oedematous and cold, showing a blotchy cyanosis intermingled with areas of erythema and pallor. He was unable to move his feet, the ankle-jerks were unobtainable, while sensory perception below the knees was absent. The femoral pulses were palpable, but the more peripheral pulses could not be felt. There were no neurological abnormalities apart from those found in the legs.

Investigations.—Hb, 125% (Haldane); blood urea, 240 mg./100 ml.; plasma albumin, 5 g./100 ml., globulin 2 g./100 ml. The serum sodium, potassium, and chloride were normal. *X*-ray examination of the chest confirmed the presence of surgical emphysema and also revealed a small left pneumothorax. The urine was sterile and contained a small amount of protein, while microscopically it was normal.

Treatment and Progress.—He was put at rest in bed with the feet exposed, no excessive warmth being applied to the body or feet. A.T.S. and penicillin were administered, and during the first 12 hours he received intravenously 2 pints (1,140 ml.) of plasma and 3 litres of glucose–saline. As a result his general condition rapidly improved, the B.P. rising to 120/70. During the next two weeks this general improvement was maintained. The surgical emphysema disappeared, but his urine continued to be of low specific gravity and contained albumin. The blood urea rose initially to 300 mg./100 ml., but returned to the normal level of

FIG. 3.—Case 2, four weeks after admission.

40 mg./100 ml. 15 days after admission. Although the feet had become grossly blistered they also improved remarkably. They became hyperaemic and warm, and movement and some sensory perception returned. Four weeks after admission, however, areas of superficial gangrene had appeared (Fig. 3) and by April, 1954, the patient was emaciated and toxic, with bilateral infected gangrene. Local excision with skin grafting produced some temporary benefit, but gradual progression of the gangrene occurred and bilateral below-knee amputations were performed on July 1.

Discussion

Exposure to cold is, of course, necessary for the production of local cold injury, but constrictive clothing, immobility, wind-blast, damp, lowered body temperature, malnutrition, shock, and wounds may all be contributory factors. The means whereby tissue damage is produced is disputed, and while vasoconstriction, oedema (Greene, 1943), and intravascular sludging of red blood cells leading to thrombosis (Lange *et al.*, 1947) have been put forward as possible mechanisms, the balance of recent experimental evidence (Lewis, 1951, 1955) suggests that the direct noxious effect of cold on the tissues is the most important factor. The clinical picture is classically divided into pre-hyperaemic, hyperaemic, and post-hyperaemic stages, and there may be no qualitative difference between the symptoms of frostbite and those of trench or immersion foot (Lewis and Moen, 1952). The systemic sequelae are few, but renal damage has been reported both in the human (Laufman, 1951) and in the experimental animal (Lewis and Thompson, 1951). Case 2 showed evidence of gross renal impairment, but whether this was the result of shock or cold injury or a combination of both it is not possible to say.

Three main lines of early treatment have been advocated. In the experimental (Kreyberg, 1948) and clinical (Isaacson and Harrell, 1953) fields sympathectomy has proved of little benefit, possibly because sympathetic paralysis is already present in the cold injured part (Webster *et al.*, 1942), and the failure of a sympathetic block to produce any demonstrable effect in Case 1 was not unexpected. Although Lange and Loewe (1946) and Lange *et al.* (1947) are keen advocates of anticoagulant therapy, their enthusiasm is not shared by Fuhrman and Crismon (1947) or Pichotka and Lewis (1949), while their results are frankly doubted by Lewis and Moen (1953). On the basis that anticoagulants might prevent the effects of secondary thrombosis and at all events would do no harm, such treatment was employed in Case 1.

The only form of therapy which has been uniformly beneficial in experimental studies is rapid thawing (Fuhrman and Crismon, 1947; Lempke and Shumacker, 1951; Pichotka and Lewis, 1951), while Adams-Ray and Falconer (1951) obtained some confirmation of these findings in humans. Overheating (above 37.5° C.) must, of course, be avoided, and if the results of animal experiments are applicable to man (Entin and Baxter, 1952; Lewis and Hoak, 1956) any beneficial effect will be lost if thawing is delayed longer than a few hours after removal from the cold environment (Edwards, 1951).

It is hoped that the opportunity will never arise for a controlled trial of different methods of treatment of local cold injury, and until such circumstances do arise opinion must, of necessity, be strongly influenced by recent experimental findings. On this basis current views on management may be summarized as follows. Immediate immobilization and rapid admission to hospital, trauma of any sort being carefully avoided; exposure of affected parts to room temperature, but, when controlled facilities are available for rapid warming to 37.5° C., these should be employed within six hours of removal of the patient from the cold environment; anticoagulant therapy, if no definite contraindication is present, together with general nursing care, adequate food and fluid intake, and prophylactic A.T.S. and antibiotics. Once the hyperaemic stage has been reached the patient will be more comfortable with the limbs exposed to a cool environment, although active cooling should be avoided, while the position of the limbs will be dictated by the amount of swelling present. Sympathectomy or ganglion-blocking drugs are not helpful in the pre-hyperaemic or hyperaemic stages, but either may be usefully employed in the post-hyperaemic state.

Accurate prognosis is difficult. In neither of the cases reported here was there any indication, when first seen, that such extensive tissue loss would occur. The fluorescein test (Lange and Boyd, 1945) was performed in Case 1 one and

five weeks after exposure, and good fluorescence was observed throughout both feet, even in toes which were already blackened. As an indication of expected tissue loss it was useless, but it certainly revealed the presence of a brisk circulation and in so doing gave strong support to Lewis's theory of direct thermal injury.

Summary

An account is given of two cases of trench-foot which occurred as a result of abnormal exposure in peacetime England.

It appears likely that trench-foot, immersion foot, and frostbite are but variants of the same clinical condition, the most important aetiological factor being in all cases a direct noxious effect of cold.

Recent experimental evidence favours early rapid warming to body temperature as the most effective form of treatment, and, provided suitable facilities are available to avoid overheating, the clinical application of this principle is advocated.

Our thanks are due to Dr. K. O. Black for permission to publish Case 1 and Dr. B. Branford Morgan for permission to publish Case 2. We are grateful to the Director of the Meteorological Office, Air Ministry, for details of weather conditions at the relevant times; and to Mr. N. K. Harrison for the photographs.

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The Institute of Dermatology held an open day on April 21 at St. John's Hospital for Diseases of the Skin, London. The object was to show visitors, both medical and lay, the research which is being done there. This includes research into the reaction of normal and abnormal skin to light which has made it possible to define light sensitivity in terms of very narrow wavelengths; work on the use of radioactive isotopes in the treatment of haemangiomata; investigations on epidermal sensitivity and the use of patch tests, particularly for cement and alkali dermatitis and cheilitis due to lipstick; and studies of the application of histochemical techniques to the detection of enzyme activity, and of cytodiagnosis to the diagnosis of skin lesions. There were also demonstrations of the L.E.-cell phenomenon, of methods of diagnosing scabies and ringworm of the nails, and of research on the penetration of ringworm fungi into hair keratin. Other studies included a survey of the serum proteins in skin diseases, particularly psoriasis, and an investigation of the changes in the nucleic acids and respiratory enzymes brought about by ultra-violet irradiation of the skin. There was also an exhibition of ointment bases. Although the main object of the open day was to demonstrate research, the opportunity was taken to display the very large collection of coloured photographs and wax moulages which is being built up for teaching purposes.

THE POTTER SYNDROME OF RENAL AGENESIS

BY

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In 1946 Potter published a series of 20 cases in infants in whom bilateral absence of the kidneys was associated with a hypoplasia of the lungs and a characteristic facies. Her description of the facies, unfortunately labelled by some as the facies renalis, cannot be bettered, and reads: "The face most characteristically exhibits an increased space between the eyes, a prominent fold which arises at the inner canthus and sweeps downwards and laterally below the eyes, an unusual flattening of the nose, excessive recession of the chin, and moderate enlargement and decreased chondrification of the ears. The face gives a suggestion of premature senility." Thus, as in mongolism, recognition of this unusual appearance and knowledge of its implications are of the utmost importance in prognosis. Such children are generally regarded as rare occurrences, but recent experience in this unit suggests this may not be so, and details of five such cases are given in the accompanying Table. Two of the mothers are known to have had normal children subsequently.

Discussion

These five infants demonstrate several features typical of this condition. Unlike most mothers of children with congenital abnormalities, all these mothers were primiparae and, at the ages of 20, 20, 21, 28, and 30, none remarkably late in child-bearing. In three, presentation was by breech, again quite frequent with this abnormality. In three a lack of amniotic fluid was apparent, and this, too, is exceedingly common, though not universal. Selby and Parmelee (1956) have described the case of an infant with this condition born tightly encased in intact membranes devoid of fluid, whilst in other reports the quantity of fluid appears normal, so that, whatever the origin of amniotic fluid, it can receive no more than a contribution from the foetal urine, as has been suggested in the past. There is a strong sex linkage, most instances being in males, and the child is most often born prematurely, weighing less even than the dates might lead one to expect. About two-thirds (Davidson and Ross, 1954) are liveborn but live for only a few hours, as the lungs are incapable of supporting life. Only a few have lived beyond a day, but Woolf and Allen (1953) have recorded an exceptional instance of a child living without kidneys for 39 days. Renal agenesis has been recorded several times in two members of the same family (Schmidt *et al.*, 1952; Baron, 1954) and in one of twins (Levin, 1952) —the twins shared the same placenta and were thought probably to be identical.

As might be expected, other congenital malformations are often found in these infants, but their pattern is again unusual, the majority involving the lower limbs and to a less extent the anus and external genitalia. Neither the typical facies nor the lung changes occur in every case, although most of those described since 1946 have done so. Of the 232 cases collected by Davidson and Ross (1954) only about 20% had no other notable evidence of abnormality and a further 10% had talipes, toe deformity, and other minor abnormality. Most of the lower-limb abnormalities are gross: absent kidneys are commonly associated with apus, monopus, and sirenomelia (the mermaid deformity). Whilst many of these are associated abnormalities, some may be secondary to the lack of amniotic fluid. Denis Browne (1955) believes abnormal mechanical intrauterine