

the individual, and not limited to a single remedy. But of all the remedies and preventive measures, occupational adjustment will, under present conditions and for such a group, be the most potent, critical and urgent, both from the standpoint of the individual's well-being and of the community's needs. These are hardly separable, since the satisfactions of the individual depend in some measure on his knowledge of the part he is playing in serving the needs of the community. Considerations of this sort, hitherto more familiar to students of industrial psychology than to doctors, have lately become matters for public discussion. In wartime almost everybody can rely upon having the elementary social satisfaction, which no insurance payments were able to give the unemployed, of taking a useful part in the activities of his social group. . . . As in so many social problems, the economic factors, because they are tangible and easy to formulate, create a screen which masks subtler psychological preoccupations" (*Times*, Nov. 19, 1942). The working conditions, both material and psychological, which are good for normal healthy workers (Viteles 1933, Wyatt and Langdon 1937, Collier 1940, Roethlisberger and Dickson 1939) are those which benefit the neurotic worker too; but the penalties for ignoring the sound principles of industrial psychology are more quickly and plainly made evident in the men with neurotic traits or symptoms. These principles can best be put into effect when the doctor (especially the psychiatrist), and the occupational adviser or administrator (especially the officer of the employment exchange and the personnel manager), work in conjunction making the most of the necessarily limited facilities at present for appropriate placement or transfer of workers.

## SUMMARY

A series of 120 soldiers discharged from the Army on account of neurotic illness were investigated by personal visits to their homes, which were in London. The average interval since their discharge into civilian life was 6½ months.

Their pre-service occupations had been: professional and managerial 8; clerical and sales 20; domestic and personal service 19; Regular Army 5; skilled 17; semiskilled 37; unskilled 20.

Their occupations at the time of the inquiry were professional and managerial 4; clerical and sales 19; domestic and personal service 14; ARP 7; skilled 14; semiskilled 25; unskilled 22; 15 were unemployed.

Of the 15 unemployed, 11 had done no work at all since leaving the hospital. The total duration of unemployment for the whole group was a third of the total period since their discharge; part of this was accounted for by the period of 1 month on pay which is allowed to category E men after leaving hospital; 22% of the men were responsible for 55% of the total duration of unemployment of the whole group; 24 of the men had not obtained any work within the first 3 months after discharge.

In spite of the general rise in wage-rates and earnings, 53 of the men are now earning less than they did before enlistment.

Of the 105 in employment, 44 are doing only light or desultory work.

There was evidence that 39 patients were socially unsatisfactory otherwise than in their occupations; they had been guilty of minor delinquency or were inordinately irritable and quarrelsome.

Their relatives considered 58 men to be in as good health as before enlistment; 63 had attended a general practitioner since discharge; 15 had been to a hospital.

An inquiry by letter was sent to another group of men discharged from the Army on account of neurosis whose homes were in the Provinces or in Wales. To 95 inquiries there were 67 answers; 4 wrote that they were unemployed, and 12 that their work was not satisfactory. The other 51 are working; 15 of these reported that their health was not good, and 8 that they were in better health than ever.

A postal inquiry on the same lines was sent to the labour exchanges of the districts to which 97 ex-soldiers with homes elsewhere than in London had returned; 66 replies were received; 59 of the men are at work.

The number of men who returned to the same sort of work under the same employer is high in all three groups.

Of the 120 Londoners, 39 did this; of the 67 in the Provinces who replied to a personal letter, 25; and of the 66 reported on by the labour exchange, 31.

Comparison of the findings at different periods between March, 1941, and June, 1942, shows that the proportion of these men who could be classed as socially satisfactory since discharge had risen. In August, 1941, when inquiries had been made about 60 of the 120 men, 22% were unemployed, and only 35% could be classed as socially satisfactory in respect of work and otherwise; by June, 1942, when the whole 120 had been visited, the corresponding figures were 12% and 50%. Such percentages cannot be used for exact comparison because of the somewhat arbitrary nature of any judgment as to whether a man is socially satisfactory, but they show a decided trend, here attributed to the increasing demand for labour, and to the introduction of an official scheme of rehabilitation in which the doctor and the employment exchange can cooperate in all cases.

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## ERYTHROPOIESIS IN SCURVY

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 FLIGHT-LIEUTENANT RA F V R

ANÆMIA is a classical feature of scurvy, but the changes in the bone-marrow that accompany this anæmia are less well known. The standard textbooks describe the bone-marrow as hypoplastic or fibrotic, and Harris (1927-28), in a full description of the morbid anatomy of infantile scurvy-rickets, described formation of a gelatinous marrow with failure of normal erythropoiesis. Mettler, Minot and Townsend (1930) examined the marrow obtained by sternal biopsy in an adult patient with typical scurvy; before treatment they found a moderate hyperplasia with scattered small groups of erythroblasts and no fibrosis; after treatment cellularity was not much changed, but there were more erythroblasts and mitotic figures were seen among them. This observation was interpreted by Witts (1932) as suggesting that ascorbic acid (vitamin C) was one of the factors important for proper maturation of red blood-cells from normoblasts. Parsons and Smallwood (1935) disagreed; they argued that increased mitosis indicated merely increased production rather than maturation, and in their opinion slowing down of the whole process of erythropoiesis was the cardinal feature of scurvy; but they did not support this thesis by describing any observations of their own on the marrow changes. Jennings and Glazebrook (1938) carried out sternal punctures on two cases of typical adult scurvy; in one the marrow picture was complicated by the coincidence of pernicious anæmia, in the other patient there were 18% of erythroblasts of various types, which is within normal limits. They did not mention the cellularity of the marrow nor did they repeat the punctures after treatment. In the present paper the results obtained on three patients with typical scurvy are given; blood-counts and sternal marrow punctures were carried out before treatment, and the time when the patients were excreting not less than 50% of a test oral dose of ascorbic acid within 24 hours was taken as a convenient point for repetition of these investigations.

## CASE-RECORDS

CASE 1.—A commercial traveller, aged 57, was admitted to hospital on April 27, 1941, complaining of extensive and persistent bruising and disability of the left ankle following a "sprain" 8 weeks previously. He also had had for about 10 days swollen and bleeding gums and a foul taste in the mouth. On examination the gums were swollen and purple; the teeth carious, blackened and loose. His complexion was sallow and mucous membranes pale. The region of the left ankle-joint was swollen, tender and discoloured; there was a purpuric rash on the leg from knee to ankle and a

BLOOD AND BONE-MARROW COUNTS IN SCURVY  
Differential counts represent percentages of total nucleated cells

|                              | CASE 1    |       | CASE 2    |       | CASE 3    |       |
|------------------------------|-----------|-------|-----------|-------|-----------|-------|
|                              | Treatment |       | Treatment |       | Treatment |       |
|                              | Before    | After | Before    | After | Before    | After |
| <b>BLOOD</b>                 |           |       |           |       |           |       |
| Red cells *                  | 3.050     | 4.600 | 3.160     | 4.320 | 4.010     | 4.420 |
| Hæmoglobin †                 | 57        | 90    | 66        | 86    | 70        | 82    |
| Colour-index                 | 0.95      | 0.95  | 1.06      | 1.00  | 0.87      | 0.93  |
| White cells ‡                | 5200      | 7200  | 5600      | 5600  | 3300      | 5400  |
| Polymorpha %                 | 61.0      | 61.0  | 53.0      | 60.0  | 71.0      | 62.5  |
| Eosinophils %                | 1.5       | 2.5   | 1.5       | 3.0   | 1.5       | 0     |
| Basophils %                  | 0         | 0     | 0         | 1.0   | 0         | 0     |
| Lymphocytes %                | 35.0      | 31.0  | 39.5      | 31.0  | 24.0      | 33.5  |
| Monocytes %                  | 2.5       | 5.5   | 6.0       | 5.0   | 3.5       | 4.0   |
| <b>BONE-MARROW (cells %)</b> |           |       |           |       |           |       |
| Hæmocyto blasts              | 0         | 0.8   | 0         | 0     | 0         | 0     |
| Pro-erythroblasts            | 0         | 1.8   | 0.6       | 1.6   | 2.4       | 3.2   |
| Normoblasts (total)          | 7.4       | 41.0  | 2.0       | 33.2  | 39.4      | 44.6  |
| Early                        | 7.0       | 3.4   | 0         | 5.0   | 2.4       | 2.8   |
| Intermediate                 | 3.6       | 20.2  | 1.4       | 19.0  | 22.0      | 29.0  |
| Late                         | 2.8       | 17.4  | 0.6       | 9.2   | 15.0      | 12.8  |
| Polymorpha                   | 56.0      | 20.0  | 56.6      | 21.2  | 15.2      | 20.0  |
| Eosinophils                  | 1.0       | 2.0   | 0.6       | 1.8   | 1.6       | 1.0   |
| Basophils                    | 0.4       | 0.2   | 0.6       | 0.4   | 0.6       | 0.4   |
| Metamyelocytes               | 3.4       | 14.0  | 13.4      | 16.0  | 12.2      | 13.4  |
| Myelocytes                   | 2.4       | 12.0  | 2.6       | 14.0  | 15.2      | 12.6  |
| Myeloblasts                  | 1.6       | 0.8   | 0         | 1.0   | 0.6       | 0.6   |
| Lymphocytes                  | 26.0      | 4.2   | 22.6      | 9.6   | 8.2       | 3.2   |
| Plasma cells                 | 1.2       | 2.4   | 0.6       | 1.2   | 3.6       | 2.4   |
| Monocytes                    | 0.6       | 0.8   | 0.4       | 0     | 1.0       | 0     |
| Cellularity                  | Dim.      | Incr. | Dim.      | Norm. | Norm.     | Norm. |

\* Millions per c.mm. † Per cent. Haldane. ‡ Per c.mm.  
No megakaryoblasts seen in any specimen.

"After treatment" indicates ascorbic acid given to the point where about 50% of a test oral dose was excreted within 24 hours. Nomenclature of marrow cells according to Israël (1941).

similarly distributed rash was also present on the right leg. Nothing specially unusual was found on examination of the heart, lungs, abdomen or central nervous system. His diet consisted mainly of puddings, eggs and bacon; no vegetables or fruit had been taken for at least 12 months.

The urinary excretion of ascorbic acid was very small and the blood ascorbic acid was less than 0.1 mg. per 100 c.cm. Ascorbic acid was given by mouth and 6500 mg. was needed to raise the urinary excretion to 50% and the blood ascorbic acid to 2 mg. per 100 c.cm. The blood-count showed a normocytic anaemia and the sternal marrow was hypoplastic, the erythroblasts and granulocytes being particularly depressed. After treatment with ascorbic acid the anaemia disappeared; there was greatly increased activity of the erythropoietic marrow, many normoblasts were now present and quite a few showed early hæmoglobinisation. Figures are given in the table. No iron or liver was given with the ascorbic acid. The clinical signs and symptoms rapidly cleared, except for the ankle which remained stiff and rather painful for some weeks.

CASE 2.—A worker in a rubber factory, aged 47, had noticed pain and swelling of his right ankle for about 10 weeks before coming to hospital. Two weeks later a dark-blue patch appeared on the inner side of the left knee which spread round the joint; movement of the joint became painful. Further discoloured areas appeared on the left thigh and leg and also on the right leg. There was no affection of the mouth. His appetite was good but he had always disliked fresh fruit and vegetables; in 1930 he had "gastritis" and since then had restricted his diet. His work was carried on in a hot and dusty atmosphere, but he took little alcohol. On examination the left lower limb showed ecchymoses of varying size all over from the gluteal fold to the ankle; the left knee was discoloured and swollen and movement was painful. The right ankle was swollen and tender and the skin over it was reddish; there was a large ecchymosis on the outer side of the right knee. The gums were unaffected.

The urinary excretion of ascorbic acid was very small and the blood ascorbic acid was 0.15 mg. per 100 c.cm.; an oral dose of 5500 mg. ascorbic acid was needed before excretion rose to 50%, and the blood ascorbic acid was then 2.1 mg. per 100 c.cm. The blood-count showed a normocytic anaemia; the marrow was less cellular than normal, erythroblasts were particularly depressed. After treatment with ascorbic acid

the anaemia improved rapidly and the marrow regained its normal cellularity, considerable erythropoietic activity being visible. Figures are given in the table. No iron or liver treatment was given. The clinical signs and symptoms also rapidly improved, though some residual pain in the affected joints persisted for some weeks.

CASE 3.—A capworker, aged 66, was sent by his panel doctor on account of bruising and a hæmorrhagic rash on the legs which had been getting worse for 6 weeks; the right knee in particular was swollen and painful. On examination both legs showed petechia and ecchymoses; the right knee was discoloured and swollen posteriorly, and movement was painful. The gums were swollen and discoloured and there were a few hæmorrhagic spots; the remaining teeth were carious and dirty. The skin of the lower abdomen showed typical follicular hyperkeratosis. He was rather pale. No exceptional signs were found in the other systems. His diet consisted chiefly of bread, tea, margarine and his meat ration; he lived mostly alone and had no facilities for proper cooking.

The urinary excretion of ascorbic acid was very small and the blood ascorbic acid was 0.08 mg. per 100 c.cm. For saturation to 50% excretion point 3200 mg. of ascorbic acid was required, and the blood ascorbic acid was then 1.85 mg. per 100 c.cm. The blood-count showed a mild microcytic anaemia, and in this patient the bone-marrow was practically normal; cellularity was not diminished and normoblasts were 39.4%. Treatment with ascorbic acid was followed by increased hæmoglobin in the blood; the marrow became more cellular, and although the proportion of normoblasts was not significantly increased there were signs of enhanced erythropoietic activity such as the presence of many mitotic figures and early hæmoglobinisation. Figures are in the table. After treatment the hæmorrhages soon faded, the hyperkeratosis disappeared, and the general condition improved. A maintenance dose of 50 mg. ascorbic acid was given daily; no iron or liver was given at any time.

#### DISCUSSION

In two of the patients the marrow showed the diminished cellularity and failure of erythropoiesis classically associated with scurvy; case 3 showed changes resembling the patient of Mettier and others (1930). The erythroblasts showed no evidence of failure of maturation at any particular stage of development such as distortion or failure of hæmoglobinisation; in cases 1 and 2 they were simply fewer than usual. The marrow in the recovery phase presented the usual picture of response to loss of blood-cells. It is difficult to eliminate failure of maturation, but evidently it is not a primary cause of the anaemia of scurvy; as Parsons and Smallwood (1935) said, slowing down of erythropoiesis is the main factor.

That lack of ascorbic acid in the diet may eventually lead to depression of erythropoiesis and consequent anaemia should be borne in mind, especially under present conditions of dietary restriction. Recent work has justifiably drawn attention to the increased incidence of anaemia, particularly among pregnant women, and inadequacy of iron in the diet has been suggested as the cause (Kay and Alston 1941, and see *Lancet*, 1942 and 1943). Present-day diets, particularly in winter, are also deficient in ascorbic acid; the evidence given here shows that this may well be a contributory cause of this anaemia, and ascorbic acid should be given to any patient whose anaemia does not respond satisfactorily to iron.

#### SUMMARY

The bone-marrow changes in three cases of scurvy with anaemia, before and after ascorbic acid treatment, are described. In two patients there was evidence of diminished erythropoiesis, in the third erythropoiesis was not significantly abnormal.

After ascorbic acid treatment the marrow showed increased erythropoiesis in all the patients. The anaemia also rapidly improved without any specific anti-anaemic treatment.

The effect of ascorbic acid deficiency seems to be more a depression of erythropoiesis than a failure of maturation at any particular stage.

The possible relation of the present shortage of ascorbic acid in the diet to the increased incidence of anaemia is mentioned.

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## BONE AND JOINT INJURIES\*

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By the impetus of war, promoting the development of surgery and of medicine, more suffering has been saved than was inflicted by all the wars of history. In pre-Listerian days a compound fracture was no less deadly than bubonic plague; and since that day, despite increasing violence, despite the multiplicity of wounds and the gravity of contamination, the mortality of compound fractures has been steadily reduced by the development of surgical skill to 70 or 80% in the early months of the last world war, to 10% in the concluding months of that war, to a fraction of 1% in the recent Spanish war, and a similar proportion in the war upon which we are now engaged. Not only lives but limbs are saved. Dominique Jean Larrey who died in 1842 is reported to have amputated 200 limbs in a single day; the casualty surgeon of 1943 is unlikely to amputate so many in the whole of his surgical career. No limb is amputated unless there is irretrievable destruction of the main blood-vessels. In a series of Royal Air Force base hospitals the incidence of late amputation for spreading infection, gas gangrene, secondary hæmorrhage and other sequelæ of wound infection was 0.1%—one amputation per 1000 severe limb injuries including infected wounds and compound fractures.

Gas gangrene has almost disappeared from the infection of wounds, and I do not hesitate to predict that, when the organisation of casualty services is so perfected that every wound is excised within a few hours, it will disappear altogether. In a series of 600 casualties from a recent action treated in Canadian base hospitals in the South there was an average time-interval of 31 hours between wounding and surgical intervention; and gas gangrene was recognised on admission in 2.2% of cases; but there was not a single instance of postoperative gas gangrene in cases submitted to wound excision and debridement. In my experience of casualty surgery in bombed cities, where despite the gravity of crushing and explosive injuries most wounds can be treated within a few hours, I have yet to see my first civilian case of gas gangrene in this war.

Not only are lives saved, not only are limbs saved, but function is saved. The malunion and non-union which were so common in former years have almost disappeared. Pseudarthrosis will soon be deleted from the list of complications of fractures. It is true that the principle of complete and continuous immobilisation has recently been subjected to another attack. Nevertheless, whether you agree with me in securing as complete an immobilisation as possible, or whether you accept a sort of homœopathic doctrine that whereas much movement is bad, little movement is good, there can be but one answer to the question "How long should this fracture be immobilised?" and the answer is "Until the fracture is united." Every fracture with an ossifiable medium between the fragments will unite if it is immobilised long enough—and this applies to closed fractures, open fractures and infected fractures. Infection is a cause of slow union, but not of non-union. In a consecutive series of 500 fractures of the shafts of the femur and tibia recently treated by many surgeons in RAF hospitals, despite a high incidence of contaminated, infected and grossly comminuted fractures, there was not a single case of established non-union.

The control of infection is within sight, and the day may not be far distant when a chemotherapeutic agent is available for every pathogenic organism, including, I trust, the tubercle bacillus and the viruses of poliomyelitis, influenza and other infections. In the treatment of shock, hæmorrhage and the crush syndrome and the practice of blood and plasma transfusion, great progress has been made. Pioneer work in the treatment of burns recently developed in this city is already gaining recognition. Operative technique and manual dexterity which Professor Illingworth described only two months ago, in a most excellent textbook, as "the hallmark of surgical craftsmanship" has gained impetus from metallurgical research adapted to the internal fixation of fractures and the technique of bone grafting. Casualty and accident services are being organised—and the cities of Scotland may yet gain a lead over the capital city of England. Rehabilitation, reconditioning and vocational retraining are being developed. Never was surgery more full of promise; never was there greater hope of future progress; never since the days of Hippocrates could a young surgeon say with greater conviction "this is the age I would have chosen."

## DANGERS OF TOURNIQUETS

"More limbs and lives have been lost by the improper use of the tourniquet than have been saved by its proper use."

In teaching first-aid workers, hours are devoted to a consideration of pressure points and tourniquets. Yet if a tourniquet is not applied tightly enough, the veins are obstructed but not the arteries; we all have memories of operating on limbs when the tourniquet has slipped, and gaining relief from hæmorrhage for the first time when the tourniquet was removed. I have vivid recollections of a child who for this reason almost bled to death; the tourniquet had been far more perilous than the wound. On the other hand if the unfortunate ambulance worker applies the tourniquet too tightly he is more than likely to cause traumatic arterial spasm and gangrene. It is not enough to remove the tourniquet at intervals, for if spasm is once induced it continues whether the tourniquet is removed or not and many cases of ischæmic contracture and gangrene have been recorded. The danger arises from the force with which the tourniquet is applied, just as much as the length of time that it is in position, and how is the inexperienced ambulance worker to judge with precision between the danger of applying a tourniquet too tightly and the still greater danger of not applying it tightly enough? There is yet another danger; the defence of the wound against infection, and particularly against anaerobic infection, depends upon the vitality, the blood-supply and the oxygenation of tissues; if wounds already devitalised are completely cut off from their blood-supply for half an hour or more they are rendered anaerobic, they become a suitable medium for the growth of anaerobic organisms, and a vicious circle is set up— infection, tension, devitalisation, therefore more infection, more tension and so on.

The dangers associated with the application of tourniquets by amateurs are so real that I suggest re-consideration of the question as to whether tourniquets are ever necessary in first-aid treatment. John Hunter gave us the answer: "An amputation below the knee in most cases would not kill by its hæmorrhage even if left to itself." When he divided the blood-vessels in the thigh of a boar bleeding ceased before the animal weakened. After exposure of the posterior tibial artery of a dog, he found the vessel so contracted as to prevent the blood from passing through, and when divided the blood only oozed from the orifice. Hunter's experimental work was the first recognition of segmentary spasm of arteries—or as it was subsequently called Kroh's arterial spasm or "stuteur arterielle"—the reflex vasoconstriction which protects against rapid and complete exsanguination. Animals do not bleed to death from complete division of an artery; neither does man. In the last war Makins recorded cases of large arteries severed by bullets without external hæmorrhage or hematoma formation. In this war an airman's foot was severed by the propeller blade of an aircraft and with no tourniquet having been applied he was admitted to hospital in excellent condition having suffered little

\* Extracts from the John Burns lecture delivered before the Glasgow Faculty on Jan. 13, to appear in full in the *Glasgow Medical Journal*.

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