ment team. I have naturally therefore tended to speak of human relations in industry in terms of the attitude of "management" to workers. But I do want to emphasize that to think in these terms alone is quite inadequate. Human relations in any case are a two-way business, and the success of anything that can be done depends not merely on how management behaves to workers but on how the individual workers respond. But there are some things which seem to me to be clear beyond all doubt.

The first is that management if it wants to retain leadership should not argue about who is to blame, but should itself accept responsibility for giving a constructive lead.

The second is this. To-day we must all make a choice between two alternative ways. Are we to go forward or back? Are we to play down to the worst motives—fear and greed—or play up to the best—pride in the job, a sense of responsibility, a desire to act a worthy part in life? I have no doubt about what is the right answer, whether viewed as a matter of practical expediency or moral rightness. The only hope is to go forward, and the chief task is to clear away the obstacles which hinder the better motives having free play.

RAT-BITE FEVER DUE TO STREPTOBACILLUS MONILIFORMIS

BY

I. R. W. LOMINSKI, M.D.
A. STEWART HENDERSON, M.B., Ch.B.

AND

J. W. McNEE, M.D., F.R.C.P.

(From the Departments of Bacteriology and Medicine,
University and Western Infirmary of Glasgow)

After many years of difficulty and confusion it is now clearly established that rat-bite fever may arise from two distinct infecting agents. Not all cases are due to actual rat bites, and in the absence of a clear history clinical differentiation of the two types is generally impossible and bacteriological evidence alone conclusive. Infection with *Spirillum minus* (originally named *Spirochaeta morsus muris* by its Japanese discoverers in 1916–17) is the commoner variety, and very many cases are on record. Infection with *Streptobacillus moniliformis* is much rarer, and Altmeier, Snyder, and Howe (1945) could trace only 17 examples published in the United States. This micro-organism was first discovered by Schottmüller in 1914, and classified by him as a streptothrix. The present name was first applied by Levaditi, Nicolau, and Poincloux in 1925, who isolated it from a laboratory worker, who, incidentally, had not been bitten by a rat.

The whole story of the elucidation of rat-bite fever of both varieties, including the relations of the streptobacillus to Haverhill fever and to the organismal cause of pleuropneumonia in cattle, is very fully reviewed by Brown and Nune-maker (1942). The incubation period of the spirillar infection is usually longer (seven days or much more) than in the streptobacillary disease (three days or more), but the period is so variable that only a clear history of a bite followed by a long interval before illness develops might clinically suggest the spirillar variety.

The newer arsenical drugs were quickly recognized to be very effective against the *Spirillum minus*, but the streptobacillary disease ran a protracted and serious course until the advent of penicillin.

This short account of a single case is intended to draw renewed attention to the *Streptobacillus moniliformis* as a

cause of rat-bite fever in Britain, to illustrate the methods of rapid bacteriological diagnosis and the chief cultural characteristics of the organism, and to emphasize the dramatic effect of adequate penicillin treatment.

Case History

The patient was bitten on the right thumb while handling a hooded rat prior to an experimental operation. His hands were "scrubbed up" at the time, and the wound was at once thoroughly washed and a sterile dressing applied. The wound appeared to be healing normally, but on the morning of the third day (i.e., within 48 hours of the bite) he felt very ill on waking. A severe rigor followed almost immediately, lasting half an hour, with fever beginning at 101° F. (38.3° C.) and reaching 103° F. (39.4° C.) by evening, and associated with severe pains in the limbs and back. Fever continued throughout the following day, with, in addition to generalized muscular pains, severe pain and redness over the right elbow at the olecranon. This first attack of fever lasted for about 48 hours, and on the morning of the third day after the fever started the patient felt much better, except for the painful right elbow. On this day a scanty rash appeared on the dorsal aspects of the feet. He continued to be fairly comfortable for 48 hours, when the first bout was completely repeated, with high fever (103° F.) and severe shooting pains particularly in the region of the right scapula. The rash also spread to involve the back, forearms, and feet. He was admitted to hospital on the seventh day of illness, about 12 hours before the end of the second attack.

On admission the patient looked very ill, with a temperature of 103° F. A fairly extensive maculo-papular rash (no petechiae) was present, most abundant on the forearms, hands, legs, and feet, and less extensive on the forehead and body. The spleen and lymph glands were not enlarged. The leucocyte count was 10,400 (85% neutrophil polymorphs, 14.5% mononuclear cells).

The laboratory investigations are given separately for clearness, but as soon as blood films proved negative for *Spirillum minus* and blood cultures had been taken penicillin therapy was started, with the idea, quickly proved correct, that the infection might be due to *Streptobacillus moniliformis*. There was no scarcity of penicillin, and 500,000 units were given intramuscularly at once. By next morning the temperature was normal, but penicillin was continued intramuscularly in heavy dosage for seven days, a total of over 12,000,000 units being administered. The patient quickly recovered without fever or relapse, and has remained completely well.

Laboratory Investigations

The clinical history suggested rat-bite fever, and the following investigations were rapidly carried out after the patient was admitted to hospital. Six fairly thick blood films were stained and examined for the *Spirillum minus*, with negative results. Two guinea-pigs and two mice were inoculated intraperitoneally with 1 ml. of heparinized blood from the patient; the results are referred to later. Blood cultures were made by dividing 20 ml. of the patient's blood among three flasks containing heparinized horse-heart digest broth, and were incubated at 37° C. After 18 hours a few fluffy granules were seen floating on the top of the layer of sedimented red blood cells, and these were found to consist of tangled chains of pleomorphic coccobacilli. They stained feebly by Gram's method, but strongly with Leishman, Giemsa, polychrome methylene blue, and carbol-fuchsin stains. Subcultures were readily obtained in glucose horse-serum digest broth and on Loeffler's serum medium, while after incubation for a further 48 hours the original cultures showed a mass of "cotton-ball" colonies covering the layer of red cells in the flasks.

The diagnosis was now made, but further bacteriological observations may be briefly but accurately summarized.

The Micro-organism.—This was pleomorphic, slender, motile, and non-sporing; occasionally occurring as short rods but mostly arranged in chains of coccal or coccobacterial bodies or in long continuous filaments spreading across several microscopical fields. All of these forms were present simultaneously, and the long filaments were so interwoven that the question of

branching remained undecided. In young cultures on Loeffler's serum spindle-shaped rods and filaments predominated, the latter being shorter than in fluid media. The filaments also showed central, terminal, or subterminal swellings (moniliform bodies) similar to those seen by one of us (I.R.W.L.) in Levaditi's laboratory in 1936. It was noted that the moniliform bodies tended to disappear in older cultures.

Staining Reactions.—Poor results were obtained with Gram's stain, but on the whole in very young cultures the organism tended to be Gram-positive and in older cultures Gram-negative. With the other stains previously mentioned the staining was irregular, the moniliform bodies being coloured more intensely than the filaments. When stained with Ziehl-Neelsen's carbol-fuchsin the organism was not acid-fast.

Characteristics in Culture.—On solid media no growth occurred on ordinary agar, very scanty growth on 5% blood agar, good growth on 25% horse-serum agar, and abundant growth on glucose-serum agar and Loeffler's serum. The colonies were at first small and translucent, but became granular and rough after several days. Even after 24 hours a number of the colonies were of R type. In deep glucose-serum agar shake cultures mulberry-shaped colonies appeared which were not limited to the aerobic zone. The organism is thus aerobic but a facultative anaerobe. Growth did not appear to be stimulated by increased carbon dioxide pressure. In fluid media abundant growth occurred, as already indicated, when serum and fermentable carbohydrates were present. The sugar reactions were as follows: acid but no gas from glucose and starch, slight acid from lactose and maltose; no indole formation; gelatin not liquefied. In fluid media containing carbohydrates subcultures were found to be essential every 48 hours. In carbohydrate-free media the organism can remain alive for five days but is dead in seven days. It is killed by exposure to 60° C. for 20 minutes. The organism isolated was found to be very sensitive to penicillin, all growth being inhibited by 0.01 unit of the drug per 1 ml. of medium.

Animal Inoculation.—The organism is pathogenic for mice, and both animals inoculated intraperitoneally with 1 ml. of the patient's blood died, in 9 and 11 days. Similar inoculations from 24-hour cultures (0.5 to 1 ml.) caused death in four to six days, but no characteristic lesions were observed at necropsy, although heart-blood cultures were positive. Both guinea-pigs and rabbits seem to be insusceptible.

Two additional points of interest may be noted. Attempts to demonstrate agglutinins, both in the patient's blood and in the susceptible animals, failed, for the organism was auto-agglutinable even in media free from carbohydrates. The whole stock of hooded rats from the cage containing the original culprit was examined, and *Streptobacillus moniliformis* was obtained by swabbing the nasopharynx in seven out of the 10 rats examined.

Discussion

There are records of at least five patients previously treated with penicillin, but their illnesses occurred in the time of penicillin scarcity and a much smaller dosage was employed. Kane (1944a, 1944b) reported the first case from Belfast, in which a positive blood culture was obtained only on the 25th day of illness. Gold therapy was tried without success, and penicillin was first used on the 62nd day, just after the beginning of a bout of fever. In all 200,000 units were injected over 48 hours; but within 12 hours, after only 60,000 units, the fever vanished and convalescence was uninterrupted. Weber and Favour (1945) began penicillin treatment of their patient on the 13th day, using at first 100,000 units a day, reduced to 80,000 units on the third day and continued for 10 days. Fever was abolished only on the seventh day. Altemeier, Snyder, and Howe (1945) gave 302,500 units over 8½ days to a child aged 10 months, 212,500 units to a child of 2 years, and 132,000 units over five days (all the drug available) to a child of 4½ years. Cure was immediate and complete in the first and second cases, but the third child relapsed four days after penicillin was discontinued and blood culture again became positive.

Summary

A case of rat-bite fever due to *Streptobacillus moniliformis* (Levaditi) is reported, developing 48 hours after the bite of a hooded rat.

Treatment with penicillin was completely successful, the disease being cured at once. Much larger dosage, probably excessive, was employed than in the few cases previously described, but the illness was severe and relapse had occurred in the days of penicillin scarcity.

The methods of diagnosis and the characteristics of the organism isolated are briefly described.

REFERENCES

- Altemeier, W. A., Snyder, H., and Howe, G. (1945). *J. Amer. med. Ass.*, **127**, 270.
Brown T. M., and Nunemaker, J. C. (1942). *Bull. Johns Hopk. Hosp.*, **70**, 201.
Kane, F. F. (1944a). *Lancet*, **2**, 548.
— (1944b). *Ulster med. J.*, **13**, 129.
Levaditi, C., Nicolau, S., and Poincloux, P. (1925). *C.R. Acad. Sci., Paris*, **180**, 1188.
Schottmüller, H. (1914). *Derm. Wschr.*, **58**, Supp. 77.
Weber, R. A., and Favour, C. B. (1945). *Bull. Johns Hopk. Hosp.*, **77**, 132.

A CASE OF ACUTE DERMATOMYOSITIS

BY

J. MacD. HOLMES, M.D., M.R.C.P.

Physician, Staffordshire General Infirmary;
Consulting Physician, Crewe and District Memorial Hospital

Acute non-suppurative myositis involving several muscle groups is a rare condition and deserves special notice when it occurs. It was first described in 1887 almost simultaneously by Wagner, Unverricht, and Hepp, but little has been added to our knowledge of the pathology of the condition since that time. The case recorded here is one of the very few in which an organism that might be regarded as causative has been isolated.

The chief clinical features of the disease are widespread oedema of muscle groups associated with intense pain and tenderness, fever, and often inflammatory lesions of the overlying skin. Unverricht coined the term "dermatomyositis" to describe the disease with cutaneous lesions, but this has since been applied to a large and ill-defined group of skin affections associated with muscular swelling or atrophy and with wide variation in the severity and duration of symptoms. Probably some of these are aetiologically different from the acute polymyositis under consideration, but it is possible that allergic sensitivity may be a common factor.

Pathology

The clinical and histological features of dermatomyositis of the acute type suggest that it is infective in origin, but organisms have very rarely been isolated and the standard textbook descriptions of the disease state that the aetiology is unknown. Deák (1931) isolated a haemolytic streptococcus in five cases of "acute haemorrhagic myositis," and Karelitz and Welt (1932) found a haemolytic streptococcus in blood culture shortly before death in one case. Other attempts to demonstrate a causative organism have been unsuccessful. Therapeutic evidence of an infective cause has recently been furnished by the successful treatment of the condition with sulphonamides and penicillin. Clark (1946) reports two cases—one treated with sulphonamides and the other with penicillin. Friedmann and Por (1947) also describe a case successfully treated with penicillin. In none of these, however, was an organism isolated from blood cultures. My case appears to be the first in which an