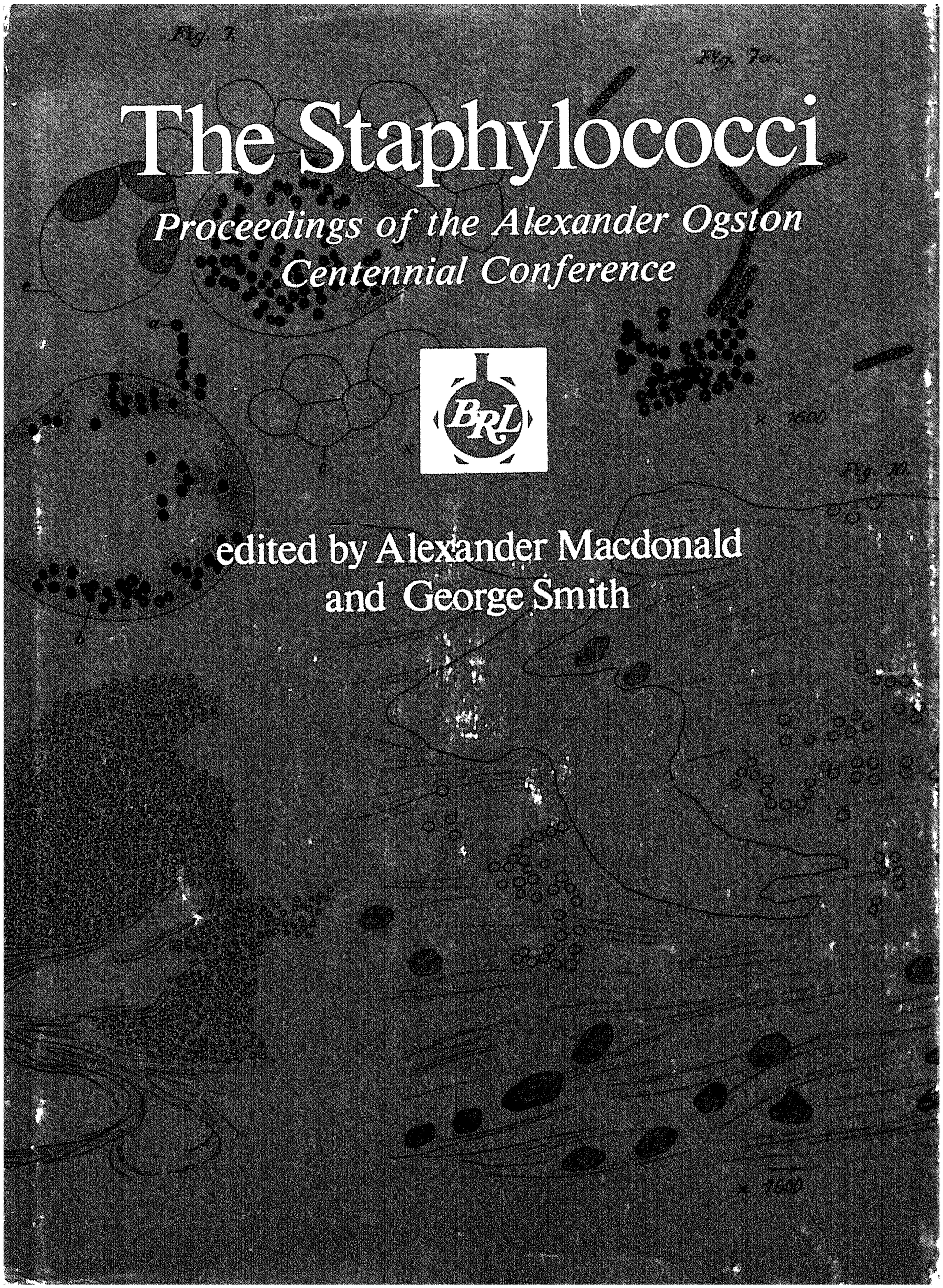
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Fig. 7a.
The Staphylococci
Proceedings of the Alexander Ogston Centennial Conference
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edited by Alexander Macdonald and George Smith
Fig. 10.
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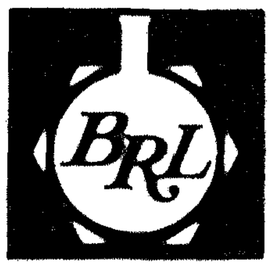
THE STAPHYLOCOCCI

Proceedings of the Alexander Ogston
Centennial Conference

Edited by
Alexander Macdonald
Emeritus Professor of Bacteriology
and
George Smith
Regius Professor of Surgery
University of Aberdeen



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Contents

Foreword

The first and indeed welcome duty of the writer of a foreword is to commend the symposium, which has been admirably summed up by Sir Robert Williams in his lecture. But it is perhaps pertinent to remind you that *Staphylococcus aureus* is to the medical world in general little more than something that is coagulase-positive with an unfortunate capacity for causing disease and widespread colonisation of man and for producing beta-lactamases. This, and a knowledge of the effective antibiotics and chemotherapeutic agents against the staphylococci is, and probably justifiably, enough for the medical world. For what, except for a few curiosities, have we to offer our non-microbial colleagues in the way of something that increases their clinical command of staphylococcal infections?

Ever since Ogston showed that there were animal pathogenic micrococci to be found in human infection and laid the foundations of the distinction between what came to be known as *S. aureus* and *S. albus*, there has been widespread interest and many thousands of research hours spent on factors that may determine pathogenicity. With the discovery of each new factor, whether soluble or attached to the cell, whether exotoxic or endotoxic, enzyme or haemolysin, there have been ingenious and often highly critical attempts to relate those factors to pathogenicity. It has been claimed that many of these factors affect the host's tissue cells or fluids, but while they may be of taxonomic importance, there is still no proof that they contribute significantly to the pathogenicity of the organism for man. The relationship has largely to be deduced from rather tenuous associations of the factor with the severity of the lesions from which they have been isolated—a not very impressive logical method. It is strengthened, of course, when it occurs in epidemic or near epidemic prevalences but in most rigorous analyses the association has usually proved to be an indication for further work. Except possibly for the Panton–Valentine leucocidin, as far as the generality of clinically encountered strains is concerned nearly all the swans have turned out to be geese, with only minor indications that they contribute to pathogenic potentialities.

I must not give the impression that I think little of the vast amount that

has been found out about the staphylococcus. Indeed, this symposium is a contribution to excellent current work. But Ogston has still given us a problem to solve which has not in any general sense been solved for *S. aureus*. It is a salutary exercise to reflect how little we really know about its pathogenicity. The epidermis splitting toxin may be cited as a triumph in the sense that we think we know how this scalded baby syndrome is brought about but these epidermal toxins found experimentally in only a few strains and the epidermolytic infections are a comparative rarity. The bulk of staphylococci are still unexplained as far as their pathogenic potential is concerned.

Perhaps we must stimulate more people to join in a wider study of experimental infections, and concentrate on the pathogenic properties of large numbers of the run-of-the-mill staphylococci which are encountered in clinical medicine. And I can think of no better way of giving this kind of stimulus than the publication of symposia of this excellence.

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Department of Medical Microbiology
The London Hospital Medical College

Acknowledgements

The Conference was planned to mark Alexander Ogston's singular achievements and to place them in present-day, as well as in historical context. Distinguished participants from Africa, America and Europe honoured Ogston in the way he would have wished by describing their research work and their varied experience of that most versatile of organisms, the staphylococcus and its enigmatic relationship with man. We thank them and we are indebted to Sir Ashley Miles, eminent medical scientist and pioneer investigator of hospital acquired infection, who has written the Foreword to this book.

Aberdeen University acted as host to the Conference and the North Eastern Regional Postgraduate Medical Education Committee helped to fund it. Professors A. S. Douglas and T. H. Pennington kindly agreed that the Davidson and Ledingham lecture funds, together with the Marnoch fund of the Department of Surgery, could appropriately be used in support of the Conference. Beecham Research Laboratories both helped with the costs and by their exceptional generosity made possible publication of the Proceedings.

Dr David Baird ensured that all arrangements for the Conference moved smoothly and we are grateful for his invaluable advice and for the constant help provided by the secretarial staff of the Department of Surgery.

EDITORS

Alexander Ogston

Fritz Linder

Fifteen years ago wound infection was the subject of a Scottish Centennial Conference held in honour of Joseph Lister and his discovery of the antiseptic principle. Lister made his decisive observation after treating 12-year-old James Greenlees in Glasgow for an open fracture of the lower leg. His achievement made it possible for the first time to reduce the incredibly high mortality in war and to reconsider the causes of death in previous campaigns. It became clear that apart from direct trauma and blood loss, mortality was largely due to wound infection followed by septicaemia, gangrene or tetanus. Even in Homer's *Iliad* it is recorded that 75 per cent of 147 wounded soldiers died following injuries, presumably as a result of infection. In the Franco-Prussian war of 1870–71 amputation was the treatment of choice for compound fractures of the femur and the mortality on both sides was between 90 and 100 per cent. Nussbaum, one of Lister's early followers in Munich, gives us a vivid impression of peace-time surgery. As late as 1874 he wrote that in hospital, gangrene 'gnawing like a ferocious beast, slew or permanently crippled' 80 out of every 100 surgical patients. Lister's discovery of antisepsis was followed by a world-wide dispute about the significance of micrococci in causing wound infection.

Alexander Ogston's work played a decisive role in settling the controversy.

Like Lister this polyglot Scotsman received early recognition, especially in Germany. On 9 April 1880, at the Surgical Congress in Berlin he delivered a lecture on abscesses in excellent German. His findings were very readily accepted by such leading men as Virchow, Koch, von Mikulicz and Czerny. As a special honour and mark of our esteem the young surgeon (at that time only 36 years old) was made a fellow of the German Surgical Society).

This paper which includes the substance of Professor Linder's opening address to the Conference was prepared by F. Linder and H. P. Geisen.

Fig. 1 (a).

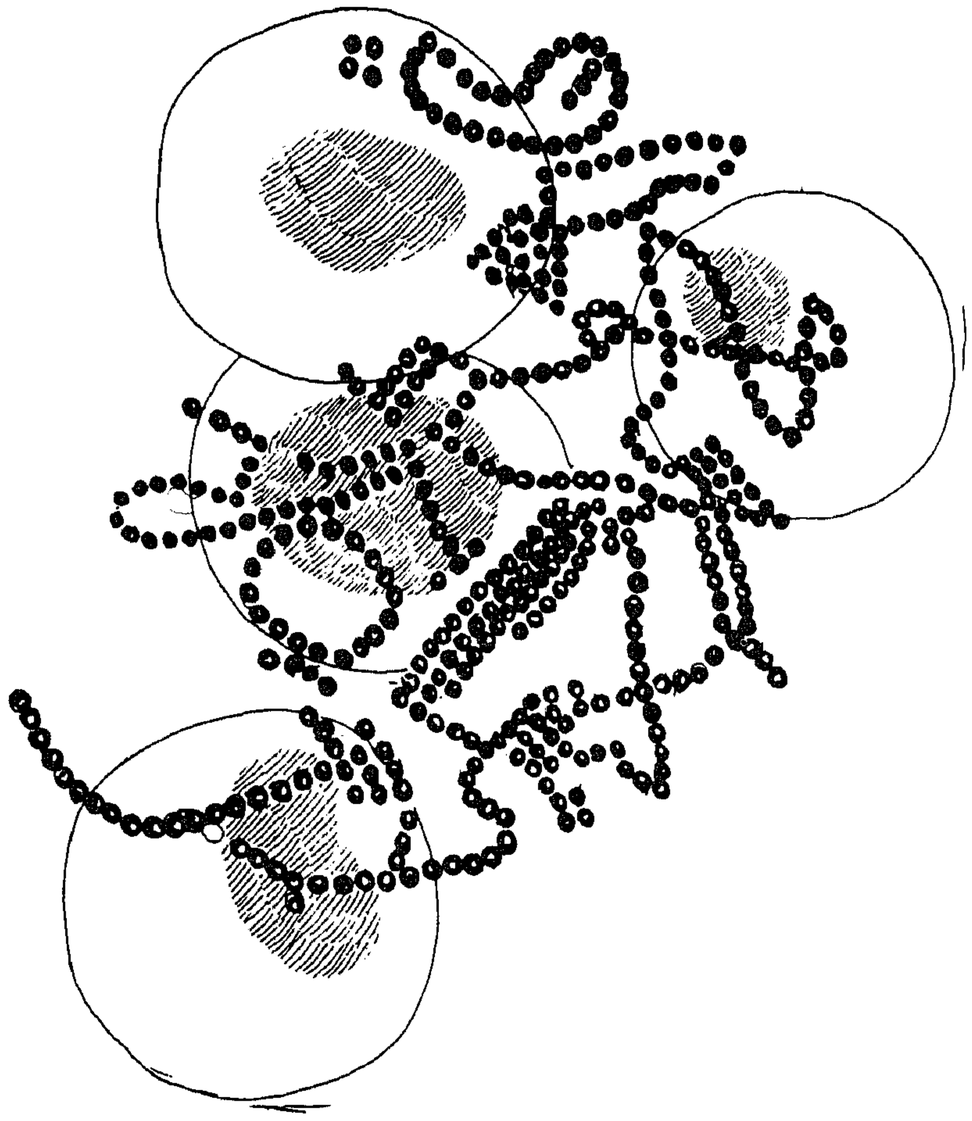

Fig 1 (b).

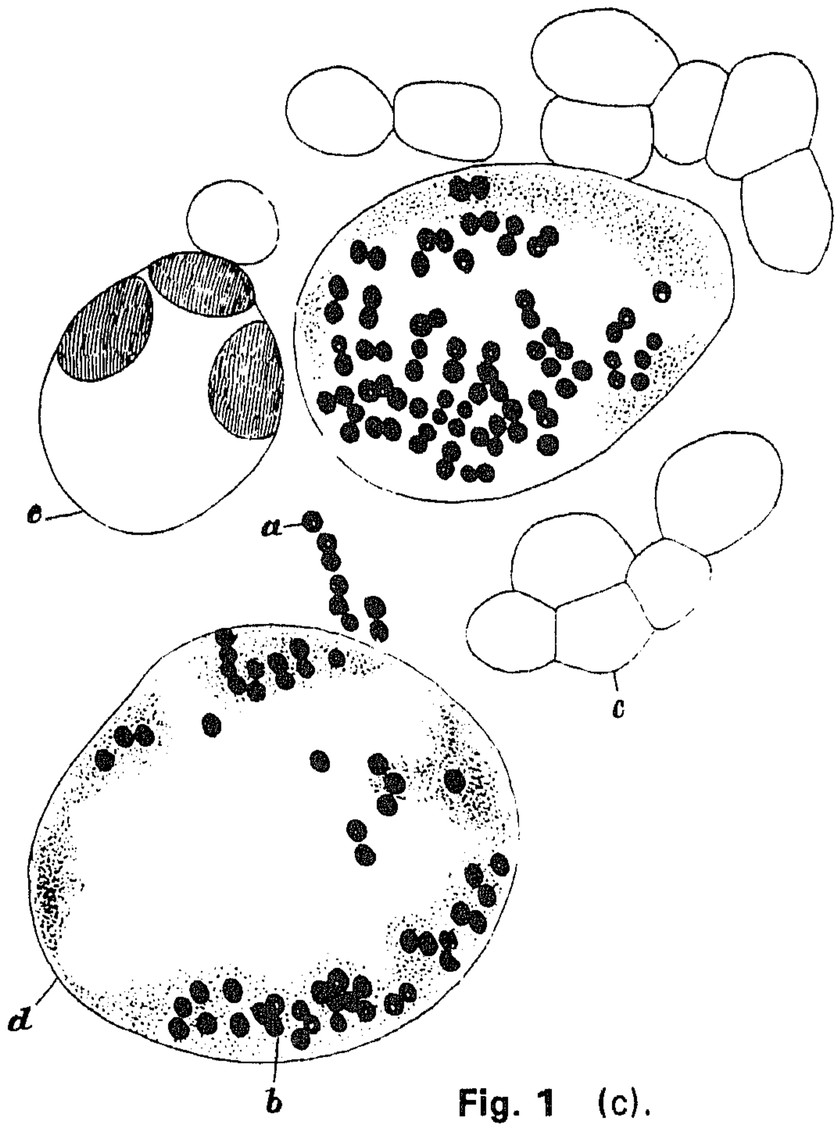

Fig. 1 Original drawings by Alexander Ogston in 'Über Abscesse' (3.1) are reproduced. (a) Micrococci in bunches in the wall of an abscess; (b) Micrococci chains in pus; (c) Micrococci within or upon large cells. (The original legends are translated.)

In the Society's Proceedings, Ogston's manuscript was illustrated by excellent drawings (fig. 1a–c). From these illustrations it is obvious that even at that time he was aware of formations in chains and formations in clusters or bunches. You can see very plainly the fissures in the tissue being invaded by cocci. Today, of course we know that we are looking at *Staphylococcus aureus*. In fig. 1b we can see the streptococci (described for the first time by Billroth in 1874). In fig. 1c there are intracellular micrococci in bunches, which Ogston called staphylococci on the suggestion of W. D. Geddes, at that time professor of Greek at the University of Aberdeen (Smith 1965).

According to Ogston, these micrococci were to be found in nearly 100% of samples of pus from 70 acute abscesses observed in the widely different parts of the body. Only in 14 cases of cold, cheesy abscesses, organisms

could never be found—this was before the discovery of the tubercle, or Koch's bacillus. The causal connection between acute suppuration and micrococci was pretty obvious to Ogston and he postulated, even before Robert Koch, a series of criteria according to which, in general: (a) micrococci are the most common cause of acute abscesses and (b) vice versa, acute suppuration is almost always linked with the presence of micrococci.

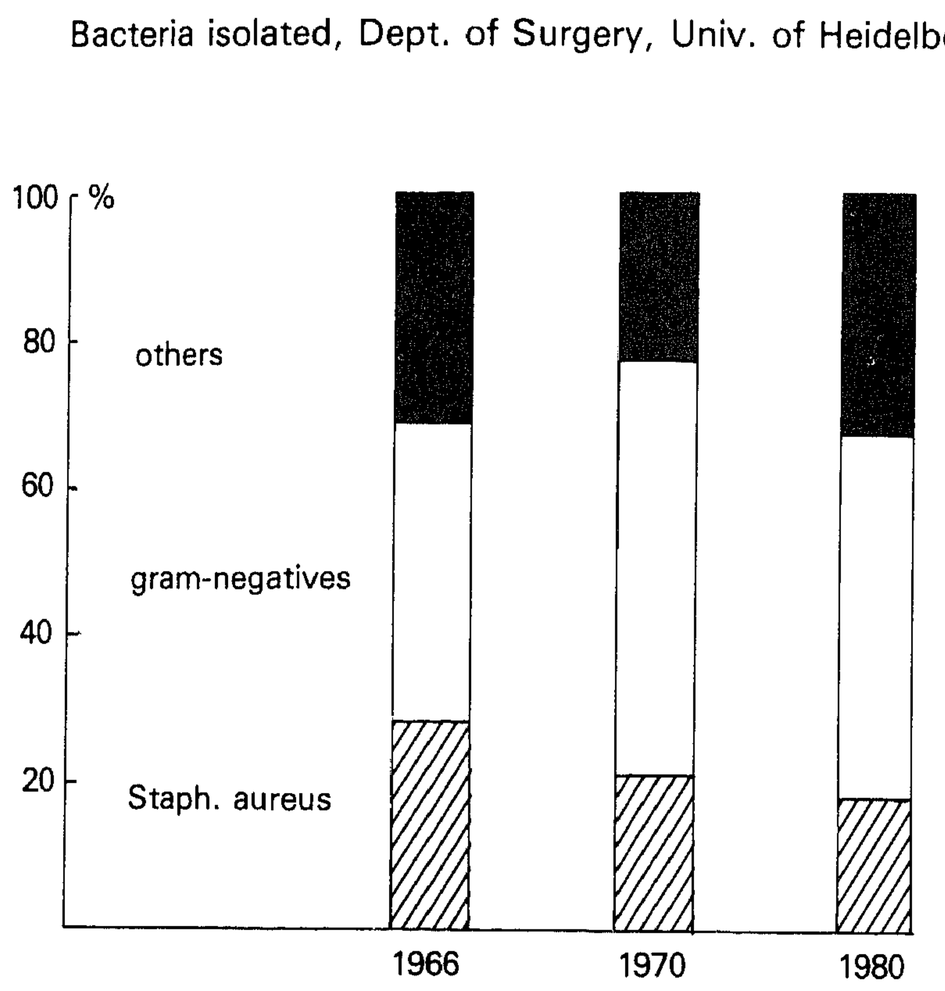

Fig. 2 Contribution of *S. aureus* to all bacteria isolated from wound smears, tracheal catheters and blood cultures from the Department of Surgery, University of Heidelberg.

The role that *S. aureus* plays today in general medicine and particularly in surgery, is as well known as the achievements of British research workers who have studied its clinical significance—particularly in connection with hospital practice. To make a small continental contribution to this subject, I would like to present the data collected in the Surgical University Hospital of Heidelberg on the more recent staphylococci situation.

The next figure shows the bacterial spectrum in our hospital—collected from wound smears, blood cultures and tracheal catheters. According to these data, the percentage of *S. aureus* has constantly decreased between 1966 and 1980 to reach equilibrium in the last 10 years at a rate of about 20 per cent of the entire spectrum. Up until 1970 we can observe a steady increase of gram-negative bacilli, especially *Pseudomonas, Klebsiella, Proteus* and the enterobacteria. Since 1971 the percentage of the gram-negative bacteria has remained at about 50 per cent. The remainder is represented essentially by organisms which are not necessarily pathogenic (*S. epidermidis,* nonhaemolytic streptococci, etc.).

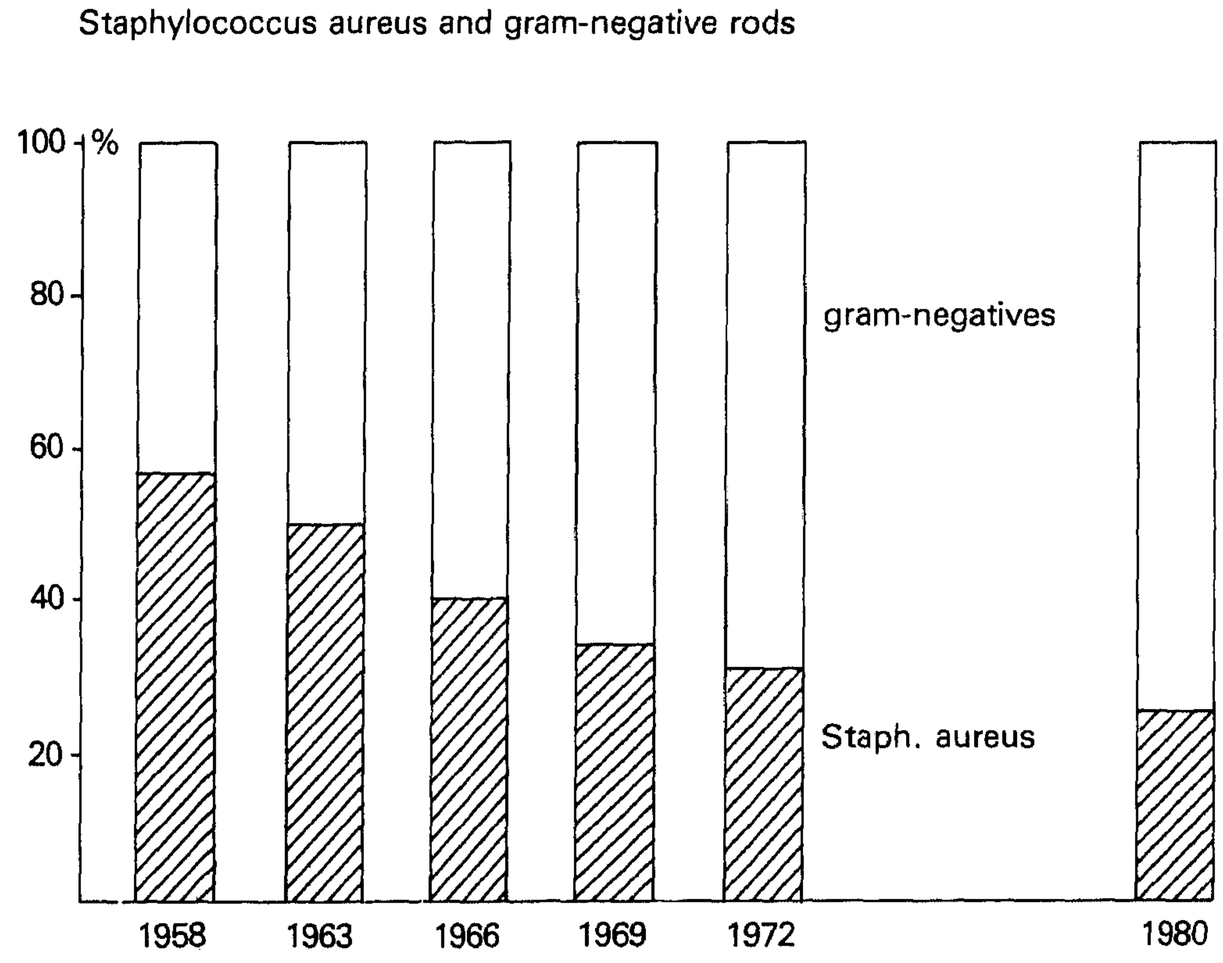

Fig. 3 Ratio of *S. aureus* to gram-negative rods during the periods 1958–80.

If we eliminate this percentage from the diagram and observe in isolation the relationships between gram-negative bacteria and staphylococci only, the result is a linear decrease of the percentage of *S. aureus* until 1969. Thereafter the straight line falls away more level until 1980.

While this reflects the general situation of patients in hospital, when we now subdivide the various kinds of patients and consider them separately, a

rather different picture emerges. Among out-patients, almost 40 per cent of all isolated bacteria are of the species *S. aureus* and, among those with infected wounds, as many as 50 per cent can be attributed to *S. aureus*. In traumatic patients, *S. aureus* is to be found in about 50 per cent of all infected wounds, whereas the gram-negative bacteria are less numerous. The opposite is true of *S. aureus* and gram-negative organisms on the intensive care wards. Here we find *S. aureus* in only 20 per cent of all

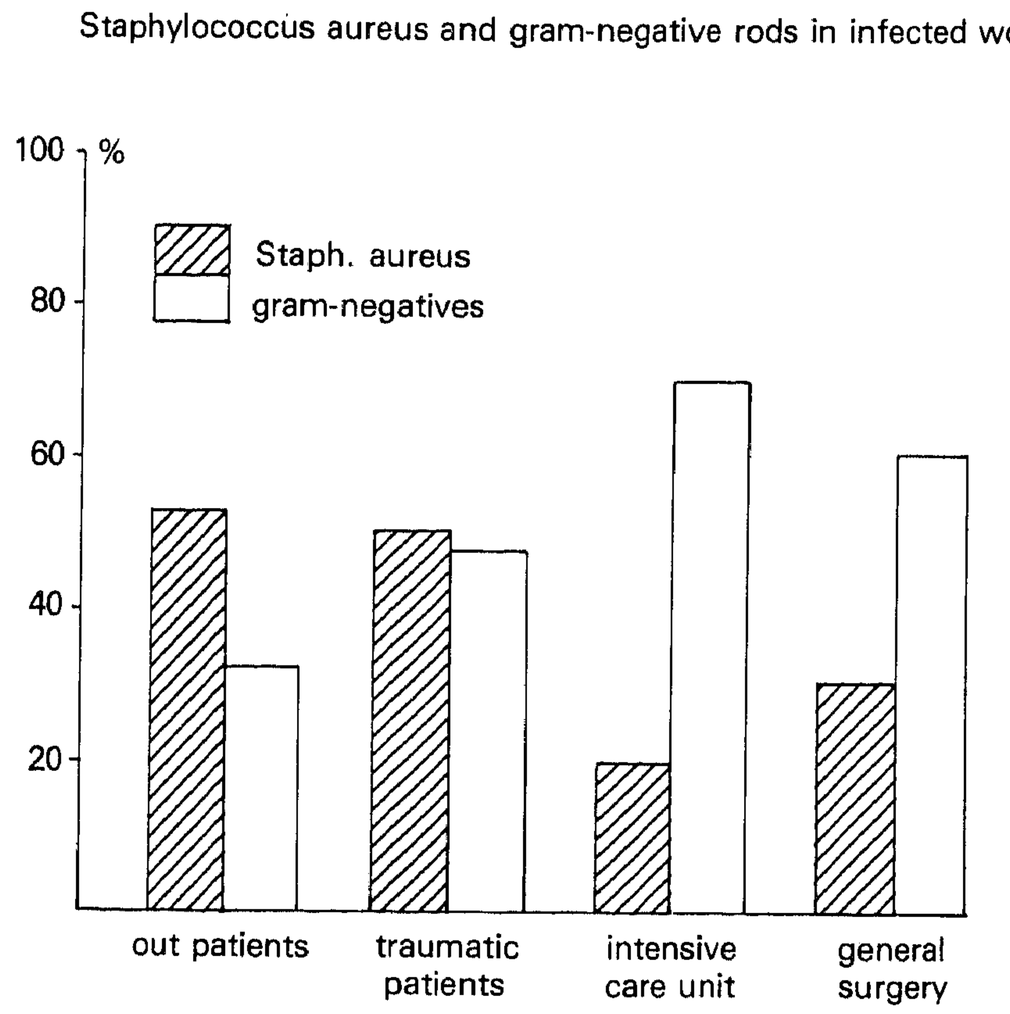

Fig. 4 Ratio of *S. aureus* to gram-negative rods in infected wounds in different groups of patients.

infected wounds. Gram-negative bacteria, however, are present in up to 70 per cent. In general surgery the percentage of gram-negative bacteria is smaller but they still far outnumber *S. aureus*. *S. aureus* is now, as ever, the most important and the most common organism to be found in traumatic surgery. On the other hand, in general surgery (essentially in abdominal surgery), gram-negative hospital bacteria predominate.

The two essential efficiency factors in the reduction of staphylococcal infections are adequate hygienic measures and antibiotic therapy, aimed at

getting rid of the infections. Successful antibiotic therapy requires familiarity with the resistance behaviour of *S. aureus*.

Figure 5 shows the developing resistance of *S. aureus* between 1966 and 1980 to ampicillin, oxacyllin, tetracycline and cephalexin. While in 1966 approximately 70 per cent of all isolated *S. aureus* strains were still susceptible to ampicillin, nowadays their response is only in the range of 20 per cent. Even in the outpatient area, about 60 per cent of all isolated staphylococci are ampicillin resistant. The number of oxycillin resistant staphylococci has also increased and is at present about 16 per cent. In contrast to this, the susceptibility to tetracyclines has constantly increased and is today higher than 90 per cent. First generation cephalosporin as well as that of later generations continues to be effective against staphylococci.

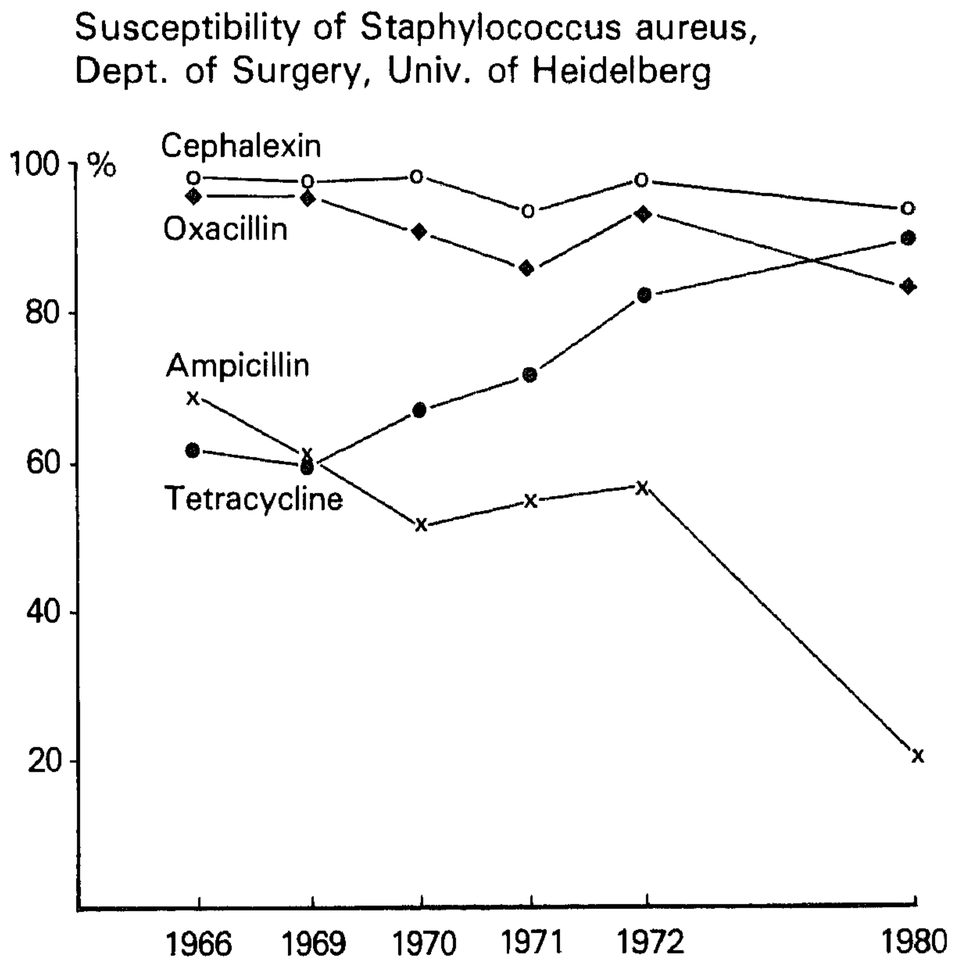

Fig. 5 Susceptibility of *S. aureus* to different antibiotics during the period 1966–80.

Antisepsis, which began with the external application of hot oil or tar, carbolic acid, honey, wine or alcohol was followed by a long period of aseptic practice. But its modern association with antibiotics has resulted also in an antiseptic renaissance, which has, in turn, through a more exact identification of the organisms present in a wound, led to significant progress in our basic knowledge of asepsis.

If we take another look back at the past 100 years of surgery, we realize that the antiseptic and aseptic battle against wound infection has revolutionized surgical treatment: first of all, the risks of limb amputation have been decisively reduced, and secondly selective operations on the three body cavities have been made possible. The subsequent identification of wound organisms and their susceptibility to newly found antibiotics brought further progress although, of course, their application has not been without well-known side effects.

Beside its very positive consequences for our surgical work, this development has also brought into prominence the new discipline of surgical microbiology. In our battle against surgical infection we have to thank microbiologists not so much for firing indiscriminately with plain buckshot but for precise marksmanship with special bullets.

We surgeons are proud of the fact that one of our previous colleagues, Alexander Ogston, served this dual cause so well, inside and outside the borders of his native country.

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