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*“To the solid ground
Of Nature trusts the mind which builds for aye.”—WORDSWORTH.*

THURSDAY, MAY 7, 1896.

SCIENTIFIC WORTHIES.

XXIX.—SIR JOSEPH LISTER.

I HAVE responded with great pleasure to the honourable request that I should give some sketch, for the readers of NATURE, of Sir Joseph Lister's scientific eminence. As a *confrère* I know him not merely from his prominent scientific renown, but also as a friend, and I too, like other German surgeons, have sought out the founder of modern surgery in his London hospital and, filled with gratitude, have laid my homage at his feet. Lister was many years ago in Leipzig, and I shall never forget the *fête* we then organised in his honour. How we cheered him on that evening, professors and students, old and young! For was it not in Germany first, rather than in England, that his scientific works met with their earliest recognition and general appreciation! Lister was in his day a prophet, and proclaimed a new doctrine for the healing of wounds. And how often prophets fail to find in their own fatherland, especially in the early stages of their activity, the recognition they so well deserve!

Lister's immortal life-work is his antiseptic method of operating and of treating wounds, and it constitutes the greatest advance which surgery has ever made. It is true that operational technique had reached a previously undreamt of development after chloroform and ether had banished pain in 1846 and 1847. But the surgery of those days wanted one thing more—certainty of a successful issue to its operations. Surgeons were still helpless in fighting the ever-present septicæmic infection of wounds, which snatched to the grave so many patients and injured sufferers. Were they but able to circumvent this deadly infection of the bodily fluids, the blood and the lymph, and could they but secure as a rule and not the exception the reactionless healing of wounds without inflammation and suppuration, then would surgery as an art be diverted into new channels, and strive for the goal of final perfection. It was exactly Lister's antiseptic method of operating and treating

wounds which first showed the way to the attainment of that healing “by first intention,” which had been a subject of discussion for centuries, and of that certain avoidance of traumatic infection of which the general nature was so well known. And now every day we note, with joyful and grateful hearts, and with hitherto unknown feelings of innermost satisfaction, the splendid outcome of this the greatest acquisition of modern surgery. Lister did not create antiseptic surgery suddenly, or without means to his hand, for the path was already smoothed with invaluable scientific facts from the domains of physiology, chemistry, botany, and general experimental pathology. Schulze, Schwann, Helmholtz, Schroeder, Dusch, and, above all, Pasteur had proved that all fermentations and putrefactions are due to organised germs, to those ever-present micro-organisms the schizomycetes or bacteria. This fact had at first received only scant attention, but in Lister's hands its importance for the development of surgery was immense. He began his experiments on the treatment of wounds in the Glasgow Infirmary, somewhere about the year 1864, and characterised his method as “antiseptic,” since it was consciously and confidently aimed at the avoidance of all putrefactive changes in the parts affected. In his views as to the nature of traumatic infection, Lister took his stand on the basis of those scientific facts regarding fermentation and putrefaction which, as already stated, had been thoroughly established. He said to himself, “It is not the mere air as such that is antagonistic to the process of healing a wound, but rather those organised germs which are so universally disseminated in the world around us: bacteria are the cause of all inflammation and suppuration, and hence of septicæmia.” In this persuasion he directly attacked the problem of how not only to exclude bacteria from entering a wound, but also to destroy by disinfectants those already present, and to stay their further development. Lister selected carbolic acid as a disinfectant. Now it is true that even before his time various antiseptics, and among these carbolic acid, had been employed in bandaging; but to Lister alone is due the unending merit of methodically and confidently working out the detailed technique of antiseptic operating

and bandaging. Like many a new invention, Lister's was also at first incomplete, and was attacked from many sides, partly as to the principles on which it was based, and partly on the grounds of the somewhat complicated manipulations it involved. But, firmly persuaded of the correctness of his theoretical views, he went on steadily developing the details of his antiseptic methods, at first in Glasgow, and later in Edinburgh and London. He endeavoured to prevent the entrance of bacteria by careful disinfection of every object which comes into direct or indirect contact with the wound, more especially of the operational area on the patient, of the hands of the surgeon and his assistants, of the instruments, sponges and absorbents. To the same end he introduced the use of carbolic "spray" during the operation itself and each subsequent change of dressings, and by his ingeniously devised carbolised gauze protected the wounds from further infection. Injuries or wounds already infected were methodically disinfected by 2·5 to 5·0 per cent. solution of carbolic acid. Lister's typical dressing, as it first came into more general use, was applied as follows. A layer of waterproof silk, the "protective," was placed over the wound to shield it from the direct action of the irritant substances (carbolic acid, paraffin) in the antiseptic dressing materials; over this came some eight or more layers of carbolised gauze or muslin, and between the outer two of these a sheet of gutta-percha tissue. The whole was then securely bound round with carbolised gauze so as to effect as far as possible an airtight enclosure of the wound. This Listerian bandage, as it soon came to be called, was both applied and changed under a continuous carbolic spray.

The results which followed the application of Lister's methods, as used not only for operational but accidental injuries, were at that time—1873 to 1875—simply astounding. We read with the deepest satisfaction the surgical reports of those early days of the more general employment of Lister's antiseptic devices, and find them inspired with proud feelings as of a mighty victory finally won after prolonged and grievous defeats. No such curative results had ever been attained up to that time. In the self-same hospitals in which till then septicæmic infection had kept the upper hand, the best results were henceforth obtained, and the once-dreaded wound-fevers became more and more a rarity. Operations were now successful which had previously been nearly always fatal. The ever-advancing scientific investigations of traumatic septicæmia, more particularly as carried on by Koch and his pupils, and dealing with its origin and nature from the point of view of the deleterious action of bacteria, gave more and more a sound scientific basis for Lister's antiseptic method and removed all doubts as to the correctness of his views. Most convincing proof of the part played by the bacteria was provided by the inoculation of animals with pure cultures of these various organisms; and it was exactly and solely these experiments that proved the all-important fact that in reality all the troubles and dangers which threaten a wound, and hence the life of a patient, are determined by the deadly action of bacteria. This is the fact on which modern surgical methods are based. And in the face of this, people are still found who contest the utility of experiments on animals! It would be well if

the opponents of vivisection could correctly picture to themselves the blessings for which the human race has to thank Lister's antiseptic method, and their relation to animal experiment. Did they but realise how many human lives are now saved in comparison with the past, surely they would be compelled to admit the use of vivisection. And, in the future also, scientific medicine imperatively demands experiments on animals for its investigations in the interest of mankind.

When once surgeons had learnt complete mastery of Listerian method, the results they obtained were progressively better. With the help of antiseptic precautions they succeeded in operations on which they would previously have never dared to venture. With these splendid results before their eyes, even those scattered opponents of the system who had at its inception raised their voice against it became silent, for they could no longer blind themselves to the conviction that a new and brilliant era was opening up for surgery.

After Lister's antiseptic method had become the common property of all surgeons, it was progressively improved and simplified, more especially in Germany. One of the most important facts for its further development was the proof that wound infections are chiefly due solely to actual contact with already infected objects, and that any infection by the entry of microbes from the neighbouring air rarely, if ever, occurs. Moreover, it was shown with increasing certainty of proof that under normal conditions the blood, lymph and tissues of healthy animals are free from bacteria. Upon these important facts the conclusion was based that it is unnecessary to disinfect a fresh and uninfected wound, such as a surgical incision, so long as every object which comes into direct or indirect contact with the wound is truly and perfectly sterilised or aseptic in accordance with Listerian requirements. Hence nowadays operations are performed with almost painfully precise sterilisation of every object or instrument employed, as Lister first taught us to do, while at the same time we limit as far as possible the action of irritant antiseptics, such as carbolic acid, and even advantageously use none at all, operating with as little fluid as possible. So far as it may be necessary the fluid now employed is a sterilised solution of common salt, or else sterilised water. In the place, then, of carrying out our operations under the former strictly antiseptic precautions, we now operate aseptically. But the fundamental idea on which Lister's antiseptic method was based has remained unchanged, and will always be the same. We deal with it in internal operations merely in a slightly different way, in so far as we omit the disinfection of wounds with such substances as carbolic acid or corrosive sublimate, regarding their action as unnecessary or even injurious. But all our precautions against traumatic infection are taken with the most minute care. The operational area on the patient is carefully disinfected in accordance with Lister's instructions, and is surrounded with aseptic linen compresses sterilised in steam at 100°–130° C. We employ exact and definite methods to free our hands from microbes, and the instruments are sterilised by boiling in 1 per cent. solution of sodium carbonate. All bandages and the outer garments we wear are made aseptic by prolonged exposure to steam at 100°–130° C. in a specially

constructed apparatus; and so, also, in respect of all else. Steam thus provides us nowadays with non-irritant bandaging materials free from germs with even greater certainty than did their earlier impregnation with antiseptic substances, for bacteria may always be found after the lapse of time in dry bandages which have been dipped in either carbolic acid or corrosive sublimate. Instead of sponges we now use muslin absorbents sterilised by steam, and these, like every other fragment of bandaging material, are burnt after being used but once. In short, the technique of modern surgery is based on Lister's method, and takes for its watchword "asepsis without the use of antiseptics." Antisepsis has given place to asepsis, but the latter is just as surely based on the ground first broken by Lister.

The results of operations carried out under aseptic precautions are magnificent. Surgery now celebrates its greatest triumphs in dealing with the skull and cranial cavity, with the brain, spinal column and spinal canal, with the thoracic and abdominal viscera, with bones and joints, with tendons and nerves. For accidental injuries, or wounds which are already infected, the older antiseptics are still employed, although we know that the complete disinfection of a festering wound is most difficult, nay almost impossible, for we cannot sufficiently reach the microbes lurking in the substance of the tissues. What we chiefly look to in this case is the efficient removal of the purulent secretion from the wound, securing this by free incisions and drainage.

Sir Joseph Lister must indeed experience a glorious feeling of deepest satisfaction when he surveys the labours of his life. His work is accomplished and brought to an incomparable conclusion. He has conquered and attained his object. When we but compare the surgery of thirty years ago, before Lister appeared on the scene, with that of to-day, what a change we see! We can scarcely carry ourselves back in imagination to the pre-antiseptic days of surgery, but each one who has known the older state of things from personal experience, cannot fail to realise with fuller understanding and livelier joy how great a blessing Lister is to suffering humanity. Formerly the healing of injuries or wounds after an operation lay by no means certainly in the hands of the surgeon. In many hospitals the conditions which existed before the advent of Lister were simply incredible. Innumerable victims were snatched away to death by traumatic infections. And how do things stand now? To-day, thanks to Lister, we can heal the most grievous injuries and carry out the most difficult operations without inflammation, suppuration, or fever. We have now a firmly grounded confidence in our surgical art, and our patients, too, trust to the capabilities of modern surgery, for they know that we can heal the wounds we make. The possibility now afforded by Listerian method of preserving and giving back health and life to our patients has led to the growth among the surgeons of every nation of a pride in their professional activities, which finds its expression in the form of active theoretical and practical work. Science and art are international. The doctors of all nations are fighting shoulder to shoulder for the welfare of suffering humanity, and we Germans recognise without a suspicion of jealousy that the sun of modern surgery first rose in the person of Sir Joseph Lister and in

England. The word surgery in its origin signifies a handicraft; but that which was thus manual at first has become an art and a science which has, thanks above all to Lister, raised itself with impetuous and surprising speed in the last twenty years to a previously unknown height of development. Modern surgery no longer stops short at the exterior, but has gone even deeper, and now includes within the sphere of its activity every organ of the human body without exception. And for this mankind is indebted in the first place to Sir Joseph Lister. As far as there is an earthly immortality it must be his, for as long as ever surgery is scientifically discussed his name cannot fail to be mentioned.

H. TILLMANN'S.

Sir Joseph Lister is not, as has been often stated, a Scotchman. He was born at Upton, in Essex, which was then a pretty suburban village, though it has long since been completely swallowed up in the metropolis, and here the greater part of his early life was spent. His father, Joseph Jackson Lister, was a man of rare ability, who devoted the intervals of business to scientific pursuits. He was a Fellow of the Royal Society, and is best known for his work on the improvement of the microscope, which is embodied in a paper in the *Philosophical Transactions* for 1831, "On some Properties in Achromatic Object-glasses applicable to the Microscope." Other papers of his appeared in the *Philosophical Transactions*, one of which was written in conjunction with the well-known Dr. Hodgkin, who belonged, like him, to the Society of Friends. They were the first to describe the tendency of the red corpuscles of the blood to arrange themselves in rouleaux.

Sir Joseph Lister was thus early imbued with scientific tastes, and learned by example, if he did not inherit by descent, the habit of accurate observation and relentless logic; in short, that capacity for taking pains which has been in a special manner the characteristic feature of his genius. He was educated at a private Quaker school at Tottenham, which numbered amongst its pupils at about the same time the late Mr. William Edward Forster and Dr. Wilson Fox; and afterwards he became a student at University College, London, from which he graduated B.A. at the University of London in 1847. He then entered upon his medical studies at University College, and here he came under the influence of Sharpey, which possibly had something to do with turning his attention, in the first place, to the study of physiology. His first publications appeared in the year 1853, whilst he was still a student, "On the Muscular Tissue of the Skin" and, "On the Contractile Tissue of the Iris." He began his surgical studies just at the close of the career of Liston, one of the last of the brilliant and rapid operators of the last generation; and he was one of the first house surgeons to Mr.—now Sir John—Erichsen. After a very distinguished career at the hospital and the University, where he graduated M.B. in 1852, he went to Edinburgh, to see the surgical practice there. Here he was closely associated with, and soon became deeply attached to the late Prof. Syme, whose daughter he subsequently married. At first he was Mr. Syme's house surgeon, but before long he was appointed Assistant Surgeon to the Royal Infirmary, and Extra-Academical Lecturer on

Surgery, in which capacity he soon attracted to himself a devoted band of admirers. Whilst in Edinburgh he not only published notes of Mr. Syme's cases, but continued to pursue his physiological and pathological researches. Between 1857 and 1860 several papers appeared on a variety of kindred matters, of which the most important are those dealing with the subject of inflammation and that of coagulation of the blood. In 1857 his paper "On the Early Stages of Inflammation" was read before the Royal Society, preceded by two others, one being "An Inquiry regarding the Parts of the Nervous System which regulate the Contractions of the Arteries," and the other "On the Cutaneous Pigmentary System of the Frog." This work remains up to the present time one of the most important contributions to the subject. Various observations on the coagulation of the blood, a much-debated matter at that time, culminated in the Croonian Lecture of 1862, which excited great interest, upsetting as it did most of the accepted notions, and forming the groundwork of much of our modern teaching on the subject. In 1860 Lister was appointed Regius Professor of Surgery in the University of Glasgow, and it was there, surrounded by the typical surgery of the old *régime*, and shocked by the prevalence and fatality of the so-called hospital diseases, that his work in connection with antiseptic surgery was begun. Those, however, who have studied his various writings will not fail to observe how his physiological observations were the precursors of his pathological studies, and these again, as he traced first the appearances and then the causes of inflammation, led on step by step to the association in his mind of the inflammation occurring in open wounds with the action of micro-organisms introduced from without, and so to the crowning performance by which his name will be principally handed down to posterity. He always acknowledged the influence of Pasteur's work on the evolution of his ideas, as has been pointed out by Prof. Tillmanns.

His writings since that time have been chiefly devoted to one branch or another of the subject of the germ theory of disease. They consist of articles scattered about amongst various periodicals, so that it would be a difficult matter to produce a complete list of them. Some are elaborate investigations into the processes of fermentation and the life-history of certain micro-organisms, most of which were carried out before the introduction of the plan of cultivating these low forms of life upon solid media, and therefore involved far greater difficulties than are met with at the present day; others are treatises on the bearing of bacteriology upon surgical treatment.

The controversy which was raised on the first promulgation of his views was very warm, and it took a strangely long time before their acceptance in this country was by any means general. To many educated under the old system, it seemed hard to appreciate, first that there was anything new in the antiseptic system at all, and secondly that the modifications of the details of the treatment in the course of its evolution, did not imply a recession from the principles upon which it was founded. It was a stumbling-block to some that, as knowledge advanced, and as it became recognised that the atmosphere was not, as it had been at first supposed, charged with innumerable particles bearing the germs of putrefaction—the details of the treatment

became simpler. By an unlucky chance, the term "spray-and-gauze-treatment" had by some been substituted for the "antiseptic treatment"; and when our German *confrères* started the watchword "fort mit dem spray," and it was enthusiastically taken up here, it was assumed that Lister had shifted his ground. The assumption was, it need not be said, absolutely without foundation. The earliest antiseptic dressings were much more cumbrous than those mentioned by Prof. Tillmanns. The first attempts consisted in making an antiseptic crust of blood and pure carbolic acid which was protected by a sheet of block tin, then followed the use of carbolic acid and oil, and then that of a layer of putty made with carbolic acid; after this came a plaister made of shellac and carbolic acid, and all these preceded the carbolic acid gauze, whilst the use of the spray was for a long time unknown. Lister was always aiming at simplifying the details of the treatment; none regretted more than he did its complications, and no one rejoiced more than he, when he found that he could give up the use of the spray with a clear conscience. His idea, in fact, has always been to make an external wound behave as much like a subcutaneous injury as possible by the simplest practicable means.

The antiseptic system was fairly launched about 1867, and in the year 1869 Lister was appointed successor to his father-in-law in the chair of Clinical Surgery at Edinburgh; and here he continued the elaboration of his system, lecturing to large and enthusiastic classes, numerically much greater than any which can be met with in London, whilst his clinique acquired a world-wide reputation.

In 1877, on the death of Sir William Ferguson, he was appointed Professor of Clinical Surgery at King's College, London, a position which he held till three years ago.

No reference has hitherto been made to the many improvements and modifications in surgical practice with which the name of Lister is associated; but though they may not be of much interest to the general reader, it would not be right to pass them over altogether.

Long before Esmarch introduced his method of bloodless operation on the limbs, Lister was in the habit of obtaining the same result in a less objectionable way, by simply elevating the limb, which, as he has shown, empties itself not merely mechanically, but by means of an active contraction of the arteries consequent upon the altered position. He also was the inventor of a tourniquet for compressing the abdominal aorta, thus diminishing hæmorrhage in operations in the neighbourhood of the hip-joint. He has introduced several new operations to the profession, notably an amputation which bears his name, and an operation for excision of the wrist, which, although it is now almost superseded, was for a long time looked-upon as the orthodox method of treatment. He was the first to undertake osteotomy for the purpose of rectifying deformity of the limbs, and the first to advocate a more complete method of operating on cancer of the breast, than had been practised by his predecessors. Another advance associated with his name is that of treating fractures of the patella and other bones communicating with joints, by means of open incisions and wiring, a procedure which, before the introduction of

antiseptic surgery, would have been obviously unjustifiable.

We have hitherto dwelt chiefly upon his scientific work, but such facts as those just mentioned serve to show how largely he has devoted himself to, and how much he has advanced, the practical side of his profession.

It seems almost unnecessary to refer to a list of his honours, which is a very long one, including that of LL.D. Edinburgh, 1878, Hon. M.D. Dublin, 1879, LL.D. Glasgow, 1879, D.C.L. Oxon, and LL.D. Cambridge, 1880. He is Surgeon-Extraordinary to the Queen, and Knight of the Prussian order, "Pour le Mérite," Knight Commander of the First Class Order of the Danebrog, and honorary member of foreign learned societies without number. He was created a baronet in 1883, and last year succeeded Lord Kelvin as President of the Royal Society. It would be more to the point if one could suitably describe the estimation in which he is held by the civilised world, and the enthusiasm he has always inspired amongst those who have come under his immediate personal influence.

AN EXPEDITION TO RUWENZORI.

A Naturalist in Mid-Africa; being an Account of a Journey to the Mountains of the Moon and Tanganyika.

By G. F. E. Scott Elliot, M.A., F.L.S., F.R.G.S. 8vo.

Pp. xvi + 413, with 50 illustrations and 4 maps.

(London: A. D. Innes and Co., 1896.)

IN 1862 Baron von der Decken discovered on Kilima Njaro a number of plants which are quite different from those of the surrounding country, and are allied to those of the mountains of Abyssinia and the Cameroons, and of the lowlands of the Mediterranean and the Cape. The collections made by the late Joseph Thomson on the lower slopes of the same mountain and on the plateau of Masai-land proved the complex nature of the East African flora, and enabled Sir Joseph Hooker, in a paper which is one of the classics of African literature, to suggest the sources whence its constituents were derived. The interest thus aroused in the geographical affinities of this flora subsequently sent Sir H. H. Johnston and a host of German botanists to undertake detailed work in Kilima Njaro. Still more recently it inspired Mr. Scott Elliot to undertake his adventurous journey to Ruwenzori; for he tells us in his opening page, that the object of his expedition was "to solve the question of botanical areas which on this side of Africa had often puzzled me."

Mr. Scott Elliot left Mombasa in November 1893, and began his march into the interior along the track known as the "Uganda road." His men had been chosen for him by the agents of the British East Africa Company, and the selection does not appear to have been a good one. Mr. Scott Elliott had to dismiss his head man, the terms of whose engagement were at least remarkable; and his opinion of Zanzibari (or "Suahili," as he generally calls them) appears to have been permanently affected by the unsatisfactory character of his men. The narrative takes us rapidly across the country of the Wakamba to that of the Masai, in which the author had the misfortune to lose all his donkeys and their loads. He pressed on to Kavirondo, and thence along the northern

shores of the Victoria Nyanza to Uganda. The direct route on to Ruwenzori was unsafe, as Kabbarega, the king of Unyoro, was then at war with the British authorities. Anxious to avoid interference from this chief, whom he describes as one of the "ruffians of the sort who always obtain the sympathy of Mr. Labouchere," Mr. Scott Elliot kept southward along the western shore of the Nyanza. Having reached the Kagera River, he followed up this, and crossed Ankole to the southern end of Ruwenzori. This was the main goal of the expedition, and Mr. Scott Elliot spent four months exploring and collecting on the flanks of this snow-capped range. He made several attempts to reach the snow-line, but the nature of the work and illness prevented him. His account of mountaineering in Central Africa is not inviting.

"It was an awful ascent. Sometimes over deep moss, where jagged root-ends of heather seemed to spring out and stab ankles and knees at every step; sometimes through a dense wood of gnarled and twisted heather-trees, fifteen to twenty feet high, and covered with grey lichens, then down a steep little ravine and dense jungle; and things soon became very hopeless. Everything was shrouded in a cold chilling mist, and first one man and then another became knocked up, until at about 10 a.m. I was left alone. I went on by myself till 2 p.m. The effect of mountain sickness was most trying; I could not walk more than fifty yards without stopping to get breath, and by 2 p.m. I was utterly exhausted, and without food or anything to sleep in. This was at about 12,500 feet."

The level at which the author suffered from mountain sickness was unusually low; but it can be easily explained as due to the effects of malarial fever, which renders men liable to attacks of this malady, at elevations at which they would otherwise be safe.

Two of the men who took part in this excursion never recovered from it, and next time Mr. Scott Elliot tried the ascent, he went alone. He succeeded in reaching the height of 13,000 feet, after a weary struggle with rain, and cold and fever. Climbing over some half-buried boulders, he fell and nearly broke his leg; after this, numbed with cold, and shivering with fever, he crawled back to the point where he had left his blanket-bag, when fireless and foodless in the drenching rain, the night passed as "a sort of horrible dream."

Though Mr. Scott Elliot did not reach the summit of Ruwenzori, he reached the Alpine meadows below the snow-line, and this for his purpose was far more important.

From Ruwenzori he returned to the Kagera River at the point where he had left it, and followed it southward through Karagwe, of Speke's description of which Mr. Scott Elliot speaks most highly. He crossed Urundi to the northern end of Tanganyika; he journeyed down the lake by dhow, marched along the Stevenson road to Lake Nyasa, and then returned home by the Zambesi.

Mr. Scott Elliot's book consists of twenty chapters, which may be divided into two groups. The larger of these is devoted to the narrative of the expedition. This gives a most interesting record of a brilliant piece of pioneer exploration, which was carefully planned, was pluckily carried out in spite of exceptional discouragements, and is described with much charm of style and