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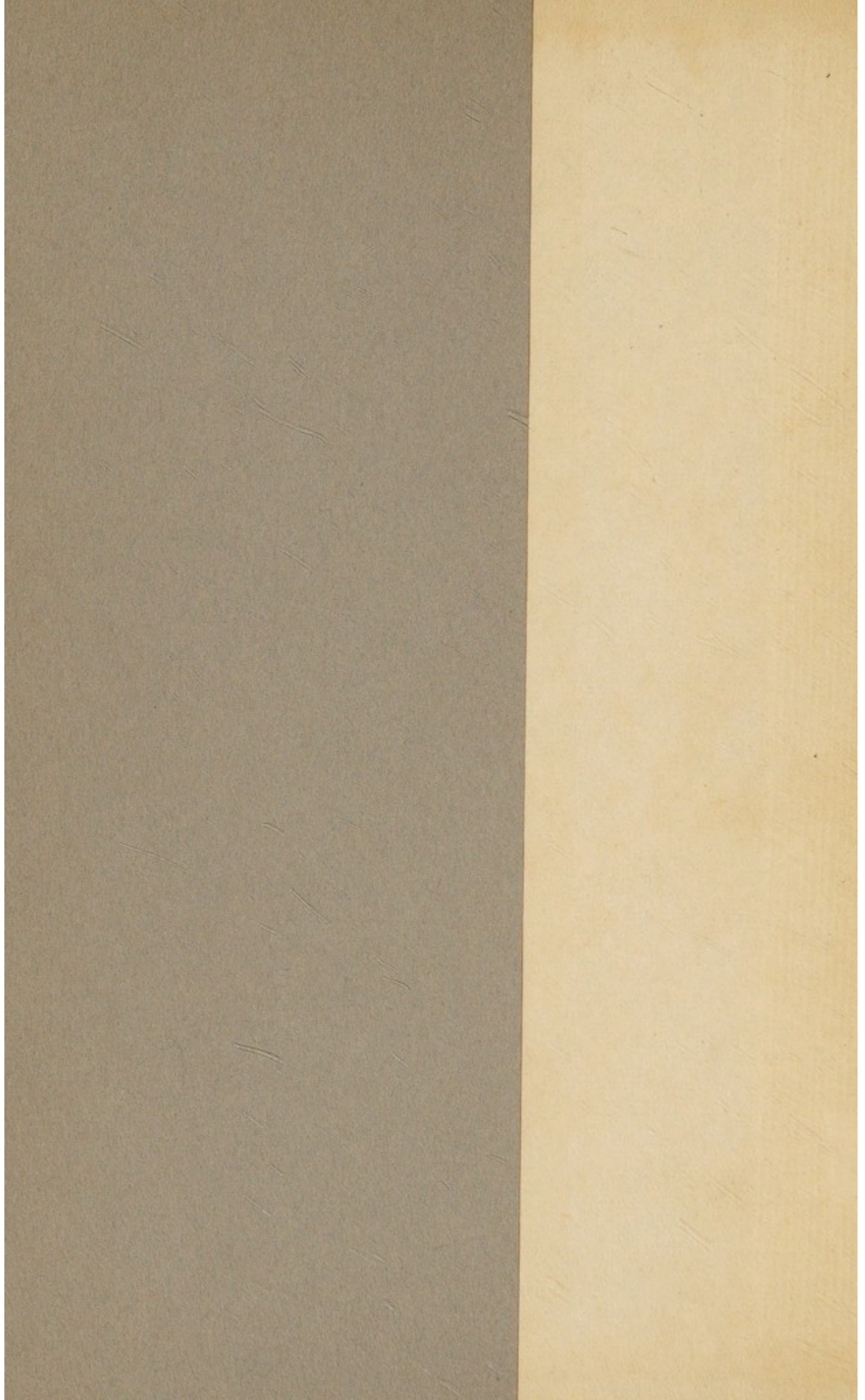


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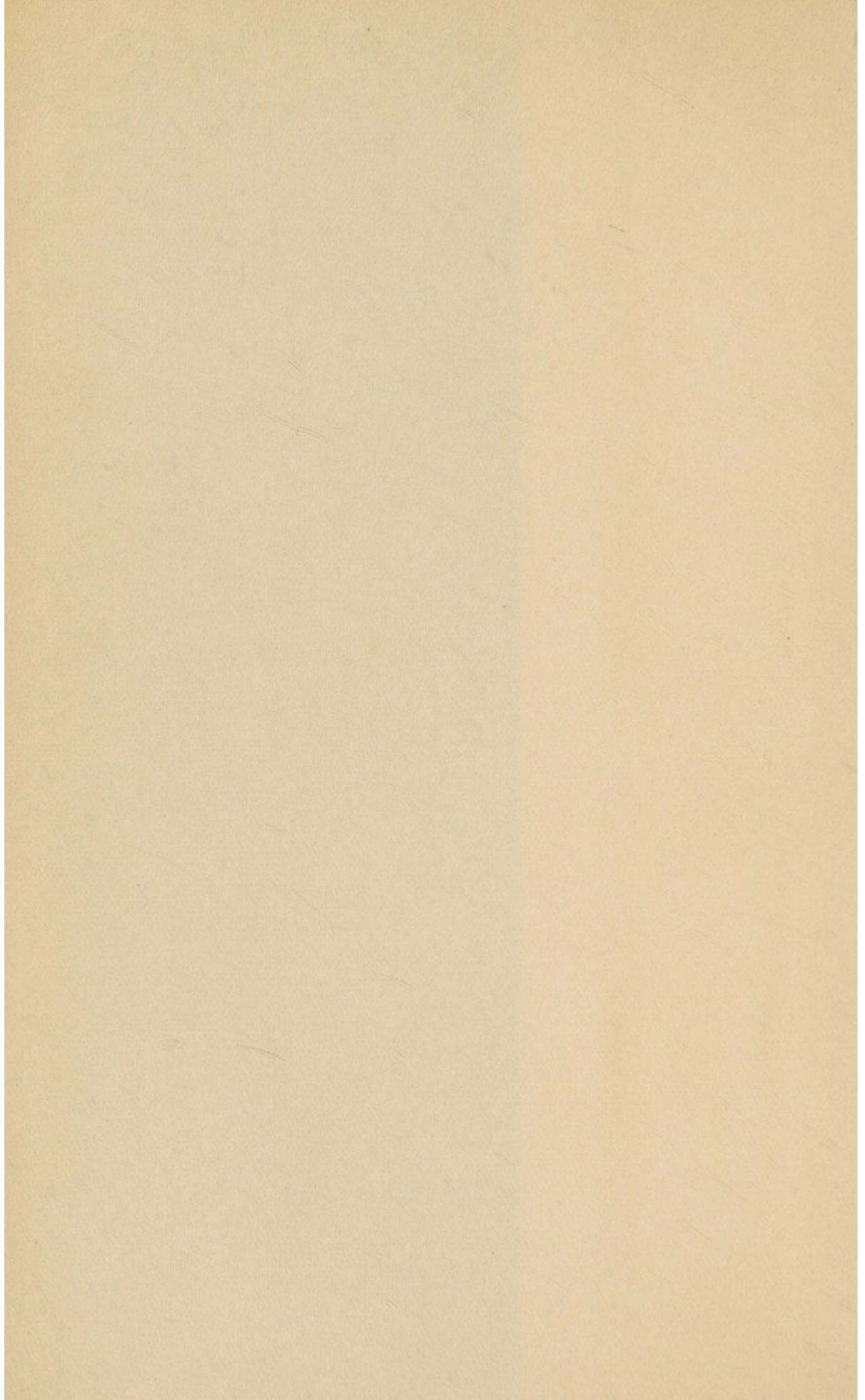
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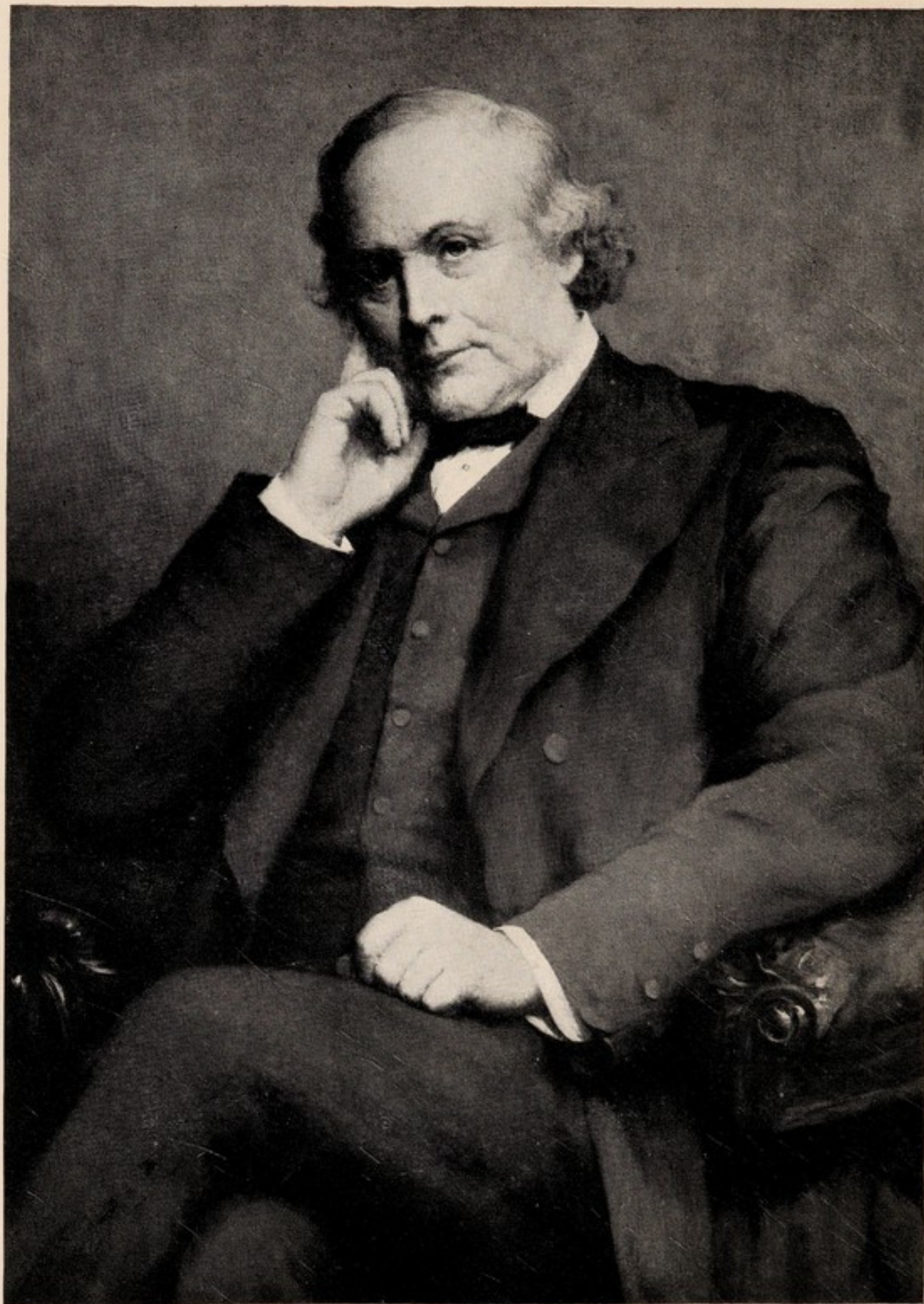
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LORD LISTER, O.M.

From the portrait by W. Ouless, R.A., in the possession of the
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LORD LISTER

THE DISCOVERER OF ANTISEPTIC SURGERY

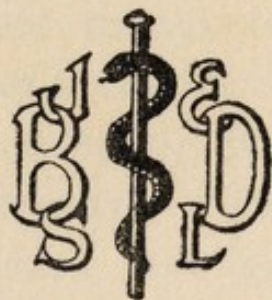
BY

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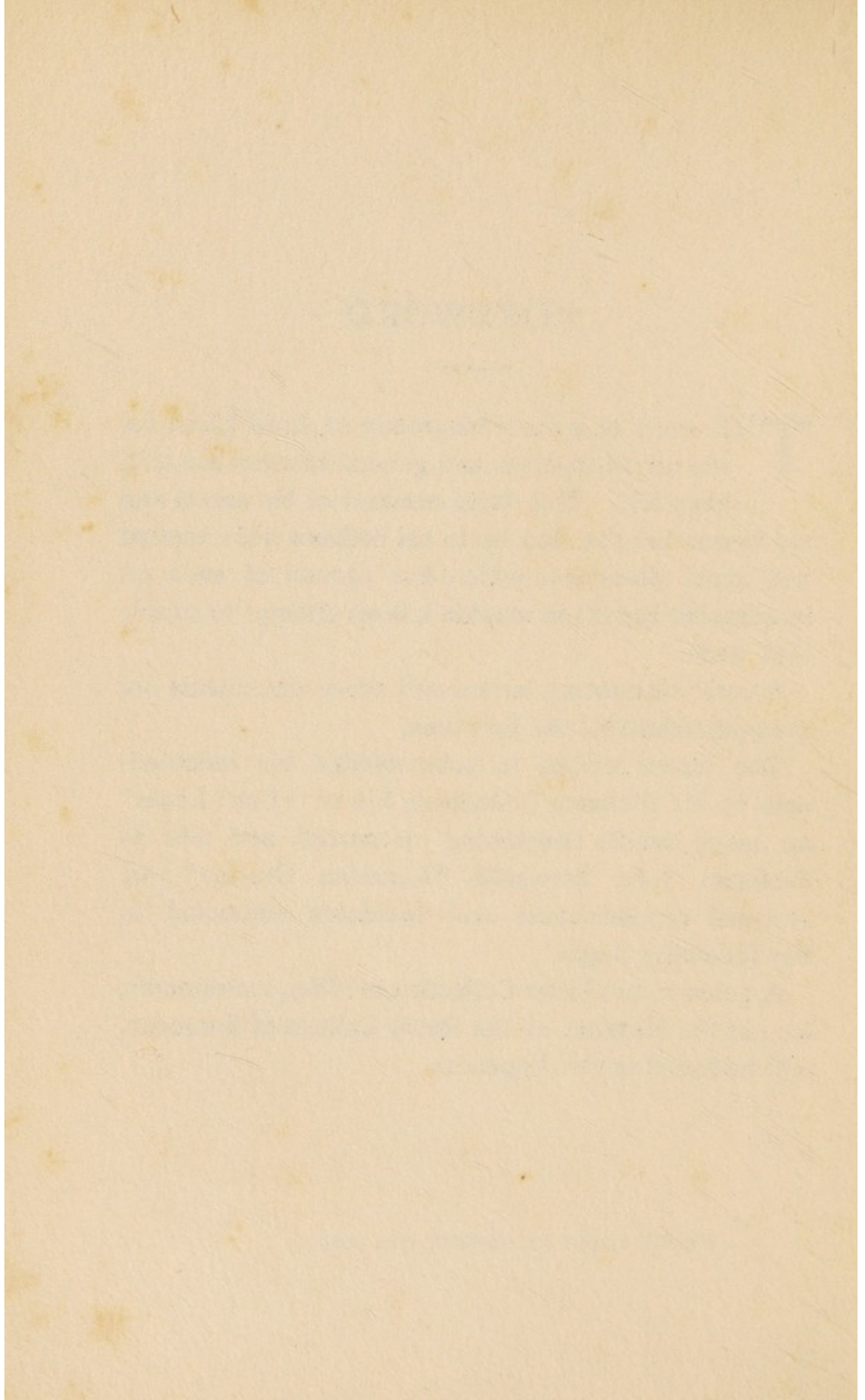
FOREWORD

THE need of a short biography of Lord Lister for the use of students and general readers has long been felt. This brief account of his career and the researches that led up to his brilliant achievement and great discovery, which has proved of such an inestimable benefit to mankind, is an attempt to supply that want.

Several interesting letters and other documents are here published for the first time.

The writer wishes to acknowledge his indebtedness to Sir Rickman J. Godlee's life of "Lord Lister" for many details concerning his career, and also to Professor John Stewart's "Listerian Oration" for personal reminiscences and incidents embodied in the following pages.

A guide to the Lister Collection of relics, instruments, etc., in the Museum of the Royal College of Surgeons, will be found in the Appendix.



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Guide to the LISTER COLLECTION of relics, instruments, documents and manuscripts in the Museum of the Royal College of Surgeons of England.

LORD LISTER

THE DISCOVERER OF ANTISEPTIC SURGERY

CHAPTER I

The Quaker Student—University College.

THERE are many people to-day to whom the name of Lister is familiar and yet they have no clear idea either of the work he accomplished, or of the great debt humanity owes to his genius. Some think his fame rests on his surgical achievements or on the fact that he invented a new surgical dressing, but how many know of the years of patient toil, and profound study of a veritable agony of sympathy with sufferings which he was powerless to prevent, that led up to his discovery.

Surgery before his time was a name of terror, but he made it a message of hope.

There can be no doubt that Joseph Lister by divine providence did more to save life, to relieve pain, to obviate deformity, and to prevent mutilation, than any other man in the history of our race.

Besides being a great pioneer, he introduced new principles which revolutionised the pathology of inflammation and made rough and perilous ways smooth and certain. In the words of one of his contemporaries, "he opened a new and beautiful door into the House of Health and gave his followers the passport and the key."

Some account of the life and the character of the

man, his personality, his ideals and the steps that led to his discovery therefore should be of more than ordinary interest.

Joseph Lister was born on April 5th, 1827, in an old Queen Anne house which stood in a garden in a winding lane that led from the Romford Road towards Plaistow, Essex. Across the lane from the windows of Upton House, as the home of the Listers was called, could be seen the extensive park of Ham House, where Samuel Gurney the banker of Lombard Street lived, on whose advice Joseph Jackson Lister had bought his country residence.

The Listers came from an old Yorkshire Quaker stock who lived in the neighbourhood of Bingley in Airedale, some of whom migrated to London in the eighteenth century.

Joseph Jackson Lister was a prosperous wine merchant who carried on business in Lothbury and, after his marriage in 1818, lived for some years in Tokenhouse Yard. Seven years later he removed to Upton House, where Joseph, his fourth child and second son, was born.

He was a remarkable man in many ways and although actively engaged in business, found time and recreation in the study of optics, in which field he made discoveries that led to the production of the achromatic lens and the perfection of the modern microscope.

For this important work he was elected a Fellow of the Royal Society in 1832 and had a large circle of friends, including such eminent scientists as Herschel, Sir Richard Owen and Dr. Thomas Hodgkin. In collaboration with the last-named he wrote a paper describing "Microscopic observations on the true shape of the corpuscles of the blood," which enhanced his reputation as a microscopist.

Thus Joseph Lister's early environment was one which encouraged the development of the scientific mind, and we can imagine him a little boy, accompanying his father on his country walks, collecting

objects for investigation and peeping through the magic tube at the marvels of the infinitely little, which was one day to be of such surpassing interest to him.

But notwithstanding their serious pursuits, the Lister family was a lively and a human one. They had their rides, games of cricket and bowls, skating in winter and merry evening parties.

Joseph was first sent to a private school at Hitchin and afterwards to Grove House, Tottenham, where a good all-round education was provided. Here he was well placed on entering and we find his mother writing, "What a high standing Joe takes at Tottenham (dear fellow, I want much to see him), it tells well for his diligence and for his old school too."

Natural history appears to have had a special attraction for him in his youth, and on his holidays he loved to collect flowers and plants, or to dissect fish and small animals and articulate their skeletons; in the latter he showed a remarkable manipulative dexterity, which was to serve him well in after years.

The following extract from a letter he wrote to his father when he was 14 shows the tendency of the boy's mind and a foreshadowing of his future career, for he was often heard to say that when he grew up he would be a surgeon.

"When Mamma was out I was by myself and had nothing to do but draw skeletons, so I finished the cranium and named the bones of it and also drew and painted the bones of the front and back of the hand and named them.

"Mamma came home on seventh day at about 2 o'clock and in the evening with John's help I managed to put up a whole skeleton that of a frog and it looks just as if it was going to take a leap, and I stole one of Mary's pieces of wood out of one of the drawers of the cabinet in the museum to stick it down upon and put it on the top of the cabinet with a small bell glass over it and it looks rather nice. Do not tell Mary about the piece of wood."

On reaching the age of 17 he left school and was

sent to University College where his first three years were occupied in passing his matriculation and taking his degree in arts.

During this time he was attacked by smallpox which was followed by a nervous breakdown. On his recovery he firmly made up his mind to become a surgeon, and his father decided to put no obstacle in his way.

In the winter session of that year he began his studies and the Quaker boy became a medical student.

At the medical school at University College he came under the influence of such famous teachers as William Sharpey, who occupied the Chair of Physiology, and Wharton Jones who was Professor of Ophthalmic Surgery. On the staff of the hospital were several eminent physicians and surgeons, including Walshe, one of the great authorities of the time on diseases of the heart and lungs ; William Jenner who was a famous physician, and John Erichsen, a celebrated surgeon, to whom Lister served as house-surgeon in 1851.

The experience he thus gained proved of great value to him, for Erichsen was not only a clever surgeon and skilful operator, but also a man of sound judgment and a most inspiring teacher.

Joseph Lister entered with zest into the affairs of the hospital Medical and Debating Society and read papers on such subjects as hospital gangrene and also on the use of the microscope in medicine, which show the trend of his thoughts at that time.

At the age of 25 he graduated as M.B.London, and took his Fellowship of the Royal College of Surgeons of England in 1852, thus bringing his long studentship of nine years to a successful end.

CHAPTER II

The First Surgical Operation under Ether at University College Hospital.

IT was during Lister's student days at University College Hospital that the first surgical operation under ether was performed in Europe and he was present on that memorable and historic occasion.

On December 17th, 1846, news came to London in a private letter from Dr. Bigelow in America to Dr. Francis Boott, of Gower Street, that a successful operation had been performed by Dr. Warren on a patient while under the new anæsthetic, in the Massachusetts General Hospital.

Two days later Mr. James Robinson, a dentist, extracted a firmly fixed molar tooth from a young lady to whom ether had been administered in Dr. Boott's house. He lost no time in communicating his success to Mr. Robert Liston, the famous surgeon of University College Hospital, who resolved to try the anæsthetic as soon as possible.

The opportunity speedily came, for Liston found it necessary to amputate the thigh of a patient in the hospital in order to save his life.

On the morning of December 21st, 1846, it soon became known among the students that Liston was going to try something absolutely new at an operation which was to take place that day. It was even whispered that the secret of anæsthesia had been discovered. There was much bustling to and fro as the news spread and it was little wonder that the theatre was crowded out long before the hour fixed for the operation arrived.

The theatre of the old hospital was on the ground

floor and separated from the main corridor by two sliding doors. When one entered, on the right was a small wash-hand basin and on the left the instrument cupboard, while in the middle the first notable object to catch the eye was a plain, substantial wooden table with four sturdy legs, which were secured to the floor by angle-irons. The top, which extended over the legs at one end, was rounded, and down the centre was a double row of slots through which straps could be passed to secure the unfortunates who had to undergo the agony of the knife. At the foot of the table was a wooden tray filled with sawdust. In front of the instrument cupboard stood a small four-legged table, and this, together with a low wooden chair, completed the furniture of the operating theatre.

Above and extending round the "well" were iron railings which separated the rising tiers of benches for the students; the lowest one being for the dressers and junior staff.

As the hour approached on this cold December morning, the theatre was packed with students and members of the staff, all eager with expectancy. There were John Erichsen, Russell Reynolds, Bertrand Norman, Brough, Buckell, Squire, Duncan, Joseph Lister, Graily Hewitt, Clover, Webster, and others whose names were to become famous in the future. In the front of the benches, down near the table, Mr. Cadge, Liston's assistant, Ransome, the house-surgeon, and William Palmer, the dresser, stood ready.

Presently, Squire entered, carrying a strange-looking object, consisting of a Nooth's apparatus, the upper cylinder being packed with sponge, that he had hastily devised for the anæsthetic. A small table was brought in on which he placed it and then proceeded to adjust the flexible tube so as to reach the middle of a pillow which had now been laid on the operating table.

He lifted the top of the apparatus for a moment and a curious penetrating odour permeated the theatre.

"Is there anyone here who would like to try it?"

asked Squire, as he looked round at the crowd of eager faces in front of him. There was no answer. "What, no one!" he inquired again. Then, as his eye caught sight of one of the hospital porters, a big muscular fellow called Sheldrake, standing by, he called out, "Come on, man, let's see if we can put you under."

With obvious trepidation, Sheldrake laid himself on the table and began to suck away at the tube while Squire held his nose. But in less than half a minute he suddenly bounded off the table, and felling Squire with a blow, he sprang over the railings and raced up the benches, scattering the students right and left. On reaching the top bench he fell with a crash, and the laughing students closed on him and held him firmly until he quietened down. When he got to his feet he made for the door, vowing vehemently that he would "never have no more of the damned stuff."

Meanwhile, Squire had recovered himself, rearranged his apparatus and put the table straight.

It was a quarter past two when a firm footstep was heard and Robert Liston entered. He was a striking figure, being over six feet two inches in height, with a fine, commanding presence and a face that at once attracted attention.

He was wearing a low-cut waistcoat and an old, loose frock-coat, the sleeves of which were unbuttoned at the wrist so they could easily be turned back.

He nodded casually to Squire, and turning round to the packed crowd of onlookers, which included his colleagues, many well-known practitioners as well as the students, he remarked, drily, "We are going to try a Yankee dodge to-day, gentlemen, for making men insensible."

Then turning to the small table he selected one of the long, straight amputating knives of his own invention.

It was evidently a favourite instrument, for on the handle were little notches showing the number of times he had used it before. Ransome, the house-surgeon, then put the saw, two or three tenacula and

the artery forceps on the seat of a chair close by, and after covering them with a towel, threaded a wisp of well-waxed hemp ligatures through his buttonhole.

"Ready, Mr. Ransome?" asked Liston.

"Yes, sir."

"Then have him brought in. Run along, Palmer."

Edward Palmer, the dresser, at once went quickly through the sliding doors, across the main passage towards the east door of the hospital and turning to the right entered Ward I.

The porters were standing by and the patient was carried in on the stretcher and laid on the table.

He was a man named Frederick Churchill, 36 years of age, who had been a butler and had been admitted to the hospital suffering from malignant disease of the skin and tissues of the calf of the leg. He had been told he must lose his limb to save his life and he had given his consent.

Squire placed the tube in his mouth, held it with one hand and the patient's nostrils with the other. A couple of dressers stood by to hold the patient if necessary, but he never moved and blew and gurgled away quietly.

Liston looked on, trying the edge of his knife against his thumb-nail.

Meanwhile, the tension among the onlookers increased.

The patient's breathing got deeper and more ether was dropped on the sponge in the apparatus.

"I think he'll do, sir," Squire remarked at last, looking at Liston.

The tube was removed and a handkerchief laid over the patient's face.

"Take the artery, Mr. Cadge," cried Liston. "Ransome hold the limb."

"Now, gentlemen, time me," he said to the students.

Watches were at once pulled out. The surgeon's strong left hand grasped the thigh, a thrust of the long straight knife, two or three rapid sawing movements

and the upper flap was made ; under went his fingers and the flap was held back ; another thrust and the point of the knife came out in the angle of the upper flap and in a few moments the operation was nearly completed. The dresser, holding the saw by its end, handed it to the surgeon and took the knife in return—a few strokes and Ransome placed the limb in the sawdust.

“Twenty-eight seconds,” exclaimed Squire.

“Twenty-seven,” cried Buckell.

“Twenty-six,” said Russell Reynolds.

“Twenty-five seconds,” quietly remarked Edward Palmer the dresser to his surgeon, who smiled in reply.

Not the slightest groan had been heard from the patient nor had his countenance been expressive of pain. The handkerchief was removed from his face and trying to raise himself he said, “When are you going to begin ? Take me back, I can’t have it done !”

He was shown the elevated stump and bursting into tears fell back on the pillow.

Then the porters came and he was carried back to the ward which only five minutes before he had left.

Both Liston, his colleagues and the students were obviously much affected at this memorable and impressive scene.

Then, as soon as he could command his voice sufficiently to speak, Liston turned to the excited audience and stammered out, “This Yankee dodge, gentlemen—beats mesmerism hollow.”¹

Thus with perfect success was the first capital operation performed in Europe, while the patient was under the narcotising influence of ether vapour. The man did not know that the limb had been removed and declared afterwards that he had no remembrance of having suffered any pain, either in the theatre or in coming away.

¹ This account is based on facts related to the writer by the late Drs. H. M. Duncan and Edward Buckell, both of whom were actual witnesses of the operation. Other details are taken from the admirable paper by Dr. F. William Cock on “The First Operation under Ether in Europe.”

What impression had this historic scene made on Joseph Lister? He does not tell us, but he, like others who were present, must have realised that surgery was on the threshold of great changes. Pain being abolished, it had been robbed of no small part of its terror.

A new era had indeed dawned which was to give a great impetus to the surgical art and the alleviation of human suffering.

CHAPTER III

Lister in Edinburgh—His Association with Syme—House-surgeon at the Royal Infirmary—Marriage.

IN 1853, Lister had intended to take the usual post-graduate tour of the Continental hospitals in order to gain a wider experience and then settle in London as a consulting surgeon ; but on the advice of Professor Sharpey he decided to first spend a few weeks in Edinburgh and see the practice of James Syme who was regarded as the most brilliant operator in the north.

Sharpey himself had taken a course in Edinburgh and had become a close friend of the great Scottish surgeon, so on his recommendation Lister set out for Edinburgh in the September of 1853.

On his arrival, he took rooms in South Frederick Street and shortly after called on Syme who received him with kindness and cordiality. Between him and the young Englishman a mutual regard and affection appears to have arisen at once. He invited him to dinner and promised to give him the opportunity of assisting at his private operations and to set him to work at the Infirmary.

James Syme was then about 54 years of age and at the height of his career. He was a remarkable man and one of the most important members of the University. Of him it was said, "he never wasted a word or a drop of blood," and he was generally acknowledged to be a teacher of great originality, as well as being one of the boldest and most successful operators of the time. He had the shrewdness to recognise the genius of the earnest young man, half

his age, and determined to give him every opportunity of exercising it.

Syme was a pioneer in the teaching of clinical surgery and one who inspired enthusiasm in his admirers and supporters, of whom Lister soon became one of the most ardent. He speedily saw that in many ways Edinburgh was far away in advance of London. He had come to the northern capital to spend a few weeks and remained for nearly seven years.

Writing to his father, he says, "The infirmary is larger than I expected to find it and there are 200 surgical beds. At University College Hospital there were only about sixty. Syme is, I suppose, the first of British surgeons, and to observe the practice and hear the conversation of such a man is of the greatest possible advantage."

Syme's consulting room was in the city but he lived in a charming house called "Millbank" which stood in a garden at Morningside.

There he entertained his many friends among whom he numbered Dr. John Brown, the genial author of "Rab and his Friends," Sir Robert Christison, the Professor of Materia Medica, and other distinguished men.

Lister became a frequent visitor at "Millbank," where not the least among the attractions to the young surgeon was Agnes, the eldest daughter, whose sweet face and quiet demeanour had made a deep impression on him.

A month soon slipped away, and realising the advantages of his stay, Lister resolved to spend the winter in Edinburgh.

Concerning this decision he wrote to one of his sisters saying that the present opportunities were teaching him what he could not learn from books nor indeed from anybody else.

As a result of this resolve, Syme had him appointed his supernumerary house-surgeon. It was a non-resident post but one much sought after as the experience to be gained was invaluable.

Meanwhile, he decided to spend the Christmas with his family at Upton House and had a short vacation. On returning north in the New Year, much to his delight, he was offered the post of resident house-surgeon to Syme which he at once accepted. The office was a coveted one and on taking it Syme gave him to understand that in his case he might consider that their mutual relations would be those of surgeon and consulting surgeon, an honour he greatly appreciated. He allowed Lister to use his own discretion as to which of the cases admitted at night he should himself operate upon, and soon gave him a free hand in a great deal of the work.

There were twelve fellow resident dressers, all keen on their work and pleasant companions and he speedily became their leader. They called Lister "the Chief", a name of affection and loyalty that clung to him long afterwards. He sent weekly summaries of Syme's lectures to the *Lancet*, besides publishing some of his own cases. So the year passed in Edinburgh and he began to be troubled by the question, should he remain on or return, and commence practice in London?

An indication of his perplexity may be gathered from the following letter he wrote to his father. "The question now is, should I not take advantage of this unrivalled opportunity of advancing my profession? It is true it must depend entirely on myself (under the blessing, if I may say so, of Almighty God in Jesus Christ) whether I succeed or not; but I am encouraged to hope that though I must not expect to be a Liston or Syme, I shall get on. Certain it is I love surgery more and more and this is one great point. . . . As to brilliant talent, I do not possess it, but I must try to make up as far as I can by perseverance." But circumstances were too strong for him and the fates decided he was to stay in Scotland. It was a fortunate decision.

On April 21st, 1855, he was elected a Fellow of the Royal College of Surgeons of Edinburgh, and two days later he took rooms at 3 Rutland Street in a house almost opposite Syme's consulting room.

In June, he paid a short visit to Paris in order to see something of the surgical practice in that city, but within a month was again back in Edinburgh.

There seems little doubt that besides his work which drew him back was the attraction of Agnes Syme to whom he had become deeply attached. Although immersed in the preparation of a course of lectures he was to deliver in November, he found time to renew his suit with the girl of his choice, and on proposing to her, to his delight, he was accepted. Then succeeded happy days for the young surgeon although his approaching marriage was regarded not without qualms by his family.

At that time, when a Quaker married one of another denomination, it led almost invariably, either to resignation of membership or to disownment, a thing which was held abhorrent by strict members of the Community, but Lister's mind was made up. He decided to resign his membership of the Society and ordered his first door-plate with "Mr. Lister" upon it, instead of plain "Joseph Lister" as it would have been if he had remained a Quaker.

His decision was justified, for his marriage, which took place in the drawing-room at "Millbank" on April 23rd, 1856, proved an exceedingly happy one, and in the end brought no change in the affectionate relations between Joseph and his own family.

Later on, he became a member of the Episcopalian Church, in which communion he found peace and satisfaction, holding as he did that true religion stands neither in forms nor in the formal absence of forms.

CHAPTER IV

Lister's First Course of Lectures in Edinburgh—A Continental Tour—Appointment as Regius Professor of Surgery at Glasgow University.

○ ON Wednesday, November 7th, 1855, Lister, who had been appointed Lecturer in Surgery at the Royal College of Surgeons of Edinburgh, commenced his first course on the "Principles and Practice of Surgery," at 4 High School Yards.

"I am truly thankful to say," he wrote afterwards to his brother Arthur, "that it (my *début*) passed off better than I had any right to expect under the circumstances. I went to bed at 2 on 4th day morning and rose at 4 after half an hour's sleep, and got the last words written just in time to go off in a cab and read them! I managed the reading pretty fairly and the students, of whom there were a good number present (I dare say 50) applauded vehemently when I finished." So his successful career as a teacher began.

Meanwhile, he continued his microscopical studies in physiology and pathology which he embodied in two important papers, namely, that "On the Early Stages of Inflammation," which he read before the Royal Society of London, and another on "The Coagulation of the Blood."

Lister had spent the first month of his honeymoon at the English Lakes. He then decided to take his wife for a three months tour on the Continent, the chief object of which was to visit some of the most famous medical schools.

He was already well known to many of the leading Continental surgeons and after visiting Brussels and

Cologne, they went up the Rhine, through Switzerland to Italy.

They stayed at Florence, where they met Pacini, the Professor of Anatomy and Physiology, and at Padua were welcomed by Vanzetti, the Italian surgeon, who was a great admirer of Syme. Through Venice they made their way to Vienna, whose medical school at that time was celebrated throughout Europe. Here the great pathologist, Professor Rokitanski, entertained them hospitably. On their return journey they visited Berlin and Leipzig, where Lister was attracted by ophthalmology and saw Graefe, one of the most famous oculists of his day.

On their return to England, after a short visit to the Lister family at Upton, they left for Edinburgh and settled down in their newly furnished home at 11 Rutland Street.

Lister's private practice at first consisted in helping Syme which did not make great demands on his time, but the election for Assistant Surgeoncy at the Infirmary for which his name had been put forward was impending, and to this post he was unanimously elected on October 13th, 1856.

In the following year his work became more arduous and engrossing, and he was much gratified when Syme gave him the charge of his wards during the summer, with performance of the operations and going round the wards with the students in his place.

"Mr. Syme," he writes, "will attend every day to see any cases particularly desiring to see him and so I shall have the benefit of his advice. This promises to be of the greatest possible service to me. . . . It is exactly what I should most have wished for."

In his ever-widening interests of the next few years in writing papers and preparing lectures, he received the greatest assistance from his wife.

In a letter to his father, Lister says, "Agnes wrote for seven hours one day and eight the next, and was most helpful in suggestions as to words and arrangement of sentences." Such assistance he doubtless

much appreciated, as it was characteristic of him to leave his papers unfinished until the last moment.

After occupying the post of Assistant Surgeon at Edinburgh, in 1860 he was appointed to the important post of Regius Professor of Surgery in the University at Glasgow, and after seven years his first sojourn in Edinburgh came to a close.

In the same year, at the early age of 33, he was elected a Fellow of the Royal Society; his reputation as a scientific man and a practical surgeon was now becoming world-wide.

He came upon the scene in Glasgow at an important crisis in the history of the University, when there was a scheme on foot to remove it from its old to new quarters.

There were many men of distinction on its faculties, including his friend Dr. Gairdner, who became Professor of Medicine, and Allen Thomson who occupied the Chair of Anatomy, while Sir William Thomson (afterwards Lord Kelvin) was Professor of Physics.

Joseph Lister was inducted on March 9th, 1860, and settled in his new home at 17 Woodside Place. At the opening lecture of the winter session he spoke about the importance of surgery, quoting the words of Ambroise Paré, the famous French surgeon of the sixteenth century, "I dressed him, God cured him," and dwelt on the value of anatomy and physiology to the student.

His closing remarks on the two great requisites for the medical profession, viz., a warm loving heart and truth in an earnest spirit, were warmly greeted by his audience.

He soon became popular with his students who numbered 182, and when the time approached for the election for the surgeoncy to the Infirmary they gave him whole-hearted support which led to his election.

Meanwhile, Lister was busy with his pen and wrote the article on "Amputation" for Holmé's "System of Surgery," in which he described a new method of amputating in the neighbourhood of the knee. He

mentions the tourniquet he had devised for controlling the abdominal aorta, especially in connection with amputation of the hip joint, that with characteristic thoroughness he improved four times before he regarded it as a perfect instrument.

He became a strong advocate of wire sutures, pointing out that if there were no tension suppuration did not occur in their track, though it was seldom absent when silk stitches were used.

For the introduction of metallic sutures he invented a needle with an eye some distance from the end, and beyond the eye two grooves in which the wire lay.

From his article on "Anæsthetics," he showed a preference for chloroform over ether, and followed Simpson's and Syme's means of administration called the open method, which meant sprinkling the liquid on a towel or lint and applying it to the face in such a way that the vapour could be inspired with a free admixture of air. On taking up his work at Glasgow Infirmary, his mind soon became absorbed by graver matters, for he found that hospital diseases were distressingly prevalent and the fate of every patient who suffered from a wound had to be regarded with some degree of anxiety. Tetanus, erysipelas, septicæmia, pyæmia and hospital gangrene were scarcely ever absent from the wards, and there was no certain knowledge of the causation of these wound-begotten diseases and no sure means of avoiding them.

These conditions produced in Lister's mind a sense of discontent with things as they were, although others appeared to regard them as inevitable.

What was the cause of these diseases which produced such terrible mortalities and how could they be prevented?

These were the great problems which Lister set himself to solve.

CHAPTER V

Lister as a Teacher.

FROM the first, when at 28 Lister became Lecturer at the Royal College of Surgeons in Edinburgh, he commanded the respect and attracted the enthusiastic devotion of his students. He proved a great and inspiring teacher, whose moral earnestness and insistence on personal responsibility always commanded the attention of his hearers. His voice which was musical, was rather low and gentle in ordinary conversation. "It was hardly loud enough," says Godlee, "to fill a great hall satisfactorily; but as he spoke deliberately and clearly in good grammatical English, and without any attempt at oratory, he could make himself heard even by very large audiences."

He had a very small impediment in his speech or a slight stammer, but this was scarcely noticeable and was said by some to add to his eloquence.

He was at his best in the lecture theatre or in rooms of moderate size. The matter was generally of such interest that the attention of his hearers did not flag, even when as often happened his more important addresses far exceeded the stipulated limit of time.

In his clinical lectures in Edinburgh, the hour passed only too quickly for the students and his originality held their attention. He had a sense of humour and could appreciate wit as well as any man. Sometimes his joke was founded on a text of Scripture and after an operation he would say, "The Bible says, 'Experience teacheth fools,' but that is no proof that it teaches me."

One day, when the instrument clerk had omitted to put a probe in the tray, Lister looked at his students

gravely but with a twinkle in his eye and remarked, "Watson has been very *improbus* as regards that probe," and alluding to his preference for chloroform over ether he used to quote :—

"How happy could I be with 'ether'
Were t'other dear charmer away."

He used to impress on his students in Glasgow that the two great requisites for the medical profession were "first, a warm, loving heart, and secondly, Truth in an earnest spirit."

He laid down as a rule that a surgeon should have a perfectly clear plan of campaign before beginning an operation but that he should be prepared to change his tactics at a moment's notice. All his students, Scottish, English and Irish, for they came from all parts of the United Kingdom, although men of widely different temperaments, spoke of him not only with admiration and respect, but as if they felt that he returned their personal affection towards him, and almost as if they had some individual share in the work he accomplished.

He seemed to have an almost magnetic influence over them, concerning which, Stewart writing in 1910 remarks, "The difficulty will be for any man to find language to express what our Master was to us. We knew we were in contact with Genius. We felt we were helping in the making of history and that all things were becoming new."

At Glasgow, he introduced into his systematic lectures a large amount of general physics, chemistry, anatomy and physiology.

Prominence was also given to his individual views on surgical questions however widely they might differ from those of his contemporaries.

On his lecture mornings Lister was accustomed to sit quietly thinking for half an hour in his armchair, during which time he was not allowed to be disturbed.

His class in Edinburgh was very large and the entry of new students was sometimes as many as 170 to 180 a year.

The large operating theatre seated about four or five hundred and was usually packed up to the top row. There was also a large area or "well" surrounded by chairs to seat a dozen or more distinguished visitors and they were often all occupied.

Four dressers in blue check aprons brought in the patient on a long wicker basket and placed him on the table. The notes were then read by the clerk and the professor proceeded to discourse in deliberate and clear language without show or ornament but rendered piquant by his very slight stammer and an occasional flash of quiet humour.

In the course of a single lecture perhaps three or four patients would be brought into the theatre and sometimes, though not always, an operation was performed on the last. "Thus," says Stewart, "his lectures gave what no book could supply and for this reason were never tedious but held the close attention of the students."

After 1865 whenever it was possible he emphasised the contrast between the usual or old-fashioned treatment of wounds and the new antiseptic method. He therefore warned his class that they would not find in books all that he was about to tell them and urged them to take pretty full notes.

He held very strong views regarding the duty of the medical profession to the public, and used to impress on his students their great responsibility in these words: "While there is probably no calling in which there is greater opportunity for deception than ours, yet when we consider the sacred interests which are committed blindfold by the public to our trust, we must allow that there is no calling in which falsehood is more unbecoming or more despicable."

Again, in the concluding words of his Graduation Address in Edinburgh he observed, "If we had nothing but pecuniary rewards and worldly honours to look to, our profession would not be one to be desired. But in its practice you will find it to be attended with peculiar privileges, second to none in intense interest

and pure pleasures. It is our proud office to tend the fleshy tabernacle of the immortal spirit, and our path, if rightly followed, will be guided by unfettered truth and love unfeigned."

Sir Hector Cameron, one of Lister's first house-surgeons, in a letter written about ten years ago, recalls the keen interest and pleasure that "the Master" aroused in those who listened to his lectures. He says, "We felt conscious that we were listening to new and valuable lessons not yet in print. But we little realised how great their value was or what was to be their unspeakable fruitfulness in the fulness of time."

He would beseech his listeners to form their own opinions and used to observe, "The minds which you bring to bear on this subject to-day are very much the same as they will be throughout your lives. Mere book-knowledge is of little value, if you have this alone you are at the mercy of the next man who writes a book."

"The whole object of your existence," he used to exclaim, "is to understand and cure disease in this world from this time forward. If death should result from our carelessness or want of thought, it is not far removed from manslaughter. Act upon thoughts as they come. Strike the iron while it is hot. If I have ever done anything it is by acting on thoughts as they occurred to me."

One day, while he was explaining certain anatomical points in connection with an operation, some of his lively hearers tittered. Turning round from the black-board on which he was drawing, he electrified them by an appeal to be attentive to details, telling them the more they studied them the more they should bow and admire the stupendous wisdom that planned them.

Although it may be said that all Lister's students were his friends, their affection was not diminished by the fact that he could at times be very severe. In his opinion, a little public reproof was useful education for his dressers, but the faults of house-surgeons were on principle corrected in private, unless he thought that

the fault if overlooked would seriously mislead the class. Such occasions, however, were as rare as they were solemn and painful.

One of his last house-surgeons says, "In the hospital wards it was not only the healing art which was taught. They were a school of gentleness and human sympathy. We can well remember the darkening of his countenance, as with stern severity he rebuked an unthinking student for lifting a broken leg somewhat roughly, and in his clinical lectures, which were models of pure classical English, such expressions as "this poor man" or "this poor woman" were much oftener heard than "this case."

He seldom spoke whilst he was operating, feeling as he used to say that "to introduce an unskilled hand into such a piece of divine mechanism as the human body is a fearful responsibility."

No better idea of the feelings Lister evoked among his students by the matter and manner of his teaching can be conveyed than is expressed by one of them some years ago in the following words: "Long after this, if we are spared to be old men, many a one of us will look back to the old dingy wards of the Royal Infirmary and think with swelling hearts and dimmed eyes of him who taught us there. Whatever monument he may get from the world he has raised his own monument in our hearts."

CHAPTER VI

The Renaissance of Surgery—Hospital Terrors— The Beginning of a New Era.

AT the time when Lister went to Glasgow, the great obstacle to progress in surgery was sepsis or the inflammation caused as we now know by micro-organisms, which regularly infected wounds of every description.

A surgeon had to recognise that there was no security against the simplest and most successful operations being followed by dangerous and even fatal results.

In Glasgow, at the period when Lister began his labours, hospital gangrene and other diseases were scarcely ever absent from the wards and some had often to be closed on account of the frightful mortality which constantly occurred. This was not only the case at home but also abroad, for in Nuremberg the authorities actually contemplated demolishing a great hospital for the same reason.

The male ward in the old Glasgow Infirmary, where Lister's first cases were treated, was in a detached stone building on the ground floor of which was a long rectangular room lighted by six windows on either side. In the centre was a brick flue with two open fireplaces, placed back to back, for heating purposes, and on each side of the ward were twelve iron cots or beds of the ordinary hospital type. After a heated controversy among the local authorities this historic building was demolished in 1924. It was in this ward that stood under the shadows of the great new infirmary which has now arisen, that Lister pondered over many things, but more especially the outstanding

surgical problem of the day, for in spite of open windows and strict attention to the ordinary rules of cleanliness, he was saddened and depressed by the many fatalities after operations.

He was constantly haunted by the problem, What was to be done?

He began by insisting on the most scrupulous cleanliness in the wards, on the frequent washing of the hands of all those assisting at operations or engaged in the dressing of wounds; while he also advocated the use of various deodorant lotions and recommended the frequent changing of dressings in all suppurating wounds. He impressed on his students the fact that the unbroken skin provided a protection that no dressing yet devised could with certainty imitate.

The hospital diseases called septic, such as erysipelas, pyæmia, septicæmia and hospital gangrene to which patients were especially liable after operations remained the nightmare of the surgeon.

It is interesting to recall Lister's first views on this problem and we find these embodied in his systematic lectures in Glasgow.

In one he remarks on the awful frequency of gangrene and his belief that it was brought about somehow or other by the impure state of the atmosphere, produced by the overcrowding of patients with decomposing sores. He noted that however crowded the patients might be in medical wards, if there happened to be an ulcer, it never became affected with hospital gangrene. He instanced a case of a man admitted with the disease who had infected the patients in the beds adjacent to him. He consequently assumed with much reason, that the pollution of the atmosphere was the chief thing to be avoided.

In his ward he determined to allot more space to each bed while enforcing the strictest cleanliness, but much remained to be done at a time when a couple of jugs and basins and a few towels were thought sufficient for the ablutions of the staff, and nothing but soap and water, with perhaps a few drops of Condy's

fluid, was used to cleanse the hands, instruments and sponges.

In those days, the house-surgeon or dresser wore his oldest coat while going his round, in the lapel of which he probably carried a wisp of ordinary whipcord for tying arteries. The operator would don his oldest frock coat, which lasted from year to year, stained perhaps with blood, which eventually acquired an incrustation of filth of which the wearer appeared unconscious or was even proud. The sanitary arrangements too were primitive in the extreme, and Lister had to complain in Glasgow that the closets communicated directly with the ward and the supply of water was often wholly inadequate.

In those days a mortality of from 24 to 26 per cent. in all major operations of the limbs for all cases was considered satisfactory. In Glasgow Infirmary in Lister's time, it was 39.1 per cent. and in Edinburgh 43 per cent.

On the continent, things were even worse, for in Paris the mortality in the hospitals was stated to be about 60 per cent. and in Vienna in 1868 it was 43.4 per cent.

In military practice the mortality after amputations sometimes reached from 75 to 90 per cent., and Sir James Y. Simpson used to assert, and with some truth, that "the man laid on the operating table in one of our surgical hospitals is exposed to more chances of death than the English soldier was at Waterloo."

And now we must go back a few years, to mention a discovery which had an important bearing on the solution of the problem which confronted the operating surgeon.

In 1848, Ignaz Phillip Semmelweis, a Hungarian surgeon, was acting as an assistant in a large lying-in hospital in Vienna, to which about 7,000 women were annually admitted. The mortality due to puerperal fever among the patients in the wards was appalling and sometimes reached the number of 25 to 23 per cent.

No one knew the cause of this disease, everywhere questions arose and everything remained without any explanation.

"All this," says Semmelweis, "reduced me to such an unhappy frame of mind as to make my life unenviable."

Then one of his colleagues died of septicæmia following a poisoned wound received whilst making a post-mortem examination, and Semmelweis *recognised that the disease was identical with puerperal fever* and due to the same cause, *infection from without*.

"In my excited state of mind," he writes, "it flashed across me with irresistible clearness, that the disease of which Kollerschka (his colleague) had died was identical with that which I had seen so many hundreds of lying-in women perish.

His first conclusion was, that the infective material from a dead body was the only cause of the disease, and by insisting that before proceeding to examine any patient his students should thoroughly cleanse their hands with chlorinated lime water, he at once reduced the mortality down to 1.27 per cent.

He, however, soon extended his doctrine and showed that puerperal fever was caused by decomposed animal organic matter without regard to its origin.

Although he proved his case conclusively, he was not believed. He was ridiculed and sneered at by his critics and at length deprived of his appointment. In indignation and disgust he left Vienna in 1850 and went to Budapest, where he devoted the rest of his life to carrying on his work.

Thus, Semmelweis was the forerunner of Lister and showed that one particular form of blood-poisoning did not depend upon mysterious causes, but upon the contamination of abrasions and external wounds.

The application of his doctrine was to be brought about by the combined discoveries of Lister and Pasteur, which did not occur until some years after his death.

CHAPTER VII

Pre-antiseptic Days—The Dawn of a New Era.

AT the present time but few can realise the condition of the surgical wards in our hospitals about 1860. Only some twenty years previously had anæsthetics been discovered that relieved patients from the horror of the knife. The pain of operation now no longer demanded haste on the part of the surgeon and he was thus enabled to undertake longer and more intricate work.

But unfortunately this increased opportunity brought further difficulties to the operator. Patients, too, no matter how serious their condition, dreaded the very name of "hospital," and the most skilful surgeons distrusted their craft. The mortality following operations was indeed terrible and the cause of this was a mystery.

Before Lister's time a routine practice was pursued in dressing wounds. They were put together without delay and their edges having been squeezed into apposition, were retained so by various means such as sutures, plasters, compresses and bandages. They were carefully covered up and concealed from view for a certain number of days. Then the envelopes of cotton and flannel, the compress cloths, the pledgets of healing ointment and plasters were taken away loaded with putrid exhalations and a profusion of bloody ill-digested fœtid matter.

"The patient was kept in a constant state of excitement, and often worn out by suffering, discharges and hectic fever, fell a victim to the practice. The system was a bad one, the application filthy and abominable ;

the whole proceeding outraging Nature and common sense."

Thus, Robert Liston, one of the most famous surgeons in England, described the method of treating wounds in 1840.

In Glasgow Infirmary, when Lister took up his work there, hospital diseases were distressingly prevalent, and the fate of every patient who suffered from a wound had to be regarded with some degree of anxiety. These conditions produced a profound sense of disquietude in Lister's mind. What could be done to lessen the evil, he asked himself again and again? The difficulty could not be insurmountable and he set himself to think out some system to overcome it.

It became obvious that cleanliness and the frequent changing of dressings were not sufficient in themselves, and he saw that if putrefaction in wounds was brought about by germs from outward sources, these septic germs would have to be destroyed. It then occurred to him that putrefaction in a wound might be avoided without excluding the air, by the application of some dressing sufficiently powerful to destroy the life of the floating particles. This led him to try carbolic acid for the purpose.

The first case in which he decided to put his principles to the test was that of James Greenlees, a boy aged 11 years, who was admitted into the Glasgow Royal Infirmary on August 12th, 1865, with compound fracture of the left leg.

The story of this historic case is best told in his own words which are extracted from a letter he wrote to Sir Hector Cameron in 1906.

He says: "In compound fracture, to which in 1865 I first put in practice the antiseptic principle, I applied undiluted carbolic acid freely to the injured part in order to destroy the septic microbes already present in it, regarding the caustic action which I knew must occur as a matter of small moment compared with the tremendous evil which it was sought to avoid. But when this had once been done no further direct action

of the antiseptic upon the tissues occurred. The carbolic acid formed with the blood a dense chemical compound which, together with some layers of lint steeped in the acid, produced a crust that adhered firmly to the wound and the adjacent part of the skin. This crust was left in place till all danger was over, its surface being painted from time to time with the acid to guard against the penetration of septic change into its substance.

“ Meanwhile, in the undisturbed wound, the beautiful result occurred that the material of the crust within it, and the portions of tissue which had been destroyed by the caustic, were replaced by living tissue formed at their expense.

“ That dead tissue when protected from external influences, was so disposed of, was a most important truth new to pathology.”

Lister became convinced that the beneficial influence of carbolic acid, as he employed it, was entirely due to its germicidal action and its consequent power against the sources of disturbance which existed in the dust of the surrounding air, and in such surfaces and objects as had come in contact with the air.

He had for some time taught that wound inflammation and its consequences were due to the chemical changes which occurred in the putrefaction of blood and serum, but only began to realise the character of the interaction of wounds with outside agencies after Pasteur had published his researches in the early 'sixties. Methods of using the antiseptic were soon adopted and carried out in a series of cases with most astonishing results, the injuries following the same quiet course as if the skin had remained unbroken.

Lister next turned his attention to abscesses which, when connected with vertebral caries, were followed by a mortality which, if not so striking and speedy as that of compound fractures, can hardly have been in reality much less.

He thus describes the first case of this kind which he treated by antiseptic methods.

"The patient was a woman above the middle period of life with lumbar abscess. Taught by the disastrous results that sooner or later followed the evacuation of such abscesses, whether by valvular opening or by cannula and trocar, I left the case undisturbed, till one day, looking at it, I found that nothing but epidermis seemed to intervene between the pus and the external world, so that if left for another day it would in all probability burst.

"I therefore resolved to open it and apply a dressing which should imitate, as much as circumstances permitted, that which we used in compound fractures. The pus which escaped on incision was as thick as any I ever saw. Mixing some of it with undiluted carbolic acid, I applied some layers of lint soaked with the mixture to the wound and surrounding skin and covered them with a piece of thin block tin, moulded to proper shape, such as we used for covering the crust in compound fracture. This metal covering, which prevented loss of carbolic acid by evaporation and soaking into surrounding dressings, was fixed by strapping and a folded towel was bandaged over it to absorb discharge.

"Next day, on changing the dressing I was greatly astonished to see nothing escape from the incision except a drop or two of clear serum.

"What was now to be done? I had no longer any pus to mix with the carbolic acid, but it occurred to me that I might make a satisfactory crust by mixing carbolic acid with glazier's putty.

"Accordingly I sent to the dispensary for some whiting and boiled linseed oil, and making a solution of 1 part of carbolic acid in 4 of the oil, rubbed it up with whiting in a mortar, thus making a carbolic putty. This I spread on a piece of block tin and applied it as I had done the first dressing. There never was any further discharge of pus; the serous oozing diminished rapidly and before long healing was complete.

"In that case, as there was no spinal curvature, I

could not be sure that the abscess was connected with the vertebræ. But similar results afterwards followed the same treatment where discharge of bone showed that such connection existed, and also in suppuration of the hip-joint, whether attended with shortening of the limb or not ; scrupulous care being taken to keep the part affected completely at rest.

“The time required for final closing of the sinus was however generally much longer than in the first case.

“Precisely the same beautiful result, so entirely novel and so full of deep interest both for pathology and practice, was seen when acute abscesses were treated in the same way, the only difference being that in the acute cases the serous oozing which followed evacuation of the pus came much more rapidly to a conclusion.”

Lister concludes by stating that “the crude carbolic acid which under the name of German creosote was supplied to me by my colleague Dr. Anderson, Professor of Chemistry in the University of Glasgow, was a brown liquid which had been adulterated with water and this lay on the top as a clear layer destitute of any flavour of carbolic acid. This led me in my first paper on compound fracture to speak of carbolic acid as absolutely insoluble in water.

“But when it was afterwards produced in a comparatively pure condition in colourless crystals, it proved to be capable of being taken up by water, though 20 parts were required for the purpose.

“Having applied it to a foul sore on the palm of the hand, I found on changing the dressing next day that all putrefactive odour had disappeared.”

Although the period when Lister was thus developing his antiseptic system in Glasgow, extending as it did from March 1865 until the autumn of 1869, was a very short one, it is hardly possible to exaggerate the changes which he accomplished in every department of surgical practice. To mention but a few, wounds were found to heal without inflammation, suppuration or constitutional disturbance ; compound fractures and

dislocations were robbed of the former dangers which surrounded them ; large chronic abscesses connected with bone disease were proved to be no longer incurable even when occurring in the adult ; arterial trunks were ligatured in their continuity without fear of secondary hæmorrhage or other mishap ; joints opened whether by accident or by the surgeon's knife healed without a disquieting symptom ; ununited fractures were treated boldly by removing the ends of the fragments in open wounds and incursions were made with success into departments of practice which up to that date were looked upon as forbidden ground.

The effects of the new treatment on the wards also were in the highest degree beneficial, converting them from some of the most unhealthy in the kingdom into models of healthiness.

Thus the renaissance of surgery began.

CHAPTER VIII

Pasteur and Lister.

IN 1857, Louis Pasteur, a young French chemist read a paper on "Lactic Acid Fermentation" before the Lille Scientific Society, and a few months later delivered a communication on "Alcoholic Fermentation" in which he laid the foundation of biological chemistry.

Few at that time realised that the researches of this young scientist were destined to have such important and far-reaching results. Of humble parentage, Louis Pasteur was born at Dôle in France on December 27th, 1822. His father was a tanner and an old Peninsular veteran who had fought under Napoleon. Louis received his early education at Besançon and fostering his love for chemistry his parents afterwards sent him to Paris to study under the famous Dumas.

One of his first pieces of original work was on "Crystallography" which was recognised by the Royal Society in London and he was awarded the Rumford Medal in 1856.

He next devoted his energies to the study of fermentation and spontaneous generation, and the possible analogy between disease and fermentation appears to have been a dominating thought in his mind.

Having proved that the changes in lactic, alcoholic and butyric fermentations were due to living organisms, he raised the question why should not the same microscopic organisms set up the same changes which occur in the human body in putrefactive and suppurative diseases?

It was not until 1865 that Lister's attention was drawn to Pasteur's researches by his colleague Dr. Thomas Anderson, Professor of Chemistry at Glasgow University, and they produced a profound impression on him. For several years he had been pondering over the question why wounds should occasionally heal by first intention but all too frequently should become suppurating and putrid. This was the vital problem he had set himself to solve and he at once recognised the importance of Pasteur's work and the bearing it might have upon the question of suppuration and wound infection.

Later on, he wrote a letter to the *Lancet* calling attention to the great light Pasteur's researches had thrown on the matter of decomposition in exposed organic substances.

Pasteur, he said, had convincingly demonstrated that the contaminating properties of air were not due to its gaseous constituents as had for many years been the belief, but were due to the minute germs of various low forms of life contained in it and long since revealed to us by the microscope. These previously had been regarded as merely the accidental contaminations of putrescence but had now been shown by Pasteur to be their essential cause.

But of all Pasteur's discoveries none impressed Lister more than his demonstration that the organisms which produce fermentation and putrefaction are carried on particles of dust floating in the atmosphere, and that these particles of dust could be destroyed by heat or filtered off by cotton-wool, or intercepted in the finely drawn-out necks of flasks through which free ingress and egress of air take place owing to the diurnal variations in temperature. Hardly less interesting was the proof that these particles of dust are more abundant in some places than others and that while plentiful in dusty rooms, they are absent in undisturbed cellars and on mountain tops.

Another important point which impressed Lister was, that Pasteur showed more clearly than any other

of his predecessors that certain natural substances like blood and urine are kept free from micro-organisms and can be kept from decomposing for an indefinite length of time, if received with proper precautions into previously sterilised vessels.

Deeply impressed by Pasteur's teachings, Lister began his experiments with the conviction that micro-organisms caused putrefaction and that they occurred in the air in overwhelming numbers. How and by what means could they be combated now that the true nature of decomposition had been revealed? He saw this was the key to the situation. The cause of decomposition being known and the means of preventing it in the laboratory having been discovered, it was clear to him that similar means ought to prove effectual in preventing decomposition in wounds, in which case suppuration would be done away with and the dread hospital diseases banished at the same time. And so he began his experiments in his wards at Glasgow Infirmary and soon proved from experience, that by the absolute exclusion of micro-organisms suppuration and putrescence in wounds could be prevented. One of the chief sources of evil he soon recognised was contamination by the surgeon's hands, his instruments and dressings. Then began the study of antiseptic substances and their application which he first successfully put in practice in 1865.

The elaboration of his antiseptic principles in operation and his treatment of wounds which followed, were founded on the germ theory enunciated by Pasteur. Their work is indissolubly linked together, and as Sir Clifford Allbutt has said, "It was Lister who saw the vast importance of the discoveries of Pasteur and he saw it because he was watching on the heights and he was watching there alone. Their experiments and investigations are among the most beautiful and interesting in the history of science."

Lister first made his system of treatment known to Pasteur in the following letter which he wrote to him from Edinburgh on February 13th, 1874 :—

“ MY DEAR SIR,

Allow me to beg your acceptance of a pamphlet which I send by the same post, containing an account of some investigations into the subject which you have done so much to elucidate, the germ theory of fermentative changes.

I flatter myself that you may read with some interest what I have written on the organism which you were first to describe in your ‘*Mémoire sur la fermentation appelée lactique.*’

I do not know whether the records of British surgery ever meet your eye. If so, you will have seen from time to time notices of the antiseptic system of treatment which I have been labouring for the last nine years to bring to perfection.

Allow me to take this opportunity to tender you my most cordial thanks for having by your brilliant researches demonstrated to me the truth of the germ theory of putrefaction, and thus furnished me with the principle upon which alone the antiseptic system can be carried out.

Should you at any time visit Edinburgh it would I believe give you sincere gratification to see at our hospital how largely mankind is benefited by your labours.

I need hardly add that it would afford me the highest gratification to show you how greatly surgery is indebted to you.

Forgive the freedom with which a common love of science inspires me and

Believe me with profound respect,

Yours very sincerely,

JOSEPH LISTER.”

This letter was the beginning of a friendship which lasted throughout the lives of these great men.

They met in Paris in 1878 and again in London at the meeting of the International Congress in 1881. In 1892 French scientists and representatives from all the learned societies throughout Europe flocked to Paris

to do honour to Pasteur when a medal was specially struck for the occasion and to celebrate his seventieth birthday. Lister represented the Royal Society of London and the Royal Society of Edinburgh at the ceremony, which took place at the historic Sorbonne.

The impressive meeting took place on December 27th, 1892, in the large theatre in the presence of about 2,500 people. At half-past ten, Pasteur entered leaning on the arm of M. Carnot, the President of the Republic, while the band of the Republican Guards played a triumphal march. A scene of great enthusiasm ensued as they, together with the Presidents of the Chamber and of the Senate, the Ministers and Ambassadors, took their seats on the platform. After some opening remarks, Lister on being called upon, rose, and with outstretched arms stepped forward to greet Pasteur who stood to embrace him. The meeting of the two Masters was described as a living picture of the brotherly unity of science in the relief of suffering. The delegates then filed past and Pasteur, who was deeply affected, replied. He thanked the delegates who had come from so far to give a proof of sympathy with France. "You bring me," he said, "the deepest joy which a man can feel who believes invincibly that science and peace will triumph over ignorance and war; that men will unite not to destroy but to build up, and that the future will belong to those who have done most for suffering humanity. And here," he continued, "I appeal to you, my dear Lister, and to you all illustrious representatives of Science, of Medicine, and of Surgery."

The death of Pasteur three years afterwards, in September 1895, was mourned not only in France but throughout the world. When his remains were finally laid to rest in the beautiful chapel specially built within the precincts of the Pasteur Institute in January 1896, Lister was present and paid an eloquent tribute to his memory.

CHAPTER IX

Antiseptics.

ANTISEPTIC surgery cannot be said to have been heralded by a single brilliant discovery, for like other great achievements it was a process that developed step by step only after careful experiment and long and patient research.

The recognition of sepsis as the result of putrefaction was no new thing, for certain substances had been employed to prevent decomposition from a period of antiquity.

As far back as the third and fourth centuries before the Christian era, honey had been used for arresting putrefaction and preserving the bodies of the dead from decay.

The ancient Assyrians are said to have placed the bodies of the dead in honey to prevent them from decomposing, and Josephus tells us that the Jewish King Aristobulus, whom Pompey's partisans destroyed by poison, lay buried in honey till Anthony sent the body to the Royal cemetery in Judea.

The word antiseptic, now so generally applied to substances used to prevent or arrest putrefaction or analogous fermentative changes, is derived from the Greek words "anti" against, and "septikos" causing putrefaction, and was first used by Place in his work on Plague printed in 1721. In it he states, "this phenomenon shows the motion of the pestilential poison to be putrefactive, it makes the use of antisepticks a reasonable way to oppose it."

Pitch and other tarry substances having antiseptic properties were employed by the Greeks in the treat-

ment of wounds, and Pliny mentions the valuable absorbent properties of certain earths for the same purpose. Wine and oil mixed with astringent drugs were used in the Middle Ages, and boiling oil was employed to arrest the hæmorrhage from wounds, until at length Ambroise Paré, the great French military surgeon, in 1552, put an end to the terrible torture inflicted by the treatment, and began to use a dressing composed of yolks of eggs, oil of roses and turpentine.

Curiously enough, it was to the Tuscan poet, Francesco Redi in 1671, to whom we owe the discovery, that by protecting a piece of meat with fine wire gauze so that flies were prevented from depositing their eggs upon it, maggots did not appear. So the theory that they bred spontaneously was shown to be erroneous.

Huxley considered this discovery to be the foundation of modern bacteriological technique, and that the wire gauze was the forerunner of the antiseptic gauze of modern surgery.

Until the beginning of the eighteenth century, the methods adopted by surgeons for the treatment of wounds made little advance, and aloes, alum, borax, nitre, myrrh, wine and walnut leaves were the substances chiefly employed.

Then came a change in wound dressings advocated by Delamotte, a French surgeon, in which brandy played an important part. In his work on surgery he describes how he successfully dressed wounds with a pledget dipped in tincture of aloes with the addition of wool soaked in brandy.

In 1720, attention was again called to the harmful effect of air on wounds by Belloste, who also declared that the promptest methods of dressing ought to be preferred to all others. He also employed brandy, alcohol and wine, and regarded them as the most effective media.

A little later, De Villars, another French army surgeon, recommended tutty powder (impure zinc oxide), white lead, burnt lead and burnt alum as useful

dressings, but for wounds he used red wine mixed with warm water, followed by a poultice soaked in brandy.

About the middle of the century the problem of putrefaction, its cause and effects attracted the attention of several observers, and foremost among the investigators was Sir John Pringle, a pupil of Boerhaave's, who became physician to the British troops in Flanders. He communicated the results of his experiments upon "Aseptic and Antiseptic substances, with remarks relating to their use in the theory of medicine," in a series of papers to the Royal Society who awarded him the Copley Gold Medal. He first carried out experiments with alkaline salts as preservatives of beef to demonstrate their power of resisting putrefactive changes, and then made a similar series with gums and resins, including myrrh, which he states he found twelve times more antiseptic than sea water and camphor.

About 1766, Madame d'Arconville astonished the scientific world by publishing anonymously a work entitled "Essai pour servir à l'histoire de la Putréfaction," in which she gave the results of three hundred experiments she had carried out on substances which retarded putrefaction and those which promoted it. The former she called antiseptics and the latter septics. She divided the substances she examined into thirty-two classes, according to the length of time they had kept meat sweet from one day to seven months. It is interesting to note that among the most powerful antiseptics she recorded was corrosive sublimate, and she also came to the conclusion that "to prevent putrefaction it is above all things necessary to exclude the outer air."

Towards the close of the century, Baron Larrey who was surgeon-in-chief to the armies of Napoleon, and Percy, another great military surgeon, advocated the use of pure cold water in the treatment of gunshot wounds with sometimes the addition of a little alcohol or extract of lead.

The next important step in the investigation of the

cause of putrefaction was made by Appert, a French confectioner, who early in the nineteenth century discovered a method of preserving meat, fruit and vegetables by means of excluding the air and hermetically sealing the vessel in which they were contained. He was followed by Schwann, who in 1837 made a series of important experiments on putrefaction and showed that it was not due to the contact of air alone. He placed decoctions of meat in flasks, sterilised the decoctions by boiling and then supplied them with calcined air, and found that under these circumstances putrefaction never set in. His discovery was confirmed by Busch in 1859, who found that the air supplied to the flask need neither be heated nor chemically acted upon, but simply be allowed to pass through a plug of cotton-wool which acted as a filter.

The next step was made by Semmelweis, whose discovery of the cause of puerperal fever has already been mentioned. He employed chlorinated soda or chlorinated lime in water, in which he insisted students should thoroughly cleanse their hands before examining a patient.

The fresh interest thus aroused in the study of antiseptic substances led to experiments with many others.

Although iodine was discovered in 1811, its antiseptic properties were not properly recognised until many years later when it was applied to wounds in the form of tincture. It then went out of use until about thirty years ago, when its value was brought forward, and since has again been proved in the Great War.

In a similar way, iodoform, which was first prepared in 1828, was not much used until 1836, and then dropped out of practice for about forty years when it again became generally popular as an antiseptic dressing for wounds.

Carbolic acid, which Lister first used in a crude form and which eventually played such an important part in his researches, was first discovered by Runge in 1834.

It was a dark liquid with a disagreeable smell and

only slightly miscible with water. Until 1858, it was chiefly used for making disinfecting powders, and beyond its action as a disinfectant and a preventive of decomposition, its antiseptic properties were unrecognised, until Frederick Crace Calvert, an English chemist, who had studied in France under Chevreul, took up the investigation of coal-tar products. He was Professor of Chemistry at the Royal Institution at Manchester in 1846, and later with others took up the the manufacture of carbolic acid, which they succeeded in producing in a pure form and fit for medicinal purposes.

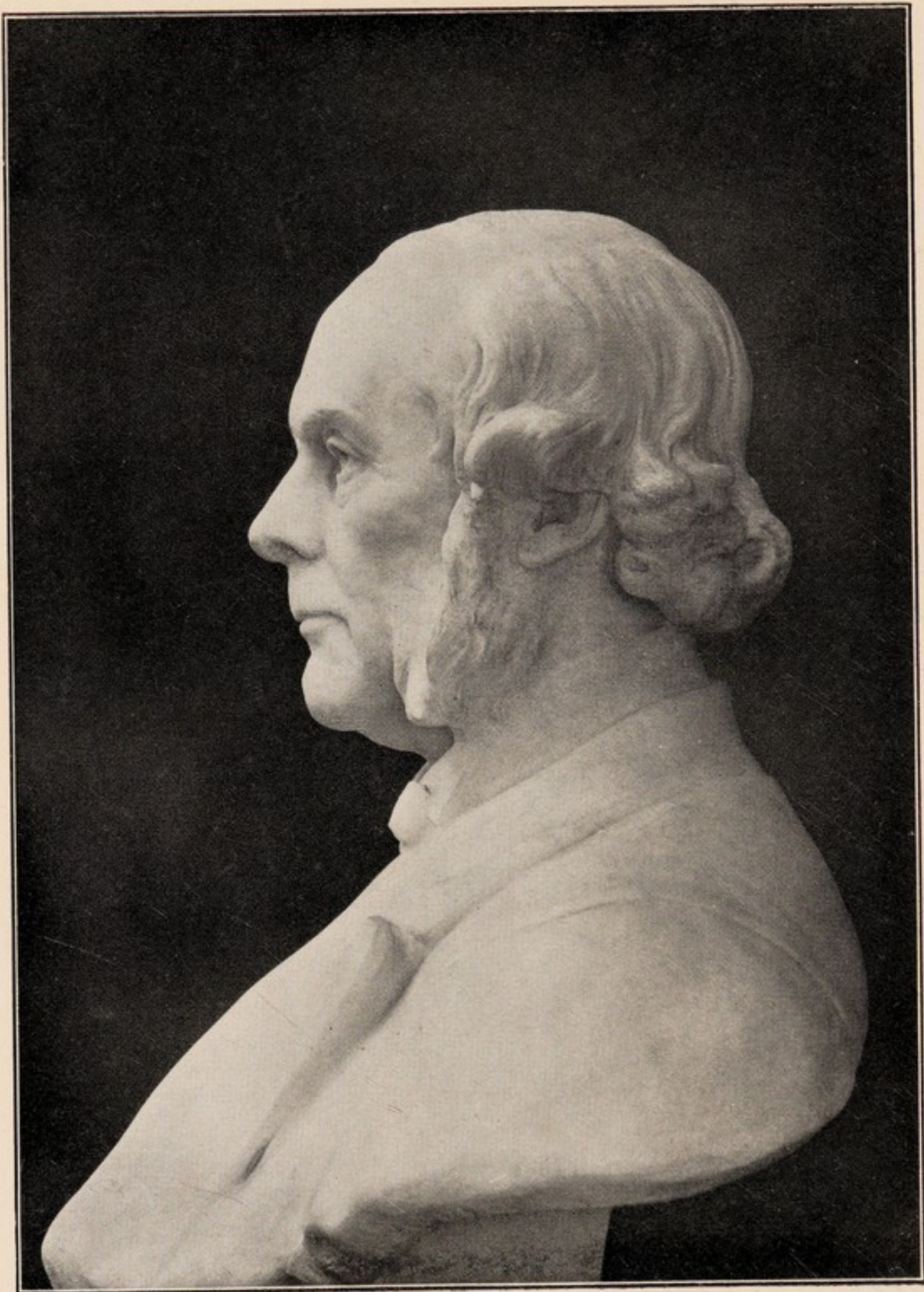
It is to Jules Lemaire, a French pharmacist, however, we owe the introduction of carbolic acid into surgical practice, who in 1860, after a long series of experiments, published a book on "Saponified Coal Tar," in which he called attention to its value not only as a disinfectant, but as a preservative of foodstuffs and anatomical preparations. He appears to have accepted the germ theory of the cause of putrefaction, and as early as 1854 employed it as a surgical dressing.

Carbolic acid was also used in St. Mary's Hospital, in London, for the same purpose in 1855, but it was not until 1867 that Lister's attention was called to this fact, two years after he had first employed it in Glasgow Infirmary.

It is important to remember that up to that time, except in a few cases, surgeons had employed antiseptic substances, not in the hope of preventing the occurrence of putrefaction, but with the object of neutralising its effects after it had developed by natural processes which it was supposed to be impossible to counteract. It was to prevent the occurrence of suppuration with all its attendant evils, that Lister based his antiseptic system. As he himself says, "It occurred to me that decomposition in the injured part might be avoided without excluding the air by applying as a dressing some material capable of destroying the life of the floating particles," and on this he based his practice.

Sir Hector Cameron puts it plainer in the statement, that "while others had attempted by the use of carbolic acid and other antiseptics to lessen the discharge from suppurating surfaces, Lister taught that its beneficial influence, as he employed it, was entirely due to its germicidal action and its consequent power against the sources of disturbance which existed in the dust of the surrounding air and in such surfaces and objects as had come in contact with the air."

This brief historical survey of some of the substances used as antiseptics before Lister's time shows, that although so many investigators came near to the mark, they failed to grasp the importance of applying the principles they had discovered to practical utility.



LORD LISTER, O.M.

From the bust by Sir Thomas Brock, R.A., in the possession of the
Royal College of Surgeons of England.

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CHAPTER X

Lister publishes an Account of Cases treated by his Antiseptic Methods—His Principles criticised—Further Experiments.

DURING 1865, Lister continued his experiments in treating wounds according to the antiseptic principles he had formulated, and it was not until the spring of 1866 that he was cheered by results from what he regarded as a good test case for the application of his methods. This was one of compound fracture of the leg with a wound of considerable size accompanied by great bruising.

He wrote to his father concerning this case on May 27th, 1866: "Though hardly expecting success, I tried the application of carbolic acid to the wound to prevent decomposition of the blood and so avoid the fearful mischief of suppuration throughout the limb. Well, it is now eight days since the accident and the patient has been going on exactly as if there was no external wound, that is, as if the fracture was a simple one. Thus, a most dangerous accident seems to have been entirely deprived of its dangerous element."

Again, a week afterwards, he wrote: "The great swelling has now almost entirely subsided and the limb is becoming firm. And, what I really could not have expected, the original crust of clotted blood, lint and carbolic acid, which was over the wound the day after the accident, still remains there without a drop of matter (pus) having as yet formed beneath it."

Lister was so delighted with the result of his treatment in this serious case, he at first thought of publishing it at once, then afterwards decided to delay publication until he saw the results in other conditions.

In October, he began to apply the treatment to

abscesses and other cases followed with equally successful results. He still withheld his pen, though he contemplated writing a book, and at length decided to publish his observations in a series of articles in *The Lancet*. These historic articles which embodied his first observations on his principles of antiseptic surgery, appeared in *The Lancet* between March and July, 1867 under the title, "On a New Method of Treating Compound Fracture, Abscess, &c., with Observations on the Conditions of Suppuration."

He divided the articles into two sections and in one gives a generous acknowledgment of the "flood of light that had been thrown upon this most important subject by the philosophic researches of M. Pasteur." The whole communication contained accurate descriptions of eleven cases that had been successfully treated by his methods, four of which had occurred in the practice of his colleagues.

The Lancet articles were followed by a paper he read at the meeting of the British Medical Association in Dublin in August 1867, on "The Antiseptic Principle in the Practice of Surgery."

The publication of such revolutionary principles in surgical practice naturally aroused much comment and criticism, both among the profession and in the medical press.

The Lancet appears to have confused the discovery of the antiseptic principle with the discovery of carbolic acid, and remarked: "If Professor Lister's conclusions with regard to the power of carbolic acid in compound fractures should be confirmed by further experiment and observation, it will be difficult to over-rate the importance of what we may really call his discovery."

Much correspondence ensued in the medical journals, many of the writers expressing scepticism and distrust. Among the critics was Sir James Y. Simpson, who like many others regarded the theory of atmospheric germs as "mythical fungi"; while some compared them to a revival of the belief in "the aerial sylphs and spirits of the Rosicrucian philosophers."

Lister suffered the abuse of most great pioneers in science, but that did not disturb him, for he patiently continued his work in Glasgow and devoted his whole soul to perfecting his system of treatment. He had now clearly and publicly explained the antiseptic principle and his system of treatment had been broadcast to the world.

Great interest began to be excited among scientific men throughout Europe and America, and emissaries came to Glasgow from Leipzig, St. Petersburg and the United States. From London, such notable surgeons as MacCormack, Berkeley Hill and Marcus Beck journeyed north to investigate and see Lister's cases. They came, they saw and went away well satisfied with the results. Lister's students who formed a band of enthusiastic disciples, also exercised an important influence in spreading abroad by practice and precept the value of his antiseptic treatment.

Meanwhile, Lister learning from experience, began to modify his methods and commenced to employ a diluted, watery solution instead of the pure carbolic acid. Further, in 1869, he introduced what he called a "protective," which was a material unstimulating in itself and impervious to carbolic acid, with the idea of preventing an immediate contact with the wound and so protecting it from the irritation of the dressing.

The material he found most effective was oiled silk covered with copal varnish. This he later improved by coating it with a layer of dextrine and starch.

The name "protective" appears to have been suggested to him by Syme, who in the following letter counsels Lister to apply the word to his system instead of "antiseptic" :—

Feb. 5th, 1865.

"MY DEAR J.

From the progress that your case has made I have no doubt it will prove entirely successful. . . .

Instead of 'antiseptic,' I think you should call the system of treatment 'protective' to avoid confusion with advertising fellows in London who profess to cure

all diseases by charcoal administered under the title of antiseptic system of treatment.

Besides, I think 'protective' more clearly expresses the object in view.

Yours affectionately,
JAMES SYME."

But Lister decided in favour of the word "antiseptic" and continued to apply it to his system.

In his laboratory at Glasgow Infirmary, however, he still sought for a perfect dressing and there first devised his "cerate," which consisted of a mixture of paraffin wax, olive oil and carbolic acid, spread on calico. But this did not prove entirely satisfactory.

With characteristic and untiring patience he continued his experiments and next evolved a plaster which was composed of ordinary shellac mixed with carbolic acid of the strength of 1 to 4.

This "lac plaster" he used in the same way as the carbolic putty, and it remained his ordinary antiseptic dressing until 1870. He first described it in an address he gave to the Medico-Chirurgical Society of Glasgow in 1868.

"On this occasion," he states in a letter, "I also took my stand distinctly as to my part in the antiseptic system. The large room was filled with probably the largest company that was ever assembled in it. Some, one or two, tried to disparage; but they did not touch my facts and made very poor appearances."

In the course of his address in taking his stand as to his own part in the antiseptic system, he stated emphatically that there was no essential relationship between the system and carbolic acid, pointing out that, though carbolic acid happened to be the first antiseptic agent he had used, it was possible that others might answer the purpose equally well.

He also insisted that in order to carry out the antiseptic treatment successfully, an intelligent belief in the truth of the germ theory of putrefaction was essential.

He showed the results of his first experiment, a modification of one of Pasteur's, originally devised by Chevreul, which had been carried out as follows: Fresh urine was introduced into four flasks, the necks of which were wide and straight when the liquid was introduced, and which, after careful cleansing, had been carefully drawn out after being heated over a spirit lamp. Three of them had elongated and attenuated necks bent at various angles, but the neck of the fourth had been cut short and left vertical, its orifice having been reduced to even smaller dimensions than the others. The contents of each flask were boiled for five minutes, then the heat withdrawn and air allowed to enter them to take the place of the condensed steam.

The flasks were then left undisturbed in the same room with the ends of the necks still open. After six months, the liquid was found to be unaltered except of that in the flask with the straight neck. From this Lister inferred, that in the case of this putrescible substance, at least, the atmospheric gases alone were incapable of producing putrefaction.

What was it then, that was essential to putrefaction of urine by atmospheric influence which the bent tubes had arrested? It could not have been any of the gases but it might have been due to some particles, such as dust suspended in them which the angles of the tubes had arrested mechanically.

This conclusion was confirmed by comparison with the other flask in which the orifice had been purposely arranged so as to afford a better chance for the introduction of particles of dust in which accordingly chemical changes soon declared themselves in the liquid. These flasks became historic and two years later, Lister carried them carefully on his knees to Edinburgh, and although churned up on the journey, it was accomplished without breakage.

They were shown to class after class of students in Scotland, and when he carried them to Plymouth and told their story, four years afterwards, the liquid in the flasks was still clear.

In 1877 he brought them with him from Edinburgh to London to show to his students at King's College. They were preserved at the Lister Institute for years, where they were seen by the writer, but were afterwards unfortunately destroyed by a fire. Their contents remained clear till the last.

In this simple way, Lister demonstrated the truth of the germ theory on which his antiseptic system was founded.

CHAPTER XI

Lister's Return to Edinburgh.

IN 1869 another change took place in Lister's career. His father-in-law, James Syme, was seized with a paralytic stroke and although he partially recovered, he decided to resign his Chair as Professor of Clinical Surgery at Edinburgh which he had filled with such distinction.

Shortly after this became known, the students of medicine of the Edinburgh University and Medical School sent the following communication to Lister which was signed by 127 of their number.

"We the undersigned students of medicine of the Edinburgh University and Medical School, beg most respectfully to invite you to become a candidate for the Chair of Clinical Surgery now rendered vacant by the resignation of our venerated teacher, Professor Syme. We take this step from a conviction that you are the man most capable from your high attainments and achievements in surgery to maintain the dignity and renown which have been conferred upon the Chair and the University by Mr. Syme.

"We believe that your researches in various departments of science and your contributions to its literature, have caused your name to stand next to that of Mr. Syme amongst the living surgeons of Scotland. Your method of Antiseptic Treatment constitutes a well-marked epoch in the history of British surgery, and will result in lasting glory to the Profession and unspeakable benefit to mankind.

"We feel that if you are appointed to the Chair the benevolence of your character and the urbanity of your

manners will speedily draw around you a large band of attached and devoted followers."

This address was received by Lister early in July in Glasgow and he consented to allow his name to be put forward, with the result that on August 18th the news reached him that he had been elected to the Chair. Within a month afterwards, he received word of his father's serious illness and he journeyed to Upton to see him. He died a few days after his arrival. The death of one to whom he was so devotedly attached and to whom he owed so much, came as a sad blow to him and resulted in the break-up of the old family home.

It was not until October 1869 that he again took up his residence in Edinburgh and eventually settled at 9 Charlotte Square, then a favourite locality with leading medical practitioners in the Scottish capital.

It was not long before he became recognised as the leading surgeon in Scotland and soon acquired a large private practice. The succeeding eight years, surrounded as he was by sympathetic friends, are said to have been the happiest of his life. Among his colleagues were his old friend Sir Robert Christison, famed as a toxicologist and physician, Matthews Duncan the great gynaecologist, Thomas Keith, a pioneer in ovariectomy, and Joseph Bell, who is said to have been the original of Conan Doyle's well-known character, Sherlock Holmes.

It was in the sombre old ward at the Royal Infirmary which contained fifty beds, that Lister took up and continued his work. The interior was dismal and unattractive and had none of the bright and cheerful appearance that the wards of our hospitals present to-day. The properly trained nurse in her spotless uniform was practically unknown at that time, and the duties were carried on by old women of more or less reliability.

Lister's own head nurse, a Mrs. Porter, was one of the more responsible type and was quite a character. She had been a head nurse in Syme's time, and was a strict disciplinarian capable of keeping the students in order and it was said the chiefs as well.

She had taken a great liking to Lister when he first came to Edinburgh and was delighted to welcome him back again. Professor John Stewart tells us "she had silvery hair, black eyes and rosy cheeks. She had worshipped Syme and loved Lister as if he had been her own son, and the tears rolled over the sweet roses of her sunken face when he finally left Edinburgh."

Henley, the author and poet, who was for some time a patient in the Infirmary, thus describes Mrs. Porter in one of his short verses included in his "In Hospital; Rhymes and Rhythms."

"The greater masters of the commonplace,
Rembrandt and good Sir Walter ——— only these
Could paint her all to you ; experienced ease
And antique liveliness and ponderous grace ;
And sweet old roses of her sunken face :
The depth and malice of her sly grey eyes ;
The broad Scot's tongue that flatters, scolds, defies ;
The thick Scot's wit that fells you like a mace.
These thirty years has she been nursing here,
Some of them under Syme, her hero still.
Much is she worth and even more is made of her.
Patients and students hold her very dear,
The doctors love her, tease her, use her skill.
They say, 'The Chief' himself is half afraid of her."

Such was Mrs. Porter, and the stout oak chair with the date 1863 carved on one of the arms in which she used to sit and knit in the ward was long preserved by Professor Caird, one of Lister's old students, who afterwards became Professor of Clinical Surgery at Edinburgh, in his consulting room in Carlton Terrace.

John Beddoe, who was a fellow student of Lister's in London, tells a story of how, when visiting him in Edinburgh, he persuaded him to climb up a rather dangerous cleft in Salisbury Crags known as Cats Nick.

He says, "Lister had been overworking himself, and before I, who was leading, had accomplished more than half the ascent, he called to me, 'Beddoe, I feel giddy ; would it not be foolish in me to persevere to-day ?'

" 'Certainly,' I replied. 'Let us postpone it till you are in better condition,' and I began to descend.

"I suppose much experience of the place made me careless. A large fragment came away in my hands and the stone and I fell on Lister. He was looking up at the time and squeezed himself cleverly against the face of the cliff; but the huge stone struck him on the thigh with a grazing blow and then whirled down the talus below with leaps and bounds. Lister was badly bruised but no bone was broken.

"I went off at once to the Infirmary and procured a litter and four men wherewith I returned to Lister.

"As our melancholy procession entered the courtyard of the surgical hospital, there met us Mrs. Porter. She wept and wrung her hands, for Lister was a universal favourite.

"'Eh Doketur Bedie! Doketur Bedie! I kent weel hoo it wad be. Ye Englishmen are aye sae fulish gaeing aboot fuslin (whistling) upo' Sawbath.'

"'We were both in bed a fortnight,' concludes the narrator of this adventure which might have been attended with more serious results.

In carrying on his treatment in the ward at Edinburgh, Lister gave his personal attention to each antiseptic case, as in those early days he deemed it essential to attend to every detail.

"It is no wonder," says Godlee, "that so many failed to obtain his results and suggested that his success was due rather to his personal supervision than to the principle upon which his practice is based."

He was convinced that he held the key to success in wound treatment, the experience of every day confirmed this faith and unfolded new visions of undreamed possibilities of saving limbs and lives.

There were still many objectors and opponents to his principles, and with the exception of Mr. John Chiene, his assistant surgeon, his surgical colleagues even in Edinburgh were hostile to his teaching or only half convinced of its truth.

In spite of this, famous surgeons on the Continent and other parts of the world were deeply interested in his work and came to see for themselves, and on

returning to their own countries inaugurated his methods in their hospitals.

The old story was repeated of the pioneer being doubted in his own country yet appreciated abroad. German surgeons in particular were attracted by his work and when in the summer of 1875 he made a prolonged tour in Germany in order to see for himself how his doctrines were applied, he was received everywhere with enthusiasm and his progress is described as "having assumed the character of a triumphal march."

Richard von Volkmann, Professor of Surgery at Halle, was Lister's principal champion in Germany, while Professor Georg Friedrich Stromeyer, of Hanover, who had adopted his teaching, was an ardent disciple.

It was the last named who wrote these lines addressed to

"LISTER."

Mankind looks grateful now on Thee,
For what thou didst in Surgery,
And death must often go amiss
By smelling antiseptic bliss.

By Volkmann's skill and industry,
Famous thou art in Germany!
Who could a better prophet be,
Than Richard Hotspur was to Thee?

HANOVER.

1st Aug., 1875.

Munich hailed him as a benefactor, and small wonder, for the condition of its great hospital had become so bad that a few months before Lister's visit it was on the point of being closed or even demolished. Eighty per cent. of all wounds, accidental or operative, became infected with hospital gangrene. Perhaps the highest tribute to the application of Lister's methods of treatment in Germany was that uttered by Professor Nussbaum who declared, "When in 1875 at one decided stroke I organised the clinic on Lister's principles, this disease (hospital gangrene) disappeared as if by magic and has not since showed itself in a single case."

But in England opinions in regard to the antiseptic system were beginning to change and at the meeting of the British Medical Association in Edinburgh in 1875, when Lister gave demonstrations of his method of operation and of dressing wounds and exhibited many successful cases, a profound impression was created among those who witnessed them.

CHAPTER XII

The Evolution of the Spray—The Introduction of Gauze Dressings—An Operation on Queen Victoria.

IN the early part of Lister's second period in Edinburgh, he introduced two modifications in his antiseptic treatment. One was his attempt to render the air innocuous by means of an antiseptic spray, and the other was the substitution of an absorbent gauze dressing for the non-absorbing lac plaster he had hitherto been using.

Pasteur's teaching had strongly corroborated the old belief that the air was the principal agent by which wounds were contaminated, and Lister was so convinced of the important part played by the air in this respect, that he conceived the idea of creating an antiseptic atmosphere surrounding the wound, far and wide, in all directions. He assumed that wherever the spray penetrated the vapour of carbolic acid given off from the drops and the drops themselves, would be powerful enough to destroy instantly all the germs that came in contact with it.

He first experimented with a small Richardson's hand-spray which was used at that time for freezing the skin or gums by means of ether, but though perfectly efficacious for a small operation, he found it did not make a cloud of sufficient volume for a large one. "Therefore," said Lister, when exhibiting his new and larger spray at the meeting of the British Medical Association in Plymouth in 1871, "I have had another apparatus prepared which I confess is a heavy and cumbrous form but I hope it will be improved in that respect before long."

He used with this apparatus a watery solution of

carbolic acid of 1 in 40. Previously he had introduced a model in which the bellows had been worked by the foot, but both the foot and the hand spray involved so much physical exertion, he found they could only be used for an operation of even moderate length by providing a relay of assistants.

The model he exhibited in 1871 stood on a large tripod and was worked by a long handle and was irreverently called by the Edinburgh students "the donkey engine." It certainly was a bulky piece of apparatus and could not even be concealed in Lister's brougham when he took it from place to place.

However, before long it was superseded by the steam spray which was made in two sizes, one being for prolonged operations and the other, a smaller one, for short operations or the changing of dressings. With the former a great cloud of fine spray could be produced which enveloped the patient and all those engaged in the operation, and it was capable of filling a room of moderate size with a more or less dense, damp, pungent mist. But although there were many objections to the use of the spray, which Lister himself admitted was "a necessary evil incurred to attain a greater good," it continued to give certain results. It came to be used all over the world and was employed wherever the antiseptic system was practised for many years.

But progress was still being made and at the meeting of the International Congress in 1881 Lister said, "I am aware that, concomitantly with the perfecting of the spray, there has been an improvement in other parts of our antiseptic arrangements, and I am not prepared to say that our increased uniformity of good results may not be due to the latter rather than the former. And it may be for aught I know that when the International Medical Congress next meets I shall be able to speak of results of a still higher order obtained without using the spray at all. For if further investigation should confirm the conclusion to which our recent facts seem to point, and it should indeed

be proved that all idea of atmospheric contamination of our wounds during operations may be thrown to the winds, then no one will say with more joy than myself "*Fort mit dem spray.*"

These prophetic words came true, for in 1887 Lister abandoned the spray, after becoming convinced in the view of important facts discovered since its introduction that it did not kill all the microbes in the air. . . .

"For the spray," he said later, "though useless for the object for which it was originally designed, had its use as a diffuse and perpetual irrigator, maintaining purity of the surgeon's hands and their vicinity as an unconscious caretaker."

Lister's next step was the substitution of a gauze dressing for the lac plaster. It was one which at once made the antiseptic treatment easier for the inexperienced to carry out, safer for the practised dresser and more comfortable for the patients.

At first he had used lint soaked in carbolised oil and then experimented with the various non-absorbent plasters, but none of these was entirely satisfactory. He was then led to try oakum (old rope picked to pieces and treated with Stockholm tar) and found it efficacious on superficial sores, but it was both dirty and sticky, while its odour proved objectionable to the patient.

Finally, he decided to try a soft fabric and after a search among the drapers' shops, he found at length a muslin gauze which was cheap, porous and soft.

It is this material, variously impregnated with antiseptic chemicals, that still forms the basis of the antiseptic and aseptic dressings employed to-day.

At first, Lister went back to his original choice of carbolic acid as the antiseptic, and this was the dressing known as "antiseptic gauze" until 1889.

He experimented on himself with various chemicals having antiseptic properties, and on February 19th, in his notes, he records the following :—

"With a view of ascertaining whether a saturated solution of the biniodide of mercury in fresh blood is

irritating or otherwise, I shed a few drops of blood from my finger upon a piece of 2 p.c. biniodide wool about $\frac{1}{8}$ in. thick. When dry and having cut the incrustrated wool to a square of about $\frac{1}{2}$ in., I applied it to my forearm with mackintosh, rubber plaster and bandage.

"Feb. 20. 8.15 a.m. I removed the dressing and found no appearance of irritation under the blood. 7.30 p.m. the arm continues free from irritation."

The following is a further record he made in testing sodium sublimate :—

"1st March, 1885. 6 p.m. I have bound upon my forearm in the usual way, pieces of lint each about $\frac{1}{2}$ inch square, wetted with solution of the salt of 1 to 20, 1 to 50, 1 to 100.

"Results. 1 to 20 showed intense redness, 1 to 50 smart redness, 1 to 100 decided redness."

Then after many trials of other chemicals he decided to replace the carbolic by a gauze charged with double cyanide of mercury and zinc, still commonly called "cyanide gauze."

Before this, probably owing to the investigations of Koch on the potency of the germicidal and inhibitory powers of corrosive sublimate and other non-volatile salts of mercury, Lister decided to adopt a non-volatile antiseptic in the gauze which he employed during the later years of his practice.

His experimental attempts were at first disappointing, but he at length found that by mixing the corrosive sublimate with horse-serum he thought he had at last found a reliable antiseptic that did not produce irritation.

He began to recommend the sero-sublimate gauze in 1884, but was still dissatisfied with the results. Again he tried nearly all the antiseptic salts of mercury, including sal alembroth, which he never publicly recommended. It was after that he hit upon the double cyanide of mercury and zinc, "which," says Godlee, "proved to be the most satisfactory of all the non-volatile antiseptic substances Lister ever used for incorporating as a gauze."

It took considerable time and research to perfect its preparation, but at length a satisfactory way of fixing the powder was discovered by accident. It was important that the gauze should be coloured, and in finding a dye for this purpose, hydrochlorate of mauvein or purified rosaline, which gave the gauze a heliotrope colour, was selected as being the best of all. With characteristic thoroughness, Lister prepared his own gauze for use in hospital as well as in private practice for a year, and, indeed, until he was completely satisfied of its value.

Before he left Edinburgh, he had spoken of a time when he hoped to get rid of carbolic acid and avoid all irritation in wounds, and he often indicated that after the carbolic acid in the deeper dressings had evaporated the air space next the wound was aseptic. In other words, he looked forward to the aseptic surgery of the present day.

The origin and development of the gauze dressing involved years of patient labour and innumerable experiments, and these researches were continued by Lister almost to the end of his professional career.

About the same time as he introduced the spray and the gauze dressing, Lister did much to familiarise surgeons with the advantages of india-rubber drainage tubes, and the first time in which he used them was in an operation on Queen Victoria in 1871.

While the Queen was staying at Balmoral Castle in that year she developed an acute abscess in the axilla. Lister, who held the appointment of Surgeon-in-Ordinary in Scotland, was summoned by Sir Edward Jenner, who was in attendance at the Court.

In Lister's account of the operation, which was not published until 1908, he describes how he made a drainage tube by taking a piece of the india-rubber tubing from a Richardson's spray producer that he had used for local anæsthesia at the operation. He cut holes in it and attached knotted silk threads to one end, so improvising a drainage tube, which after being steeped in a watery solution of carbolic acid was introduced and

proved satisfactory. "For," he says, "the discharge rapidly diminished, and within a week of the opening of the abscess I was able to take leave of my patient."

At the changing of the dressings Lister entrusted the spray to Sir Willian Jenner, and one day some of the pungent vapour of the carbolic acid reached the eyes of the august patient.

Jenner excused the accident by saying that he was "only the man who worked the bellows."

When Lister left the Castle the Queen described the whole performance as "a most disagreeable duty, most pleasantly performed."

Before leaving the subject of dressings, mention should be made of boric or boracic acid, the antiseptic properties of which Pasteur had brought to Lister's notice in 1876.

In a letter dated June 29th, 1876, the French scientist, in asking Lister to experiment with boric acid as a lotion and as a powder, says: "If it has the valuable properties which I attribute to it no one is better able to recognise them than yourself."

Taking advantage of its far greater solubility in boiling than in cold water, Lister succeeded in introducing a very large amount of the acid into lint, much more than would be at once dissolved and washed away by the discharge from a wound, and thus he secured another ideal dressing containing a store of the antiseptic sufficient to last a considerable time.

CHAPTER XIII

The Invention of the Catgut Ligature.

FOR some years Lister had been giving much thought and attention to discovering the best method of arresting hæmorrhage in aseptic wounds.

In all septic wounds ligatures gave rise to irritation and had to come away. The cause of this was a problem constantly on his mind, and he set himself to solve it.

Ligatures used by surgeons at the time consisted of silk or thread, the ends of which were left hanging out of the wounds so that they might be pulled out when they had ulcerated through the artery to which they had been applied.

Lister was well aware that a needle or a smooth metallic body might remain for an indefinite time in the living textures without inducing suppuration, but yet a piece of silk or thread might harbour putrefactive germs which might give rise to the products of decomposition, which in their turn would stimulate suppuration. If the silk or thread ligature was steeped in some liquid calculated to destroy the life of the germs which might lodge in its interstices, and the wound was dressed antiseptically, might it not be allowed to remain?

He first put his theory to a practical test on December 12th, 1867, by tying the carotid of a horse with a piece of unwaxed purse-silk which had been soaked for some time in a watery solution of carbolic acid. The wound was dressed antiseptically. Healing took place without redness or swelling, and the health of the old horse was unaffected. When its death had taken place some six weeks afterwards, Lister found the silk unchanged but bridged over externally by dense fibrous tissue.

Encouraged by this success, he next tried it on a human subject, in this case a lady with a femoral aneurysm. The operation was a serious one. The silk ligature he used had been previously soaked for two hours in strong liquefied carbolic acid. To his delight all went well and his hopes were realised, for he wrote to his father later telling him that the lady had made a perfect recovery.

He next turned his attention to the discovery of a more suitable animal material which would be more absorbable than silk and his thoughts turned to catgut.

This idea he first tested on a calf at Upton in 1868 where he had gone to spend a Christmas holiday.

He soaked the catgut for four hours in a saturated solution of carbolic acid and the dressing was formed by a towel soaked in carbolised oil. Although he considered the result to be practically satisfactory, he saw that ordinary catgut needed further preparation as it was absorbed too quickly. He then tried placing it in a mixture of liquefied carbolic and oil, and by so doing found that an excellent and trustworthy ligature was obtained. This product was prepared and sold in bottles kept on a winder devised by Lister, and for more than ten years was employed by most surgeons.

He at once began to use the carbolised catgut freely in wounds with complete success, which success was confirmed by Mr. Bickersteth, the well-known Liverpool surgeon who was the first to use carbolised catgut for ligaturing an artery in its continuity. He made this known to his old teacher, Professor Syme, in the following letter :—

Liverpool, Apl., 1869.

“ MY DEAR MR. SYME,

First of all let me tell you I am a firm disciple in the antiseptic theories and practice.

“ This day fortnight I tied the carotid artery for aneurism with the antiseptic catgut ligature—cut off short to the ends, and the wound completely healed *without one drop of pus* in about 7 days.

“ To make sure, I continued the carbolic oil for 4 days more and then removed everything.

"The cure is complete, and I am lost in wonder and admiration at this great discovery.

"I think I am the first who has succeeded with the catgut ligature in the human subject.

"Of course Lister has the entire credit of this great step which removes all the risks from the ligation of great arteries.

"I wonder what will become of acupuncture now !!!

"Poor Simpson and his book may be consigned to the dust heap.

Yours sincerely,

E. R. BICKERSTETH."

It was not until some years later that Lister gleaned from the chance remark of an old fiddler who used to come and play to the patients in Edinburgh Infirmary, that his fiddle would not sound properly because the weather was wet and his fiddle strings were not sufficiently seasoned; how much the trustworthiness of catgut depended on the seasoning which comes from age.

He therefore began to carry out a series of extensive experiments with the object of improving and perfecting the catgut ligature and not only tested the texture of the gut, but also the length of time that was required for its absorption by the living tissues. He tried many substances and in 1881 first recommended chromic acid and carbolic acid for the preparing medium, but in 1908 he finally decided that chromic sulphate and corrosive sublimate were the best media for the making of catgut ligatures. This important discovery completely changed the method of arresting hæmorrhage in wounds, and made the tying of arteries in their continuity a perfectly safe, instead of an anxious and hazardous proceeding, and did away with the old plan of leaving the long ends of the threads hanging out of the wounds.

CHAPTER XIV

Instruments and Appliances invented and devised by Lister.

NO account of Lister's life work would be complete without mentioning some of the instruments and appliances he invented and devised as a surgeon.

To the surgeon an instrument is the means by which he is enabled to utilise his knowledge and exercise his skill for the benefit of humanity. An inanimate object truly, but like the sculptor's chisel by means of which he transforms the block of marble into human form, or the brush of the painter which enables him to interpret his art, the surgeon's instrument is the indispensable medium without which he could not carry out his work. It is therefore natural that the surgeon should endeavour to conceive and design an instrument that is well adapted to his hand, and one that will lend itself best to the accomplishment of his task.

From his boyhood, Joseph Lister showed remarkable manipulative dexterity. He had a joy in the work of his hands which served him well in after life.

As a surgeon, the instruments he invented are of special interest, showing as they do the thought and ingenuity which characterised his work. He devised new operations and improved others and was thorough in his methods.

In his earlier years, he devoted much study and attention to the perfecting of an abdominal tourniquet, as he believed that until about 1860 no thoroughly efficient instrument was known.

The first type he designed was not quite satisfactory, for he found in practice that the body-bar was too

short and there were other small defects, so he devised another model. This again did not prove effective, so in a third type he placed his lumbar pad transversely on the bar, a change which he found was of great advantage to the surgeon. But with characteristic thoroughness he made a still further improvement and introduced a fourth model, which he regarded as the finished and perfected instrument.

Probably no instrument associated with Lister's name is better known than his sinus forceps which he introduced in 1875. He first described the forceps in a paper on "Recent Improvements in the Details of Antiseptic Surgery" which he published in that year. In this, he states, "the narrow drainage tube may be readily inserted by means of a simple modification of the dressing forceps introduced by myself several years ago but hitherto unpublished. This instrument which goes by the name of sinus forceps will be found very useful for extracting small exfoliations and for various other purposes."

The total length of Lister's own pair is 6 in., the blades being 2 in. long, very slender, and with blunt points.

They have fine transverse grooves on their opposing inner surfaces and ring handles like scissors. When the handles are closed the shanks do not touch, only the grooved extremities of the blades come in contact.

Lister used to demonstrate that a properly constructed pair of these forceps would pick fluff out of the barrel of the smallest key on his ring.

He next turned his attention to urethral forceps for extracting calculi from the prostate. The first type he designed were 11 in. long, the blades forming a thin oval ring by their fenestræ and he was much pleased with them, but later improved them by eliminating the fenestration and giving them a simple screw or scissor lock. The shanks are about $\frac{1}{4}$ in. apart where they spring from the rings, and lie almost together at the blocks when the handles are firmly closed.

"This arrangement," says Godlee, "was designed by

Lister himself and he was justly proud of it. This was no mere surgical toy."

Shortly before he retired from practice, Lister devised a new method of dealing with fractures of the patella of long standing and says that "he found a great advantage from the use of a very strong sharp hook, the point of which was inserted in the tendon of the quadriceps at its attachment."

The sharp hook he invented was $9\frac{1}{2}$ in. long and was bent slightly backward on the stem. It was very strong and had a very sharp point.

In 1883, he devised a wire hammer and described it in his address on, "The Treatment of Fracture of the Patella." The instrument is made entirely of steel and was used in the case of ununited fracture of the olecranon.

Lister employed steel or bone pegs for ununited or badly united fractures. His steel pegs were four-sided, very stout with blunt points, and when using them he first bored a round hole of suitable size and then drove the square peg into it, for he states he "found it easier of introduction than a round peg." The head of the peg was allowed to project from the dressings and it was removed when union seemed satisfactory.

Lister considered that the blunt end of a hernia knife was usually made too long, so he designed a bistoury which he employed for hernia and fistula, the total length of which measured 7 in. Most surgeons have their favourite shape for a scalpel blade and Lister preferred a narrow one. Those he employed for general purposes in operative surgery about 1865 had convex sides and handles of ebony. The blades are narrow, while the backs are broad at the handles, turning slightly downwards especially at the points. Like Sir Benjamin Brodie, he had a preference for rigid metallic instruments in place of flexible bougies, and so devised his own dilating sounds which he used instead of a catheter for gradual dilatation of strictures.

The cleft palate needles he invented are somewhat like Smith's, but have a smaller cutting angle. They are 5 in. long, curved and bent laterally at right angles to the stem and are mounted on ebony handles.

Among the instruments and appliances devised by Lister mention must be made of the apparatus he invented for the purpose of spraying antiseptic solutions. The first primitive type called by his students the "donkey engine," the original of which is still preserved, was employed by him in the operating theatre of the Edinburgh Royal Infirmary. He exhibited and described it in 1871. It stood on a stout wood tripod stand, the legs of which were about 3 feet long. On the top was a tray for the glass vessel containing the solution and alongside of it a brass pump worked with a long handle to produce the spray which was conveyed by a pipe and a rubber tube.

This simple contrivance was succeeded by his well-known and more portable antiseptic steam spray, by means of which the spray was produced by steam pressure. He had several types of this apparatus constructed, each of which embodied improvements and these came to be used all over the world wherever the antiseptic system was practised.

CHAPTER XV

Lister comes to London—Professor of Clinical Surgery at King's College.

THE death of Sir William Fergusson on February 10th, 1877, who had been Professor of Clinical Surgery at King's College, London, created a vacancy on the staff of that institution and the Medical Committee decided to invite some distinguished surgeon to take his place. On rumours reaching Edinburgh that Lister was likely to be appointed to the Chair, the students alarmed that they might lose their much-loved teacher, at once drew up a memorial which was signed by 700 of their number, begging him to remain. But, however much he regretted it, for he had so many ties and happy associations with Edinburgh, he felt it would be well for him to accept the appointment if it was offered.

His name was put forward and he was elected on June 18th, 1877, to the Chair of Clinical Surgery.

On removing to London, he took a house at 12 Park Crescent, at the top of Portland Place, and on settling there he commenced practice. He soon acquired a large connection and patients were sent to him from all parts of the world in order that they might be treated antiseptically.

Lister, on accepting his appointment, stipulated that he should be allowed to bring from Edinburgh four men whom he had trained to form the nucleus of his staff at the hospital, and among them were Watson Cheyne and John Stewart to whom he was much attached. With these trusted and tried friends and two dressers, he began his difficult task of introducing his new system amidst unsympathetic surroundings, for

he had but few convinced supporters in London. Even the nursing staff regarded it with suspicion and "at that time" says Godlee, "Sisterhoods were veritable *imperia in imperio*, armed with a code of inflexible rules to which not only patients, but medical officers, were expected to submit."

Stewart, who in due course became house-surgeon, tells a story in illustration and says, "One afternoon as Lister was about to leave the hospital Dr. Duffin asked him to see a boy in his ward. He did so, and soon satisfied himself that it was a case for immediate operation and while some of us went to get things ready in the operating theatre, I went with others to have the patient removed.

"The porters were off duty and could not be found. When we arrived at the lad's bedside, the Sister-in-charge told us we could not be allowed to remove him. Why? Because no patient could be removed without a permit from the secretary! I pointed out that the secretary had left the hospital, and Dr. Duffin and Mr. Lister were now waiting in the theatre to carry out an immediate operation.

"All was of no avail. I lost all patience and proceeded to wrap the unconscious boy in his bedclothes in order to place him on the stretcher. But the Sister and nurses adopted so resolute and I may say so menacing an attitude that my dressers fled, except Addison, who held the ward door open while I walked out with the patient in my arms, the nurse actually pulling at the bedclothes in an attempt to rescue the patient.

"I carried him to the theatre and he was then our property. It was a serious case . . . but the lad got well."

These and other similar incidents show the kind of obstacles which through prejudice were placed in the way of the reformers. Lister would never allow patients to be discharged from his wards until they had received prolonged and scrupulously careful treatment. To send them back to their homes before healing was complete he believed was practically to send

them to their deaths or condemn them to years of misery, and to carry this out he had often to combat the hospital authorities. It was difficult to convince them and it took years for them to appreciate the change that had been brought about by the introduction of the antiseptic treatment. When in Edinburgh, for some cases in which he believed prolonged treatment was necessary, he had the patients removed to private lodgings in Melville Place at his own expense where he could watch them.

Lister's first public appearance in London was on the occasion of the introductory address to the students at King's at the beginning of the winter session in October, 1877. He chose for his subject, "The Nature of Fermentation, the Foundation Stone of the Antiseptic Treatment."

Stewart, who was present, tells us that it was "a brilliant and most hopeful beginning of what we regarded as a campaign in the enemy's country, but there seemed to be a colossal apathy, an inconceivable indifference to the light, which to our minds, shone so brightly ; a monstrous inertia to the force of new ideas."

He and his three colleagues had wandered about, now in the wards of King's, now through older and more famous hospitals and wondered why men did not open their eyes.

"In these wards," he continues, "the air was heavy with the odour of suppuration, the shining eye and flushed cheek spoke eloquently of surgical fever.

"We thought of the crowded hours of glorious work in Edinburgh where Lister had half a dozen wards and sixty or seventy patients, and groaned over our two wards with a capacity for a couple of dozen, but only empty, beds. We remembered the enthusiasm about the introductory lecture of a session in Edinburgh, when the theatre would be crowded with 400 eager listeners, and our hearts were chilled by the listless air of the twelve or twenty students who lounged into lectures at King's."

So the outlook seemed dismal and as far as teaching

was concerned, the situation was depressing. But the faith of this little band of Lister's followers never wavered.

As time went on their numbers were swelled by the presence of a few general practitioners and foreigners. Others, who may have only heard of what was taking place at King's, remained for a while sceptical and even scornful, and Lister found that he had yet to convince London surgeons of the truth and value of his teachings.

But although his methods were making such slow progress in England, his fame was growing on the Continent. In June 1878 he was chosen President of the Jury on matters connected with medicine at the first Universal Exhibition at Paris, and in the following year he was received at the Sixth International Medical Congress in Amsterdam with the greatest enthusiasm.

When he stood to give his address, the whole assembly rose to their feet and with rounds of cheers hailed the distinguished professor of King's College. This remarkable scene and the ovation continued for some minutes until the President, Professor Donders, advanced and took Lister by the hand as he stood overwhelmed by his magnificent reception, and addressing him, said, "Professor Lister, it is not only our admiration which we offer you ; it is our gratitude and that of the nations to which we belong."

The meeting of the Seventh International Medical Congress in London in 1881 was again the occasion for an endorsement and recognition of Lister's principles, and Pasteur, who was present, paid the following graceful tribute to his work. Addressing the Congress he said : "By your hearty reception, you have revived the feeling of pleasure I felt when your great surgeon Lister said that my publications on the lactic fermentation in 1857 were the starting point of his thoughts on his invaluable surgical method."

It was at the greatest surgical event of the Congress, during a debate on the causes of failure in obtaining primary union in operation wounds and on the methods

of treatment best calculated to secure it, that Sir William Savory, who had always opposed Lister's views, declared that "surgical wards, not long ago hot-beds of poison, are now made fairly safe for patients.

"Need I say to whom the chief glory of this reformation is due?"

CHAPTER XVI

Lister—the Man.

WE owe to the recollections of some of his old students much of interest concerning Lister's personality, and particularly to Professor John Stewart who sat under him in Edinburgh in 1874.

He has given us a vivid account of his character and charm, from which we can gather what manner of man this was who accomplished so much and devoted his life to the alleviation of human suffering.

At the time when he was in "the prime of his strength and activity," says Stewart, "in face and figure, he was one of the handsomest men I have ever known."

His brown hair was beginning to turn grey. His bright expressive eye was a clear hazel colour and he had a pink and white complexion which even a young girl might envy. In height he was about five feet eleven, exceedingly well-proportioned, active in his movements and gave the impression of vigorous health and strength. With all this manly grace and vigour, and an energy that carried him swiftly through the corridors of the hospital and up the stairs two steps at a time, there was then and on into serene old age an indescribable air of gentleness and even shyness.

He always dressed plainly in the conventional frock coat and silk hat of the doctor in Victorian days and constantly wore a narrow black tie in a bow knot, mother-of-pearl shirt studs, and, usually, light grey trousers. In cold weather he wore a light fawn-coloured overcoat. He was fond of horses and particularly of the pair, a black and a dark grey, that drew his carriage to the hospital gate.

His holidays were active, both physically and mentally. From his boyhood he had been fond of birds and flowers, and he delighted to collect and classify the plants of any district, at home or abroad, where he and his wife spent their vacations. Notes were kept of birds and scenery and he was also interested in languages and dialects. Although not an expert angler, he was very fond of fishing and was a good swimmer. When at Skye or on the Cornish coast, for which he had a great liking, he loved to lend a hand at the oars with the boatmen on returning from a happy day's excursion.

We have glimpses of him in his letters taking long walks in the Western Islands with his vasculum slung over his shoulder and field-glass in hand for the study of birds.

He always seemed to take a personal interest in his hospital patients and invariably treated them with unaffected kindness, but it was with the children his warm-hearted affection was chiefly shown. Childless himself, the sight of a suffering boy or girl seemed to awaken within him deep feelings of interest and love.

Stewart says, "In my ward there was a small 'street arab' whose wrist Lister had excised. I was dressing the case one day while Lister was making his tour of the ward with his house-surgeon and the students. The lad was paying no attention to the proceedings. His eyes followed 'the Chief.' When he had gone the boy said to me, "I think it's the yins and the auld wimmin he likes best."

Another of his house-surgeons, Sir Hector Cameron, also tells a story of Lister's love for children. On one occasion, when visiting his wards, he found a little girl in tears because the nurse had taken away her doll. On inquiry it turned out that a slit had been found in the doll's body and sawdust was escaping on the sheets of the child's cot. Lister at once asked the nurse to bring him the doll and a needle and thread. Sitting down by the child's cot, he sewed up the wound, thus staunching at the same time the hæmorrhage of saw-

dust and the tears of the little girl who received back her doll with great delight.

He had a remarkably retentive memory, and was fond of repeating extracts from Milton, Dante and Horace to his friends, and although he had a wide acquaintance with modern literature, his favourite books are said to have been the Bible and Shakespeare.

He was fond of music and especially Scottish songs, and delighted in some of Burns' poems.

He loved to entertain his friends in his own house and was the perfect host. Cares and anxieties were laid aside, and he made it his sole object to make his guests happy.

From his Quaker upbringing and his experience of the strict observance of the Sabbath day in Scotland, he had a special routine for Sundays. He invariably came to the Infirmary on foot, so that his coachman and horses should have a rest, and Stewart gives us a picture of his usual Sunday afternoon in Edinburgh.

"It is the old Reserve Ward, a large ward for men, and about two o'clock on a summer afternoon. Clerks and dressers and some students from other clinics are standing about chatting together or talking to the patients. The instrument clerk in charge of the famous spray is seated on the broad window-sill at one end of the ward, now examining the flame of the spirit lamp or touching the safety-lever to let steam escape, for the spray must be kept ready for instant use; and now looking across the smoky roofs of the old town where his eyes rested on "the blue gleam of the Forth, North Berwick Law with cone of green and Bass amid the waters."

Then someone suddenly says, "Here comes the Chief!" and we see Lister's figure through the little side gate down the slope with his easy rapid stride, a light cane in his hand and on his handsome face a look of happy meditation. The house-surgeon meets him at the main door and in a few minutes they enter the ward.

Students come to attention, patients' faces beam.

“Was there a surgeon in the world whose pupils held him in more reverent admiration, whose patients so trusted him, loved and positively adored him? He cannot be unconscious of this feeling. The “soft lines of tranquil thought” grow softer, that “face at once benign and proud and shy” is suffused with the unaffected pleasure of this modest and simple-minded great man as he begins his tour of the ward.

“It was his wish on Sunday to see every patient in his wards, and as there were often sixty or seventy, it meant a visit of three or four hours. He goes from bed to bed, occasionally conversing with a patient or discussing a case with the house-surgeon and perhaps himself changes a dressing; drawing the attention of dressers and students to clinical facts, but never using a word to alarm or distress a patient, and performing his manipulations with the gentlest, steadfast, firmest hand of which any sufferer could possibly dream.

“And so through all the men’s wards, then downstairs to the women and children. How their eyes followed him! Then perhaps the visit ended in that famous little ward at the back, a room really meant for one bed and one patient, but in which there were two big beds. “In one, lay or sat, looking at picture books or playing games, were three small boys, all chronics, spines and joints, doomed to an early death or at least deformity and lameness but for him, and now all happy and recovering. In the other bed was the tall, gaunt, russet-bearded figure of Henley the poet, who lay there with a saved limb, musing and framing his “Sketches in a Northern Hospital.” To him we owe that charming pen-portrait of Lister which he called

“THE CHIEF.”

His brow spreads large and placid, and his eye
Is deep and bright, with steady looks that still.
Soft lines of tranquil thought his face fulfil—
His face at once benign and proud and shy,
If envy scout, if ignorance deny.
His faultless patience, his unyielding will,
Beautiful gentleness and splendid skill,

Innumerable gratuities reply,
 His wise, rare smile is sweet with certainties,
 And seems in all his patients to compel
 Such love and faith as failure cannot quell.
 We hold him for another Herakles,
 Battling with custom, prejudice, disease,
 At once the son of Zeus with Death and Hell.

Another marked element in Lister's character was his firmness, and if after careful thought he had come to the conclusion that a certain operation or a definite line of treatment was the best thing for his patient, no considerations of danger or of difficulty prevented him from carrying it out. And so with all his beliefs and principles he kept "the law in calmness made," regardless of the consequences to himself.

Lister not only did great deeds but had a great heart. He was devoted to his friends, just and generous to his rivals and patient under opposition.

Stewart, who was his close friend, gives us some insight into his religious convictions and tells us, that "one day when they were talking about some phases of belief and of that philosophy which holds that in the light of modern science all the old faiths in the Resurrection of the Body and the Life everlasting are untenable, Lister confessed that, for him, if this were the truth, there would be no more pleasure or satisfaction in his work." In speaking of men whose lives were exemplars of the Christian virtues but whose intellectual convictions denied the Christian revelation, he said, "These men are better than their creed," and mentioning one distinguished leader of thought generally, although I think unjustly regarded as "an adversary of the Faith," he said "this man could never have been what he is were it not for Christianity."

Lister owed much to his parents and from them inherited a calm earnestness of purpose. He followed their advice to "cherish a pious and cheerful spirit, and remained gentle, modest and patient. He was undismayed by failure and unspoiled by success and so

he persevered calmly for years in his long battle with custom, prejudice and disease. As a man thinketh in his heart, so is he. Thoughts are actions. The mind is the man."

No one could be much in contact with Lister and not feel that he was in touch with other powers and another world than this. In one of his early pathological studies involving a consideration of the properties of living tissues, he says "Here then it appears to me we have a sure though imperfect glimpse of the operation of mysterious but potent forces peculiar to the tissues of living beings . . . forces which I suspect will never be fully comprehended by man in this present state of his existence and the study of which should always be approached with humility and reverence." Like Pasteur, he had the child heart and bowed before a power greater than human power.

CHAPTER XVII

Recognition—Honours.

LISTER was elected a member of the Council of the Royal College of Surgeons of England in July 1880, and in 1887 delivered the Bradshaw Lecture on "The Present Position of Antiseptic Treatment in Surgery."

On December 3rd, 1883, Mr. Gladstone wrote to him offering a baronetcy, which honour he accepted.

In 1903 he became the first President of the Lister Institute of Preventive Medicine, which had been originally formed as a national tribute to Edward Jenner. In the work of this institution he took the keenest interest throughout his life and lived to see the present building completed in 1910.

In March 1893, Lister was elected an Associate of the Académie des Sciences, the highest distinction which the French world of science bestows, and other honours followed.

In the same year he suffered a great blow in the loss of his wife, who died after a few days' illness while they were on holiday at Rapallo in Italy. He was stricken with grief and never entirely got over his sudden bereavement. As he had reached the age of 65, he retired from the post at King's College Hospital, but later, in 1895, succeeded Lord Kelvin as President of the Royal Society.

When he went to Glasgow in May 1894, to fulfil a long-promised engagement to give an address at Glasgow University Medico-Chirurgical Society, he received a great ovation from the professors and students.

He alludes to this enthusiastic welcome in the following letter to his brother :—

May 24th, 1894.

“Certainly nothing could have been more enthusiastically cordial than my reception by the present students, who filled the body of the large hall, and former pupils, who in large numbers occupied the galleries. When the meeting ended, the students must need unyoke the horse of my cab and draw and push me by a circuitous route to this house where, it is said, there was more singing of the inevitable ‘Auld Lang Syne’ before they withdrew.”

In 1894, a number of the Fellows and Members of the Royal College of Surgeons subscribed to a portrait that was to be presented to the College as a mark of their esteem. W. Oules, R.A., was commissioned with the painting and Lister consented to give sittings to the artist. It was completed and presented in March 29th, 1897, at the College, where it remains as a permanent memorial, and is regarded as the finest portrait of Lister ever painted.

At the meeting of the British Association held in Liverpool in 1896, Lister was elected President and delivered his last great address on the subject of antiseptics.

He took for his subject “The Interdependence of Science and the Healing Art.” He spoke of the discovery of anæsthesia just fifty years before, and the story of Pasteur’s work on fermentation which led up up to a fuller account of what he himself had accomplished with the aid of Pasteur’s discoveries.

The Times, in commenting on this address, stated : “He was compelled by the nature of his subject to speak of himself and of his own work, but he did this with such modesty and reticence, that none who were unacquainted with the subject would gather from his words the extent to which he has been a benefactor to mankind.”

The death of Pasteur in September 1895, was a cause of national mourning in France and was deeply regretted throughout the whole world. When his remains were laid to rest within the precincts of the Pasteur Institute in Paris, on January 1896, Lister was present to pay a tribute to the memory of the great scientist and brother worker to whose genius he owed so much.

In 1897, on the occasion of the second Jubilee of Queen Victoria, Lister was raised to the peerage, an act which gave universal satisfaction throughout the United Kingdom. Other honours soon followed, and in the summer of 1898 he received the freedom of the city of Edinburgh in the company of Lord Wolseley. The city was *en fête*, and in a speech he made on that occasion he spoke of his association with Edinburgh as his best and happiest years, and the enthusiasm of his students, whom it had always been a joy for him to teach.

When Professor Virchow came to London in 1898 to deliver the "Huxley Lecture," Lister presided, and at the close of his address, Virchow said, "The opening up of further regions of clinical medicine to the knife of the surgeon and a perfect revolution in the basis of therapeutics have been the consequence of the anti-septic system. Lord Lister, whom I am proud to be able to greet as an old friend, is already, and always will be, reckoned amongst the greatest benefactors of the human race."

Shortly afterwards, Lister accompanied Virchow to Liverpool to be present at the opening of the Thompson-Yates Laboratories for physiological and pathological research, then the finest of the kind in the country, and he received from the University of that city the honorary degree of Doctor of Science.

As a crowning honour he was awarded the Order of Merit by the King in 1902, being one of the twelve original recipients.

Lord Lister's last public appearance was on the occasion of a great gathering at the Guildhall, when

he received the Freedom of the City of London on June 28th, 1907.

It was obvious to all at that assembly that age was now telling upon him, and in 1908, for the sake of his health, he went to live at Walmer in Kent. But in his retirement he was still hopeful of returning to London, and Godlee tells us that even when he became weaker and weaker and months lengthened into years, his horses stood in their stables in town ready to take him home.

In the summer of 1909 his sight and hearing began to fail, and he could no longer read nor write, but he still dictated many letters and listened with interest to the reading aloud of books and papers.

In the autumn of that year he was almost confined to bed, but occasionally on fine mornings he sat in a chair to watch the sun rising over the sea, for he was ever a lover of the morning. The end came on February 10th, 1912, at Park House, Walmer, when to the deep sorrow not only of the Empire but the whole world he passed away in his eighty-fifth year.

The Nation desired that his remains should be laid to rest in Westminster Abbey, but by his own expressed wish he was interred beside his much-loved wife in the cemetery at West Hampstead.

A public memorial service, at which the Royal Family were represented, was held in the Abbey on February 16th, and was largely attended by representatives of scientific bodies throughout the British Isles, as well as the general public who mourned the loss of this great benefactor of the human race.

CHAPTER XVIII

Humanity's Debt to Lister.

WHAT Lister did for the human race may be best judged from the tributes paid to his memory by the famous surgeons and scientists of the world at the time of his passing.

Of these, perhaps no words can better express the value of his work than those uttered by Sir Frederick Treves who said, "Lister's genius accomplished the greatest advances that surgery has ever witnessed. His gift to the world is the most magnificent ever made. He was an embodiment of humanity and probity; an earnest soul with a true instinct. So long as a civilised world exists, Lister will be immortal in humanity's cause. By his brilliant genius and unceasing work he saved countless lives and prevented untold misery. He is the *greatest benefactor of mankind which any age has known. His life and work will live for ever.*"

Professor Tillmans, of Leipzig, declared, "Lister's immortal life-work, his antiseptic method of operating and of treating wounds, constitutes the greatest advance which surgery has ever made. Previous to 1865, however skilful and accomplished surgeons might be, their most brilliant efforts were often dogged by failure. However careful the operator might be, sepsis or wound infection often set in, followed by inflammation, suppuration, putrefaction and death. The soldier treated on the battlefield and nursed in an improvised field hospital had a better chance of recovery, while his comrade removed to the regular hospital, where every possible care and attention was given, often succumbed to gangrene."

"Science was struggling with an unseen force. And

no wonder," says Professor Mikulicz-Radecki, of Breslau, speaking of those terrible days, "for tables and instruments were used indifferently for operations on the living and the dead." A man with a compound fracture of the leg might die within two days of the accident as plainly poisoned by the products of putrefaction as if he had taken a fatal dose of some toxic drug.

"Whence the poison? Lister's epoch-making discovery supplied the answer."

Pasteur had shown that fermentation was due to vegetable germs, and Lister, who always acknowledged his indebtedness to the great French master, forged the final link by his discovery that if bacteria were excluded from wounds the surgeon's scourge disappeared. Then followed a most important change in the system when it came to be found from experience that there was no need to disinfect a fresh wound and that the application of antiseptics such as carbolic acid and corrosive sublimate could be dispensed with. The principal thing to be seen to was that no infection was conveyed in the operation. It was thus surgery became aseptic or germ preventing. The aseptic methods employed at the present day have been acknowledged by famous surgeons such as Sir Hector Cameron and Watson Cheyne to be merely continuations of Lister's work, the fulfilment of the object which he set before him. Not merely have lives been saved by the adoption of Lister's principles and their outcome but countless operations have been avoided with a consequent saving of great human suffering.

The Times in its account of Lister's life-work remarked: "He may be called the great life-saver. More than ten years ago it was computed that he had saved more human lives than all the wars of the nineteenth century had destroyed and the record has been steadily rolling up ever since."

Lucas-Championniere once said that "there were only two periods in surgery—that before Lister and that since Lister."

Sixty-five years ago, at the private clinic of a famous German surgeon, we are told, 80 per cent. of all wounds were attacked by hospital gangrene, and erysipelas after an operation was almost considered normal.

Compare this with conditions prevailing at the present time in one of our great London hospitals. In the London Hospital to-day, it is stated that 98 per cent. of the wounds in operations heal by first intention. Professor Chiene has said, on comparing the surgery of his student days with that of to-day, "the outstanding impression on the mind is the amount of physical suffering which Lister had saved the human race. It is in my opinion incalculable. We hear often of lives and limbs saved ; to my mind, the pain saved is even more striking. Anæsthesia saved pain *during*, asepsis *after*, operation."

The acceptance and application of Lister's principles and their elaboration has rendered all mankind his direct debtors. He never wrote a book, but no literary monument is needed of his personal qualities or his scientific fame. His "Collected Papers," which were published in two volumes in 1909, testify the immense amount of hard work, doggedly pursued, that led up to his ultimate triumph.

His name will ever be honoured and venerated as one of the greatest benefactors of the human race, and his discovery which has proved of such estimable benefit to mankind will to all time remain an everlasting monument to his memory.

APPENDIX

A GUIDE

TO

THE LISTER COLLECTION OF RELICS,
INSTRUMENTS, ETC.,

IN THE MUSEUM OF THE
ROYAL COLLEGE OF SURGEONS OF ENGLAND.

THE extensive collection of instruments, formerly the property of Lord Lister, was presented to the Museum by his executors, through the late Sir Rickman J. Godlee, Bart., his nephew, in 1912. The collection is divided into three groups, viz. :—

- I.—Instruments designed or modified by Lister.
- II.—Instruments used by James Syme, of Edinburgh, Lister's father-in-law.
- III.—Instruments mostly given to Lister by their inventors, but were rarely used by him in his practice.

The instruments in the first group are exhibited in Room I in the Museum, chiefly in a special case which also contains original drawings made by Lister, notes for lectures, letters from Pasteur to Lister, lectures on clinical surgery, commonplace books (four volumes), autograph letters from distinguished men, and illuminated addresses presented to him by various bodies.



The Case in the Royal College of Surgeons containing the Instruments and other Relics of Lord Lister.

(Reproduced by permission.)

GROUP I.

The following is a list with the numbers corresponding to their labels :—

- *1. Lister's abdominal tourniquet. Type I.
- *2. Lister's abdominal tourniquet. Type II.
- *3. Lister's abdominal tourniquet. Type III.
- *4. Lister's abdominal tourniquet. Type IV.
- *5. Lister's cork aortic compressor.
- *6. Portions of a Skey-Weiss tourniquet.
- *7. Suture buttons for stitches of relaxation.
- *8. Small suture-buttons for stitches of relaxation.
- *9. Lister's sinus forceps.
- *10. Case containing six bistouries for hernia, fistula, &c.
- *11. Lister's bistoury for hernia, fistula, &c.
- *12. Lister's cleft-palate needles.
- *13. Lister's ear-hook.
- *14. Lister's conical bougies.
- *15. Lister's urethral forceps for prostatic calculi.
- *16. Urethral forceps.
- *17. Bigelow's lithotrite made for Lister.
- *18. Lister's retractor for suprapubic work. Type I.
- *19. Lister's retractor for suprapubic work. Type II.
- *20. Lister's retractor for suprapubic work. Type III.
- *21. Sharp hook for fractured patella, &c.
- *22. Lister's wire hammer for patella.
- *23. Lister's steel pegs for ununited fracture.
- *24. Lister's steel pegs "from the Dane."
- *25. Lister's bone pegs for ununited fractures.
- *26. Bone peg showing effects of use.
- *27. Tracheal plug used by Lister in laryngotomy.
- *28. Copperas stick.
- *29. A pair of copper tracheal retractors.
- *30. Case containing three Liston's amputation knives.
- *31. Two Liston's amputation knives.
- *32. Liston's bone forceps.
- *33. Barker's flushing gouge. Type I.
- *34. Barker's flushing gouge. Type II.

- *35. Volkmann's sharp spoon. Type I.
- *36. Volkmann's sharp spoon. Type II.
- *37. Volkmann's sharp spoon. Type III.
- *38. Volkmann's sharp spoon. Type IV.
- *39. Dieffenbach's forceps.
- *40. Lister's flask for sterilised solutions.
- *41. Test tubes for experiments on lactic fermentation.
- *42. Lister's antiseptic steam spray producers.
- *43. Lister's primitive spray apparatus.
- *44. Roll of lac plaster used by Lister.
- *45. Lister's carbolic gauze dressing.
- *46. Lister's pocket caustic holder and caustic case.
- *47. Bottle and spool for carbolised catgut.
- *48. Catgut prepared and bottled by Lister.
- *49. Chromic catgut prepared by Lister.
- *50. Tannic catgut prepared by Lister.
- *51. A case of Lister's scalpels.
- *52. Syme's ankle-joint knife.
- *53. Case of dissecting instruments used by Lister.
- *54. Stethoscope used by Lister about 1850.
- *55. Stethoscope employed by Lister about 1880.
- *56. Original pamphlet on the antiseptic spray producer.
- *57. Bottles for antiseptic dressings.
- *58. Lister's microscope. A large binocular with objectives by R. and J. Beck.

GROUP II

Consists of over 200 surgical instruments of various kinds chiefly bequeathed to Lister by James Syme.

They are exhibited in a glass case in the Instrument Room where a catalogue may be seen.

GROUP III

Consists of a collection of over forty instruments, many of which were presented to Lister by their inventors. These also are exhibited in the Instrument Room where a catalogue may be seen.

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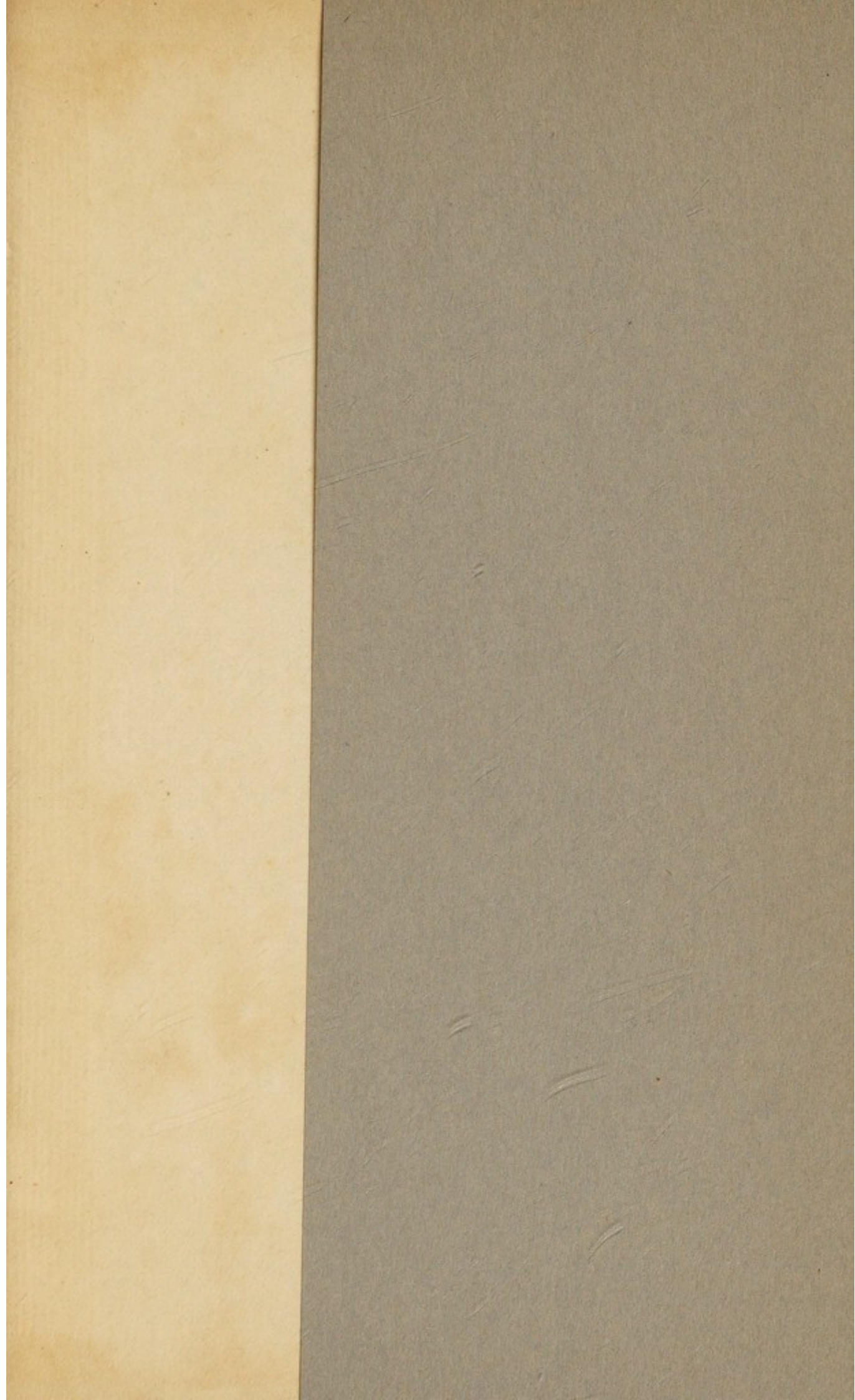
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