Hunterian Oration

ON

HERO WORSHIP IN SURGERY.

DELIVERED BEFORE THE ROYAL COLLEGE OF SURGEONS OF
ENGLAND ON FEBRUARY 14TH, 1930,

BY

ERNEST W. HEY GROVES, M.S., F.R.C.S.,
PROFESSOR OF SURGERY IN THE UNIVERSITY OF BRISTOL.

"One comfort is, that Great Men, taken up in any way, are profitable company. We cannot look, however imperfectly, upon a great man, without gaining something by him."—CARLYLE, *Hero Worship*.

WE have met to-day on the birthday festival of John Hunter, one of the greatest heroes of English surgery. Considerably more than a century has elapsed since, in 1814, this Oration was founded by Hunter's executors, Dr. Matthew Baillie and Sir Everard Home, "in honour of surgery and in memory of men by whose labours it has been advanced." In pursuance of this bequest the Oration has now been delivered seventy-five times, thirty-eight of which have been in the present theatre. Of these, sixty-eight have been published and are now in our library. It would be presumptuous on the part of the present speaker to utter one word without having first read all these published orations. They now cover a sufficient period of time (1814 to 1928), and that a period of the greatest growth and activity in surgery, to make their perusal one of great interest and instruction, especially in marking notable landmarks in the history of surgery and of this College.

Some Notable Hunterian Orators.

The first Oration was delivered in 1814 by Everard Home. He was Hunter's brother-in-law, and will always be famous as one of the founders of this festival and infamous as the destroyer of the great bulk of Hunter's manuscripts.

William Norris, in 1817, after tracing the beginning of the improvement in modern surgery to the teaching of anatomy, states that "in London there are seven large hospitals." In 1818 Sir David Dundas enlarges on a theme already mentioned by Home in the first Oration—namely, the emancipation of surgery from medicine. He says: "If at any former period surgeons allowed themselves to be under the control of physicians, that is not likely to happen again." In 1819 John Abernethy makes a plea for a legal provision of bodies for dissection. Of Hunter he says: "Those who far precede others must necessarily remain alone." Sir Everard Home, giving the Oration for the second time in 1822, and now raised to the dignity of a baronetcy and the Presidency of this College, refers to the granting of the Charter by George the Fourth, by which this College became "The Royal College of Surgeons."

Sir William Blizard, in 1823, states the "council of this College are unshaken in their confidence in the efficacy of vaccination." The same orator deplores the practice of surgery by unqualified persons, and also the establishment of special military and ophthalmic hospitals. Samuel Cooper, in 1832, refers to the "noble and opulent as the patrons and dupes of murderous quackery."

Sir Benjamin Brodie, in 1837, speaks of Hunter's work being the first instance of the inductive method of philosophy being applied to pathology. He refers to the completion of the new building. Babington, in 1842, says: "John Hunter's discoveries are great in themselves, but their true value is to be found in numbers of other discoveries to which they have given birth." Arnott, in 1843, discusses Hunter's operation for aneurysm, and refers to 389 cases in which the operation had been done, with 277 successes.

Sir William Lawrence, in 1846, mentions that Paget had been appointed to prepare a catalogue of the pathological specimens in the Museum. He enters into a heated defence of the policy of the Royal College of Surgeons and a criticism of the proposal for a Royal College of General Practitioners. Joseph Henry Green, in 1847, refers to the recent institution of the Fellowship of the College and speaks most eloquently on the value of a liberal education. Richard Grainger, in 1848, speaks of the recent development of the science of embryology.

In 1849 the Oration was for the first time graced by the presence of Royalty. Caesar Hawkins, speaking before Prince Albert about the great progress of the Museum, notes the increasing international co-operation by scientific workers. He refers to the discovery of anaesthesia.

In 1859 John Bishop refers to the work of Virchow and of Lister. In 1861 Coulson mentions that Hunter's remains had

been transferred to Westminster Abbey. In 1875 Le Gros Clark refers to the proposed co-operation between the Colleges of Physicians and Surgeons in the conduct of a conjoint examination.

Sir James Paget, in 1877, speaking before the Prince of Wales, says: "In the world of mind, he that is mortal may produce that which becomes immortal." Sir George Murray Humphrey, in 1879, makes the first reference to the antiseptic treatment of wounds; he refers to the practice of ovariectomy by Keith and Spencer Wells. Spencer Wells, in 1883, speaks of the progress of abdominal surgery, the discovery of bacteria, and of Cheyne's visit to Koch's laboratory. Henry Power, in 1889, speaks of the experiments and research of Sir Joseph Lister and of the erection at the College of special rooms for research. Christopher Heath, in 1897, makes the first reference to the agitation by the Members for a share in the government of the College. In 1899 Sir William MacCormac, speaking before the Prince of Wales, says: "Lister has finally crowned the edifice whose corner stone John Hunter laid." Sir Henry Morris, speaking in 1909 before the Prince and Princess of Wales, discussed the conflict of inductive and deductive philosophy in Hunter's work. Edmund Owen, in 1911, tells us that John Hunter was examined by the Court of Examiners in July, 1768, at the age of 40, and received his diploma. He describes Hunter's inoculation with venereal disease and the effect of this in causing his death. Sir Rickman Godlee, in 1913, mentions that the original 13,600 specimens in the Hunter Museum had been increased to 64,766.

The controversial subjects referred to have been: the teaching of anatomy as the foundation of sound surgery; the emancipation of surgery from medicine; the problem of procuring bodies for dissection; the menace of quackery; and the agitation by Members of the College for a share in its government. The chief matters of surgical advance have included: vaccination; scientific physiology and embryology; anaesthesia; bacteria and antiseptics; abdominal surgery and ovariectomy. Notable stages in the advance of the College referred to have been: the granting of the Charter by George IV; completion of the present building; foundation of the Fellowship; formation of the Conjoint Board; moving of John Hunter's remains to Westminster Abbey; and the growth of the Museum from 13,600 specimens, bequeathed by Hunter, to 64,766. Six times the Oration has been delivered before members of the Royal Family, the first time by Caesar Hawkins, before the Prince Consort in 1849, and the last by Sir Berkeley Moynihan in 1927, before the Princess Mary.

Recent Losses.

When I undertook to deliver this Oration I had hoped to say that all the orators subsequent to 1913, its first centenary, were still with us, but now we have to deplore the death of Sir Anthony Bowlby, who gave the Oration in 1919 and was our President from 1920 to 1922. Intimately known and dearly loved by all the Bart's students who came under his kindly supervision, a sound surgeon and a wise teacher, Bowlby, during the time of the great war, reached the zenith of his fame and influence. He served at the front in France during the entire conflict, and he was largely responsible for the organization and equipment of the casualty clearing stations. No one in trouble at home or in the war ever applied to him for help without receiving it in the form of wise counsel and true comradeship.

Three other men notable in this College have also been recently claimed by death. Thelwall Thomas of Liverpool was a Member of the Council from 1921 to 1927. His skill as a surgeon and his kindness as a friend will always keep him in our memory, but in addition he has bequeathed the generous sum of £5,000 to the College, which the Council has determined to devote to the benefit of the Library. Thomas Horrocks Openshaw, for many years surgeon to the London Hospital, and chiefly known for his pioneer work in orthopaedic surgery, was a member of the Council from 1916 to 1924. He was a safe surgeon and yet always abreast of the times, and his genial personality and splendid fortitude in the tragic death of his brilliant son greatly endeared him to us. Mr. Victor G. Plarr was the librarian of this College from 1897 to 1929. His quiet and unobtrusive personality made him a stranger to many of our Fellows and Members, but he was always working for the good of the College. That by which he will be best remembered is the work he did in writing lives of the Fellows. The publication of these lives under the editorship of Sir D'Arcy Power is now being undertaken, the expenses being defrayed by Thelwall Thomas's bequest.

We have also to deplore the loss of the last known descendant of the Hunter family in the person of Miss Helen Hunter-Baillie, the great-grand-niece of John Hunter, who died in February, 1929, at the age of 86. She had been a regular attendant at these orations, and had presented a valuable collection of letters and family documents to the Library.

Having given this brief tribute to the memory of men by whose labours surgery has been advanced, I would follow the example laid down by most of my predecessors in mentioning outstanding events in the history and progress of the College.

The Royal College of Surgeons: Outstanding Events in its History and Progress.

The agitation by some of the Members of the College for a direct share in its government, the idea of which was first referred to by Sir William Lawrence in 1846 in his heated denunciation of an attempt to make the Royal College of Surgeons into a Royal College of General Practitioners, and which was first actually mentioned by Christopher Heath in 1887, has continued year by year. It may be said now to have entered upon a new phase, inasmuch that the annual meeting at which this topic is discussed, which at one time was the scene of angry strife, is now one of amity and good will. This amity has been further increased by Mr. Buckton Browne's generous endowment for the provision of an annual dinner, at which Fellows and Members meet for convivial intercourse. It is not for me to say if and when the Council of this College will directly represent the 18,000 Members as well as the 2,000 Fellows, but I may express a sincere wish that the change, which is in harmony with the modern democratic spirit, may take place soon. The chief thing which is needed to bring it about quickly is convincing evidence that the change is desired by the great body of the Members.

The attainment of the Fellowship has been greatly facilitated for those in the overseas dominions by arranging for the primary examination to be held each year abroad. The first examination held last year in Canada was so successful that it will probably be repeated each year, and a similar arrangement is now being made for Australia and New Zealand.

Mrs. Macloghlin has left £10,000 and the residue of her estate for the purpose of founding and endowing scholarships for medical students in memory of her husband, the late Mr. Edward Macloghlin, M.R.C.S., formerly in practice in Wigan. A sum of approximately £30,000 has been left by the late Sir George Mackenzie in memory of his friend Sir William Mackinnon, Bt., jointly to the two Colleges for the endowment of medical research.

The Honorary Medal, the award of which was instituted in 1802 for liberal acts or distinguished labours conducive to the improvement of the healing art, and which has only twelve times been given, was this year bestowed upon Sir George Makins, in appreciation of his valuable services to the College, more especially in arranging and describing the series of drawings in the Army Medical War Collection.

Scholarships for research have been founded in this College. Lord Beaverbrook's gift of £1,000 was quickly allocated for tissue culture work, and the need for more permanent endowment was evident. The Council has therefore set aside £500 a year for research work, and generous benefactions from Lord Melchett and Sir Louis Baron have placed at our disposal two more similar sums for a like object, so that there will now be expended on vital research a larger sum of money each year than was received by the College as its total income in the days when Hunter received his diploma. One can hardly question that this movement of greater activity for research would have had Hunter's whole-hearted approval. He spent all his income on his museum and his experiments. The museum was bought by the nation and placed in our trusteeship.

We are proud to think that what originally was a unique collection of 13,600 specimens had increased to over 64,000 when Sir Rickman Godlee delivered his Oration in 1913, and now numbers 72,675, due largely to the addition of the military section acquired during the war, the

Onodi and the Strangeways collections, illustrating respectively anatomy of the nose and disease of the joints.

But Hunter's spirit of never-tiring adventure in the search for knowledge, although belauded, has not hitherto been adequately followed. We are too apt, perhaps, to be satisfied with what, after all, is only a collection of dead things, and to forget that Hunter's absorbing thought was that of probing the secret and mystery of life. How he would have been thrilled if he could have used a modern microscope, and yet more if under that instrument of precision he could have seen the living cells growing and dividing! It is therefore a happy thought that among the recent objects of research in this College is that of the culture of living tissues.

One of my predecessors, Sir Rickman Godlee, having spent many hours in the Council room of this College, gazing at the famous portrait of Hunter, became convinced that the look of rapt attention and reverie on his face was an indication that he was absorbed in the contemplation of this great question, "What is life?" The story of the portrait, well known to many here, is nevertheless worth repeating. Hunter had promised to sit for his portrait to Sir Joshua Reynolds, but he proved so restless a sitter that that great painter was in despair of ever getting a soul-revealing picture of Hunter's face. He had made an unsatisfactory beginning as his sitter fidgeted and grumbled, but then, owing to some unknown cause, Hunter became absorbed in contemplation as we now see him. The painter, without a moment's hesitation, turned the canvas round, and hastily but faithfully depicted the face at rest, painting it in the space between the legs of the original portrait. I believe that one of the reasons which have led experts to advise against this picture being restored is the fear that restoration might reveal a pair of inverted legs surrounding the leonine face.

We hope that the recent endowment of research and the building of the new laboratories may go a long way towards removing from us the reproach that, whilst we have treasured and added to the *things* which Hunter left us, we have lost sight of the *ideals* for which he was for ever striving.

Another auspicious event has taken place since the last Oration was given. The President of the Royal College of Surgeons has been elevated to a peerage. Only twice have surgeons been made lords. The first instance was that of Lister, who received his peerage when his days of active surgery were over, but when he was President of the Royal Society. In the second instance we are happy in the knowledge that not only is Lord Moynihan President of this College, but also that he is in the heyday of his surgical virility. Never has his brain been more active, his tongue more eloquent, his hand more firm, or his eye more keen. Because that eye is now upon me I must desist from any further words of eulogy, and I excuse those I have already uttered because it is of this College and the honour which he has brought to it that it is my duty to speak. In Hunter's day surgery was only just emerging from the lowly position of serfdom to medicine. The very name of barber-surgeon indicated this status, half tradesman and half apothecary, and now, two centuries later, the Royal College of Surgeons is presided over by a peer.

Thus far my path has lain on conventional lines laid down by my honoured predecessors, and I felt that I could not venture further without seeking for advice and guidance. For these I have sought for inspiration to speak my best about the great Scotsman, John Hunter, from two other Scotsmen, both of whom, like Hunter himself, came to this city to enlighten our darkness. I asked Sir Arthur Keith, and his answer was "Bones," and I asked Carlyle, and he said "Heroes." In all diffidence, therefore, I will try to follow both their counsels, only asking you to aid my poor words with your imagination in thinking of Keith speaking to you about bones, or of Carlyle thrilling you with his rugged eloquence as he discoursed to you about "the hero as a surgeon."

Hunter's Experiments with Bones.

A great part of Hunter's life was spent in handling bones. Anything big and strong and lasting had as much fascination for him as anything that was curious or

inexplicable. His greedy longing for the skeleton of the Irish giant, satisfied at last by its nefarious purchase, is the best-known instance of this. Hundreds of skeletons of reptiles, fishes, birds, and mammals were prepared, articulated, and preserved by him, and hundreds more were collected as fossils. Indeed, I suppose it would not be far from the truth to say that never before or since has any one man handled so many bones as Hunter. But while his hands were busy with the bones his mind was busy with the questions of their formation and their growth. It is with his specimens dealing with these questions that we must occupy ourselves chiefly to-day. They fall into three categories—the first dealing with growth, the second with inflammation, and the third with transplantation.

In Hunter's day bone was supposed to grow by a process of interstitial accretion. This was the doctrine of Duhamel. True to his principle of "Don't think, but try," Hunter determined to put this idea of bone-growth to the test. He buried two shot, two inches apart, in the tibia of young animals (both the pig and the fowl were used). After a certain period, when the animals had grown considerably, they were killed, and the shot were found to be the same distance from one another but much further from the two ends of the bone, thus proving that the growth in length of a bone was due to additions to its extremities.

Again, knowing of Belchier's discovery, that madder taken in the food is deposited in the bones, he fed young pigs upon food to which madder had been added. By giving and withholding the dye for varying periods and then killing the animals it was proved that madder-stained layers of bone were superimposed on unstained layers, and that as new layers of bone were added to its surface the inner layer next to the marrow cavity was absorbed. He thus proved that the growth of a bone in thickness was due to the addition of new layers of bone to its outer surface, and he recognized the occurrence of the physiological absorption of bone. He went further in this last observation, because he studied it in detail as it occurs in the shedding of a stag's antlers. He even anticipated some of the modern doctrines of internal secretions by noting the effect of castration in stunting the growths of the antlers. In regard to one of Hunter's specimens, the head of a deer, in which the left antler is dwarfed, he tells us that from this animal the left testis had been removed.

In the second group of experiments Hunter demonstrated the process of inflammation, necrosis, sequestration, and the formation of an involucrum in a manner so perfect that his series of specimens stands to-day unique among our pathological collection. No better instance, I think, exists of how badly his tongue and his pen served his hand and his brain than is afforded by the laboured and involved description of the inflammation and necrosis of bones contained in Volume I, Chapter 18, of his collected works edited by Palmer, as compared with the simple eloquence afforded by the specimens from which his learning was drawn. Most of these specimens were obtained by applying the actual cautery to one or other bones of an ass. Possibly this was the same animal the tendo Achillis of which was divided and its union studied, and on which other more elaborate experiments were performed. If this was the case then Hunter's ass certainly deserves a place in history even more honourable than that of Balaam.

In the third group of experiments Hunter showed how animal tissues could be removed from their natural situation and grafted elsewhere. In the most striking of these he cut off the spur of a cock and implanted it into the vascular comb. The transplanted spur not only lived in its new environment, but grew prodigiously. An even more startling experiment was that of implanting a human tooth into a cock's comb, and noting that, having taken to its new bed, it became vascularized, so that an injection into the vessels of the cock passed into the tissues of the transplanted tooth. He transplanted the spur of a hen into the leg of a cock, and obtained perfect healing with good growth of the transplanted bone. This, I believe, is the first instance of successful bone-grafting of which we have any record.

In Hunter's day it was not possible to carry out any but the most simple experiments with bones, because any deliberate exposure and cutting of bone was followed by

septic inflammation. Since the advent of aseptic surgery, however, the bones have proved amenable to experimental work as well as to surgical operations.

Macewen's Work.

There have been added to the Museum two notable series of experimental specimens, the one by Sir William Macewen and the other by the Jacksonian Essayist of 1913. The one series is of great scientific and historical interest, because it really settled what may be called the battle of the periosteum once and for all. Until Macewen's work the periosteum was regarded as the veritable matrix of the bone, chiefly because of the work of Ollier of Lyons. But Macewen showed that bone could grow and live without periosteum, and that the so-called periosteal new bone was merely bone which had grown into the periosteum from its basal attachment, and that the periosteum was merely an inert limiting membrane. These ideas were at first scouted by American and Continental workers, but that they have now been converted is proved by the words of Leriche, Ollier's most brilliant pupil: "An area of ready ossification, the periosteum is not a specific organ of osteogenesis"; and "the functional characteristic of periosteum appears to reside in the limitation of ossification."

Quite recently Cowan, an American worker, has shown that not only does the periosteum not produce new bone, but that it is one of the chief agents in preventing the union of fractures, by its capacity of forming dense fibrous tissue, which is apt to grow between the fragments and so hinder the union of the callus which these produce. But the ultimate mystic problem of how bone is laid down and again taken up is not only still far from solution but seems now to us much more complex than it was in Hunter's day. We know a little of some of the distant forces which determine how much bone shall be laid down or to what size or to what density it shall grow.

We know that the ductless glands—the pituitary, the thyroid, the parathyroid, the ovaries—have some influence on the growth of the skeleton; that food elements which can neither be isolated nor analysed—the vitamins—may determine its density; and, most mysterious of all, that not only can sunlight cause bone to grow, but that this sun power can be first given to the food and by this transferred to the bones. In fact, the whole bewildering chapter in physiology called calcium metabolism appears to concern itself with all aspects of life and growth. But even the simple facts of the relationship between bone salts and bone cells are still matters of doubt and dispute. That animal tissues can be grafted was proved by Hunter, but the exact changes which take place in this process are most difficult to understand or explain. Hunter took it for granted when he transplanted a human tooth into a cock's comb and it remained in organic connexion, allowing injection from the bird's vessels to permeate its tissues, that the tooth had become a living part of the cock's tissues. The modern view, however, would be that the vascularization was only that of granulation tissue, by which the foreign tooth would have been eaten away and destroyed.

As I have said before, no practical advantages could have followed in Hunter's time from his grafting experiments. But in the modern era of aseptic surgery bone-grafting has become an everyday method of repairing fractures and of making good defects in the bones. For a time, it is true, the possibility of suture and fixation of bones by metallic substances—wire, plates, screws, and the like—absorbed the attention of surgeons. But both clinical experience and experimental work soon showed the drawbacks and limitations of the use of metal substances and proved the great possibilities of grafting with bone tissue.

The Jacksonian specimens illustrate many of these points, of which the following may be mentioned as the most important. Any metal substance, whether wire or screw, exerting firm pressure upon living bone, causes either necrosis or else absorption of the bone, and therefore is to be regarded as essentially a hindrance to bone growth or repair. This bone destruction, whether by necrosis or absorption, is a vital and not a septic process, but it leads to conditions very favourable to the latter. When, however, metallic fixation is efficient and bone

union occurs, there is produced in the end a reactive inflammation by which the foreign body becomes encased in a layer of dense new bone. Thus the method used clinically may, and often does, lead to painful osteitis, which finally requires the removal of the offending metal.

Living and Dead Bone Grafts.

In regard to bone-grafting, the specimens under consideration give by no means a complete picture of the process. But they do illustrate two points of cardinal importance. The survival and functional union of the graft to the host bone depends essentially upon perfect contact and adequate fixation between the graft and the host. No living graft, however carefully cut even from the same animal, will survive or function if it is laid loosely into the tissues of the host. In other words, the graft manifests no innate vitality of its own. Further, if two small grafts, one of living autogenous bone, the other of dead boiled bone, be fixed firmly in the shape of pegs into holes bored in the living host bone, then at the end of six weeks both will have grown in place and neither naked-eye nor microscopical examination can detect any difference. Dense bone, when transplanted, always dies, in the sense that its cell spaces and vascular channels become empty. It is then invaded by new vessels and inhabited by new bone cells provided by the tissues of the host. From this it follows that in many cases it is just as good to use dead bone in the first place and to trust to the activity of the host's tissues to vascularize and vivify it. Of this I shall show you a convincing proof presently. But it would be going too far to assert that the living autogenous graft has no advantage over the dead one. Certainly when a gap in a bone has to be bridged, the living graft becomes a vital and growing part of the skeleton much more surely and more quickly than does a dead graft. Therefore in such cases as making good the gap left by the destruction of the whole diaphysis by osteomyelitis, or the fixation of a tuberculous spine by the insertion of a tibial graft—a suggestion which we owe to the genius of an American colleague, Dr. Albee—it is better to use the living bone taken from the patient himself. Whether this superiority of the live graft is due to the survival of superficial cells or to its more ready permeability by the host blood vessels we do not know, but it is certainly not due to the survival of the graft as a living entity.

In the beautiful specimen lately presented to the Museum of a double bone-graft of the spine, obtained three months after the grafting operation, the grafts are seen to be in close vital union with the vertebrae. But it is evident that the great vascularity of the grafts represents a new process of permeation and invasion by new blood vessels, as the tibial crests from which they were taken contain no such blood channels.

Probably I have raised in the minds of many of my hearers a feeling of scepticism about the possibilities of dead bones being capable of functioning as real vital grafts—vital, that is to say, in the sense that they become an integral part of the living skeleton. Therefore I will venture to give you three illustrations, which I am happy to say are not dead specimens in bottles, but living, healthy people.

The first is from a lady of 39, who had an ununited fracture of the neck of the femur of two years' duration. The bone was mended by exposing the hip-joint and nailing the head of the bone to the neck after the former had been dislocated. For this purpose a nail, 3 in. long and 3/8 in. thick, made of dead bone cut from a stag's antler, was used. She made a rapid and complete recovery, and to-day, three years after the operation, it is impossible to detect from her active movements which of her hips has been injured. The x rays show very well how the bone nail first merely held the broken neck of the femur together, then slowly but surely became incorporated into the living skeleton.

The second instance is in a man of 25, who at the time of the operation was 18. He had developed fibrocystic disease in the upper part of the left femur, which had become reduced to a mere shell of bone, causing a definite aching pain, premonitory of a spontaneous fracture. The exact nature of the condition was revealed by a preliminary operation in which a mass of firm fibrous tissue was found occupying the whole

cavity, shown by the x rays. An exact model of this cavity was prepared from a tooth of a walrus, which by its curve and size seemed just made for the purpose. The whole cavity in the bone was exposed by cutting a trapdoor from the back of the femur, the fibrous mass was removed in one piece, and the ivory graft inserted. There it remains to this day, surrounded but not replaced by the human bone, the dense ivory having proved resistant to penetration by new blood vessels. The patient, a quarryman, has been in good health and active work ever since. It is to me a happy thought that whilst Hunter was able to graft a tooth into a cock's comb 150 years ago, we have succeeded in implanting a walrus tooth into a man's leg in such a way as to form an integral part of his skeleton.

The third instance is perhaps the most instructive of all, because the dead graft was made to bridge a gap, and has been associated with very active growth of a long bone. The boy, as he then was, ten years ago, between the ages of 7 and 10 had broken the right humerus four times, usually by trivial causes. The x rays showed a cyst in the middle of the shaft of the bone. The whole thickness of the affected portion of the bone was cut out for a length of three inches by a subperiosteal resection. The gap was made good by thrusting a long piece of beef bone into each fragment and then bolting together the projecting ends of the grafts. Each graft had had many small drill holes made into it in order to facilitate its penetration by living tissues. He made a smooth recovery without the use of any splint, and was able to return to the dangerous environment of public school life six weeks later. The x-ray pictures show how the beef bone has remained in place for ten years, becoming gradually merged, especially at the ends, in the structure of the human bone. That this bone has suffered no diminution of growth from its invasion by an ox bone is evident from the pictures, but that you may be finally convinced of this I have brought the gentleman himself to show you, and you will admit that the addition of a piece of beef bone to his anatomy has not interfered with his growth. (He is now 6 ft. 2 in., and an undergraduate.)

I have selected the study which Hunter made of bones and some of the things which have arisen from it as an example of his work, chiefly because it has not been touched upon by any of my predecessors, and also because it is most familiar to myself, and this leads me to my first observation about Hunter as a great man. Think of it! Seventy-five orations about one man and his work, and still there is left a great subject almost untouched.

Hunter as a Worker.

The first, but I will not say the greatest, claim which Hunter makes to be regarded as a veritable giant among men is his capacity and enthusiasm for work. He came as a young man from Scotland and began his life in London, making anatomical preparations in the school of his elder brother, William; he then taught anatomy and got himself qualified after working at Chelsea, St. Bartholomew's, and St. George's Hospitals. He was already deeply engaged in scientific research work, chiefly in dissecting all the animals he could get. His health threatening to break down, he applied for and obtained a military surgeon's post and served for three years in Belle Isle and on the Peninsula.

On his return to London, his practice having vanished, he began strenuous work in dissecting, describing, and collecting specimens, which was the beginning of the present Museum. He became a surgeon to St. George's Hospital, and he lectured on anatomy and surgery. He acquired a great and prosperous practice, and with its proceeds bought a country place at Earl's Court, in which he collected a veritable menagerie of wild animals and continued with his experiments. He became the Deputy Surgeon-General of the Army Medical Service. He had been for a long time a Fellow of the Royal Society and was already engaged in writing and contributing scientific papers for that learned body. Before he reached the zenith of his fame he had begun to suffer from attacks of angina pectoris, all the symptoms of which he relates with vivid exactitude.

His whole day being taken up with his practice and his teaching and his body racked with an ever-progressive disease, his last thought was of seeking rest or repose. On the contrary, his passion for work kept him up until midnight writing, and awakened him again at four in the morning, when he settled down to his dissecting. If a

stranger wrote to him, wishing to see his work and proffering an introduction from another distinguished surgeon or scientist, Hunter would name 5 a.m. as a suitable hour for an appointment. This all sounds incredible, but its truth is vouched for by many witnesses, including Hunter's arch-enemy, the notorious Jesse Foot.

But in addition to witnesses from the past we have the convincing evidence afforded by 13,600 specimens in the Museum. It is not easy to grasp in a moment the significance of these figures. Hunter began his work at the age of 20 and died at 65. Allowing, then, full forty-five years, and 300 working days in each, we have the total of 13,500 days with 13,600 specimens collected, or an average of one specimen for every day of his life. Many of these necessitated experiment or elaborate dissection, and he also left many folios of drawings, notes, and descriptions, besides those destroyed by Home and the fifty-five papers or treatises written by Hunter or prepared from his notes after his death.

A few people there may be, but very few, who in intellectual pursuits really do work hard, but how many of these continue their self-imposed slavery right up to the end of their lives, even when fame and fortune have smiled upon them? Hunter knew full well that he was suffering from a mortal disease, for he told a friend that his life was at the mercy of any rascal who chose to anger him, and yet he went on at full pressure to the day of his death, when his own prediction came true, and some colleague giving him the lie in the board room of St. George's Hospital he felt that the fatal blow had been struck, and expired in the arms of Dr. Robertson.

Hunter as a Seeker.

This brings me to the next point, which unhesitatingly may be said to be his chief claim to greatness—and this is the driving force which lay behind his work. Hunter was desperately in earnest. He was inspired by a vision of the mystery of life, which called him on and ever onwards, trying, experimenting, asking and seeking to know something of the truth of life and nature. "No man adequate to do anything, but is first of all in right earnest about it; what I call a sincere man. I should say sincerity, a deep, great, genuine sincerity, is the first characteristic of all men in any way heroic." That sentence of Carlyle's I take as literally applicable to our hero.

Nothing serves better to illustrate Hunter's desperate enthusiasm for research than his own deliberate inoculation of himself with disease. Unhappily this experiment was only too successful, though he himself failed to understand, what has been so amply demonstrated by others, that this disease, when it had apparently disappeared, laid relentless hold upon his blood vessels and led to angina and to his tragic death.

It has been many times claimed that Hunter's secret lay in his having adopted the Baconian or inductive philosophy. But others have justly remarked that he often allowed himself to lapse back into the deductive method, and that whenever he did this he wandered from the path of truth. It is highly improbable that he ever consciously adopted any philosophic system. He just went straight to Nature, and, demanding to know the answer to her riddles, he thought nothing of giving his fortune and his life as a price for his knowledge.

In biological science Hunter was the greatest seeker the world has ever known, though by no means the greatest finder. It was his desperate earnestness in seeking, and not merely the products of his research, which then and now rivets men's attention. It was an arresting spectacle to see a Scotsman spending £70,000 in collecting specimens which had no intrinsic value. It was his supernatural faith that there was in Nature something worth seeking which made other men follow his lead. The mere sight of a man earnestly gazing at some object in the street is enough to draw a crowd, who will endeavour to find out what all are looking for. The pioneer who refuses to be satisfied with the bare tillage of the surface soil, worn poor by many generations of cultivators, and, convinced that a rich vein of gold is to be had for the digging, spends all his energies, his fortune, and his life in delving into the earth for buried treasure—who brings up many strange

things, which at first only a few know to be auriferous ore—this is the man whose faith and enthusiasm compel others to follow. The pioneer does not himself, maybe, find the largest nugget or the purest gold, but he shows where gold may be found and how to find it.

Such a pioneer was Hunter, and to Lister coming after him was accorded the good fortune to bring to light the most precious treasure that the surgeon-digger has ever given to his fellow men. It was John Hunter's faith and vision which raised surgery from the level of a craft and art to that of a science, and which has proved an inspiration to his followers. "For consider," as Carlyle says, "what mere time will do in such cases; how if a man was great when living, he becomes tenfold greater when dead."

His Human Frailties.

The wonderful influence which Hunter exerted upon contemporary thought is made much more remarkable when we consider his many shortcomings and frailties. He was gifted with neither learning nor eloquence. Of his writings I am almost tempted to quote what Carlyle says of Mahomet's Koran: "I must say it is as toilsome reading as I ever undertook. A wearisome, confused jumble, crude, incondite; endless iteration, long-windedness, entanglement." I sometimes wonder whether his brother-in-law, who afterwards became Sir Everard Home, the first President of the Royal College of Surgeons, deserves all the obloquy which has been heaped upon him for taking a cartload of Hunter's unpublished writings away with him and quietly destroying them, after he had extracted so much learning from them as, by papers contributed by himself to the Royal Society, earned him a Fellowship in that body.

Although Hunter lectured for many years he found it a painful task, and often took laudanum beforehand to quiet his discomfiture. He had none of the classic learning considered essential for a scholar in his day, and even when he had a chance of acquiring it at Oxford he impatiently threw it aside, saying that he would rather learn from living Nature than from dead languages. Even in those uncouth days Hunter was a rough customer. He was always quarrelling—whether with fellow officers in his military service or with his own brother, or other workers at home. He bursts into his wife's drawing room and addresses her visitors: "I knew nothing of this kick-up; I ought to have been informed of it beforehand, but as I am now returned home to study I hope the present company will retire." It seemed that he must quarrel even to the end, even though it cost him his life.

If it should seem strange to mention these human frailties when speaking of one who was truly a hero, if ever there was one, I do it deliberately in order to emphasize that Hunter owed his influence to the greatness of his work, the almost blinding sincerity of his vision, and to his unquenchable enthusiasm, rather than to any charm of manner or polish of language. I must quote Carlyle again when he says: "On the whole we make too much of faults; the details of the business hide the centre of it. Faults? The greatest of faults, I should say, is to be conscious of none."

His Heritage and Inspiration.

To the whole surgical world who have come after him Hunter's most priceless bequests have been his inspiration and his heritage. The heritage is here as the most wonderful museum of its kind in the world; the inspiration is impossible to limit or define.

We know that Hunter's experimental methods laid the foundations of modern physiology and pathology. He taught us to seek out the relations between structure and function in the normal tissues and between disorder and disease in the morbid. In his collection of animals and of fossils and his observations on development, with its parallelism between the growth of the individual and the elaboration of the race, he came very near to the Darwinian theory of evolution. His methods, closely followed by Lister, were the basis of the discovery of the antiseptic treatment of wounds. "Worship of a hero is transcendent admiration of a great man." The great turbulent heroic soul of Hunter has never lacked this worship, or else these seventy-six orations have been poor sham mockeries.

But even if we admit that orations are but empty words, there exists a far more vital evidence that the torch of inspired enthusiasm has been faithfully handed down from his day until now.

First, there was that dear old man Clift, who like a watch-dog guarded his master's treasures after his death, when it seemed that nobody wanted them. For seven years he lived on seven shillings a week, whilst he kept his trust, and then later became the first formal custodian of the Museum. The watch-dog growled and showed his teeth, but, alas! could do no more when his master's precious papers, many of which Clift had himself helped to write, were carted away and secretly destroyed by Home. Clift's daughter married Richard Owen, who succeeded him in the guardianship of the Hunter Museum and became the greatest palaeontologist and comparative anatomist of his day. He was later transferred to the Natural History Museum at South Kensington. Owen was followed by Paget, a most notable torchbearer, whose ceaseless labours added so much to surgical pathology, and whose silver-tongued eloquence is remembered by many now living. Then came the greatest of Hunter's followers, Lister, whose name is held in honour all the world over as the one whose work has saved more lives and suffering than have been sacrificed by war. Lister, it is true, never held high office in this College, though he was a member of Council for eight years. His gentle soul did not love fighting with his detractors, and he preferred to pursue his quiet research in the laboratory and at the bedside. And lastly, we are fortunate in having to-day, in the person of our beloved Curator, Sir Arthur Keith, one on whom the mantle of John Hunter seems perfectly to rest, the depth of whose learning and the eloquence of whose tongue fit him so well to be the guardian of Hunter's heritage and the exponent of Hunter's inspiration.

Hunter may truly be said to have raised the idea of the scientific pursuit of truth to the level of that compelling influence in men's lives which is called religion. For he had a vivid faith in his quest, an unquenchable enthusiasm for his ideal; he left an inspiration for all who come after him, and a real hero for us to worship.

ADVANTAGES TO THE DIABETIC OF A DIET RICH IN CARBOHYDRATES.*

BY

J. A. NIXON, C.M.G., M.D., F.R.C.P.,

PROFESSOR OF MEDICINE IN THE UNIVERSITY OF BRISTOL; PHYSICIAN TO BRISTOL ROYAL INFIRMARY.

WHEN Banting revolutionized the treatment of diabetes by the introduction of insulin he provided a means whereby the diabetic can metabolize carbohydrate. It was unfortunate that this discovery should have come at a time when Allen had revived Guelpa's method of treating diabetes by starvation. Because the "starvation" method unquestionably became grafted on to the insulin method of treatment, with the result that, in addition to the necessary evil of having to endure daily hypodermic injections, the diabetic is often subject to deliberate and, in my opinion, unnecessary degrees of undernutrition. The high fat dietary is another survival from pre-insulin days.

The practice of feeding diabetics with an excess of protein was more readily dropped when insulin was introduced, although many advertised diabetic foods still claim as a merit their high protein content. I cannot conceive that in these days there is any advantage to the patient in offering as a substitute for carbohydrate an excess of fat or of protein. For, to speak plainly, if a diabetic deprived of carbohydrate does not convert the fat or protein of his food into glucose or glycogen he dies. There are a few people so constituted that they can derive from fats and protein an adequate glycogen supply—the Eskimos as a race seem capable of this physiological *tour de force*. In our race or our climate the healthiest of us mostly fail miserably if we try to accomplish it. The diabetic, with

or without insulin, is equally liable to fail; it is almost a miracle when he succeeds.

The question I propose to consider is whether a diabetic need nowadays ever be asked to attempt either the task of deriving his glucose exclusively from fats and proteins or the alternative task of living cheerfully and working usefully whilst balancing on a sort of knife-edge of starvation.

The importance of keeping the blood sugar low if a diseased pancreas is to have a chance of recovery is universally admitted, but the prospects of recovery are decreased if the low blood sugar is accompanied by a general starvation. A starved pancreas will not regenerate, even though the blood sugar is low; new tissues are not built up by such means.

Before, however, the regeneration of the pancreas is considered, there may come the far more pressing question of keeping the diabetic patient alive. The first fear is that diabetic coma may supervene. Insulin treatment has reduced the mortality from coma to such an extent that one can say "a death from diabetic coma is an unnecessary death." Nevertheless diabetic coma is not an unreal danger even to-day, and it is only by constant supervision on the part of the doctor and intelligent co-operation on the patient's part that this danger is averted.

We know that the chief factor in the production of diabetic coma is incomplete oxidation of fats. These fats may be either exogenous, the fats of food, or endogenous, the fats of the body. If insufficient carbohydrate is ingested, the body endeavours to derive its caloric wants from the fats; in any case a certain amount of carbohydrate is required to secure complete oxidation of the fats. If the oxidation is incomplete ketosis ensues, and finally such a degree of ketosis is reached as produces coma and death. Thus if a patient with diabetes, in whose urine acetone bodies are present, comes under observation the immediate aim of treatment is not to regenerate the pancreas, it is to prevent coma. The treatment of coma when established is admitted to be the administration of glucose rendered usable by insulin. No one urges that the least particle of fat is needed when the patient is comatose.

When treating a diabetic I am never satisfied so long as any trace of ketone bodies can be detected in the urine. I know that Rothera's sodium nitro-prusside test is unduly delicate, but it seems to me that any patient who has had sufficient ketosis to give a positive ferric chloride (Gerhardt's) response, may as well be cleared completely, even to the point where Rothera's test becomes negative. In like manner, when Rothera's test becomes positive in a diabetic where previously it was negative, it is better to push the patient back on the safe side and render the urine completely negative, rather than let him continue on a path, whose width we cannot presume upon, which divides a positive Rothera's reaction from a negative Gerhardt's.

In a patient showing even slight ketosis there seems no sound reason for administering fats at all. The first object is to eliminate the ketones, and we only know one practical way of doing this—namely, the administration of carbohydrate. When the subject of ketosis is not a diabetic we give glucose, either by the mouth or intravenously, but if diabetes is present then insulin must be added to enable the ketones to be oxidized with the carbohydrate. If the diabetic patient should chance to have a high blood sugar it may be that insulin alone will enable the blood sugar to be utilized, but there is no way of determining whether the blood sugar all by itself is sufficient to counteract the ketosis when insulin has been given.

One may meet with a patient in diabetic coma with hypoglycaemia, because the insulin has enabled the blood sugar to be exhausted and yet was insufficient in amount to burn up all the ketones. Obviously this can only be avoided by giving carbohydrates freely with the insulin and ignoring glycosuria. As the majority of patients threatened with coma are under-nourished, we need not fear that their weight will increase immediately. Make them safe first, then consider their nutrition.

The patient with ketosis, however slight, does not stand in immediate need of fat. On the contrary, a diet rich in fat but poor in carbohydrates produces fat deposit rather than glycogen in the liver, and where fat has got in there

* Presidential address to the Bath and Bristol Branch of the British Medical Association, 1929