JOHN HUNTER AND EXPERIMENTAL SURGERY

Hunterian Oration delivered at the Royal College of Surgeons of England

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by

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An engraving by C. Josi from William Sharpe's print of Sir Joshua Reynolds's portrait of John Hunter. 1782.

MR. PRESIDENT, MEMBERS of Council, Ladies and Gentlemen: I have been collecting data bearing on John Hunter as a pioneer in Experimental Surgery and if any of my gleanings are of interest to you I shall be very gratified. So far as I can find out, John Hunter was the first surgeon to establish an experimental research station, buying in 1765 the leasehold of three pieces of land for this purpose at Earl's Court where he had previously rented a house. As you know well, it was Hunter's example that influenced the late Sir Buckston Browne in 1931 to make it possible for our College to build and endow a modern " Earl's Court " at Downe in Kent, next door to Darwin's old home.

Thanks to the laborious enquiries of the late Mr. George Peachey (1862-1935) we know that Hunter made this bold purchase at Earl's Court in 1765 when his worldly prospects were at their very bleakest, and it is perhaps not without interest to treat of the events that led to this enterprise.

When John Hunter first came to London in September 1748, his first task was to prepare specimens for his brother's demonstrations and lectures and even at this early period he came into contact with the resident pupils at the house in Great Piazza, Covent Garden, where the two brothers lived. It is perhaps not generally realised that, quite apart from the tremendous influence exerted by John Hunter himself in the world of natural science and surgery in England, his ideas were dispersed over a far wider area through these and later his own students. So great was the reputation of the Hunters for their courses of instruction that many of those desirous of qualifying as medical men would travel great distances for the privilege of attending their classes. One of these early pupils was John Jones, a student from Philadelphia who, after gaining his M.D. of Rheims in 1751, returned to America to become one of the ablest surgeons of his time, distinguished as having written in 1775 what is said to be the first book to be published on surgery in the American States: " Plain, concise, practical remarks on the treatment of wounds and fractures."

In the spring of 1756, William Hunter changed his residence to Jermyn Street but the house in Covent Garden still remained John Hunter's home and the hostel for the resident pupils. It was here that William Shippen, also from Philadelphia, stayed when he came to London to study with the Hunters in 1759. Mrs. Corner, in her excellent biography of Shippen, published in 1951, includes extracts from the diary that this young American kept during this period and these reveal that John Hunter not only supervised the dissections and lectured to the students but was also willing to go on " talking anatomically " with them far on into the night. There is no doubt that he inspired them with his own industry, for one of the entries in Shippen's diary reads: " Rose at 6; dissected till 12 "; and another: " Rose at 7, dissected 7 hours; after lecture operated till 9 supper time under the direction of Mr. Hunter." On his return to

America in 1762 Shippen was fully determined to teach anatomy by dissection and to practise midwifery, both new ventures in that country. He began to give private anatomy classes in the November of that year and as illustrations he used Rymsdyk's crayon drawings of dissections prepared by Charles Nicholas Jenty under the supervision of John Hunter. When the Philadelphia Medical School was opened in 1765, Shippen was appointed its first Professor of Anatomy and Surgery.

Another pupil at the house in Great Piazza was John Morgan, also a pioneer in the systematic teaching of medicine in America. From the Hunters he learned the art of making injected preparations and at a meeting of the French Academy of Surgery in 1764 he showed injected specimens of the blood vessels of the kidney and was the first to demonstrate this technique in Paris. In his paper on the "Art of making anatomical preparations by Corrosion " published in the Transactions of the American Philosophical Society in 1786, he mentions that he gained the first rudiments of this art from the two Hunters and that the knowledge of it was at that time confined to Great Britain.

Hunter's life of teaching and research was now interrupted and it was in the spring of 1763, being then in his 36th year, that he returned to London after serving abroad for two years and a half as surgeon in the Army. He found that his brother William had no longer any need of him, having given up his anatomical school in Covent Garden and having engaged William Hewson (1739-1774) to fill the post formerly filled by John in a new school that he was equipping in Litchfield Street just off Charing Cross Road. According to Peachey, John went to lodge with William Jones, a druggist who lived in Great Russell Street, Covent Garden. The only income he had then was his half pay from the Army and it was at this juncture of his affairs that he resolved to build up a school of his own. It was for this purpose that he now set to work to prepare specimens of his own to illustrate his lectures and these form the nucleus of the fine collection the remains of which are now preserved in our College.

During the time that he had served as an Army surgeon in Belle Isle, he had made observations on the oeconomy of lizards. He noted that when the stomach is in a torpid state, as during hibernation, the process of digestion ceases. He also observed that when these lizards accidentally break their tails, they possess the power to grow a new one. One of the specimens that he brought back with him, and which is still in the museum (Fig. 1), shows a lizard with a tail in three parts :—

> " the stump of the original tail, the first new growth covered with scales different in form from those of the stump, and the second new growth, without scales, smooth, soft and slender."

It was while serving in Portugal that he made his investigations into the organ of hearing in fishes, made a geological investigation of the Alentejo plateau that he later incorporated into his " Observations and Reflections

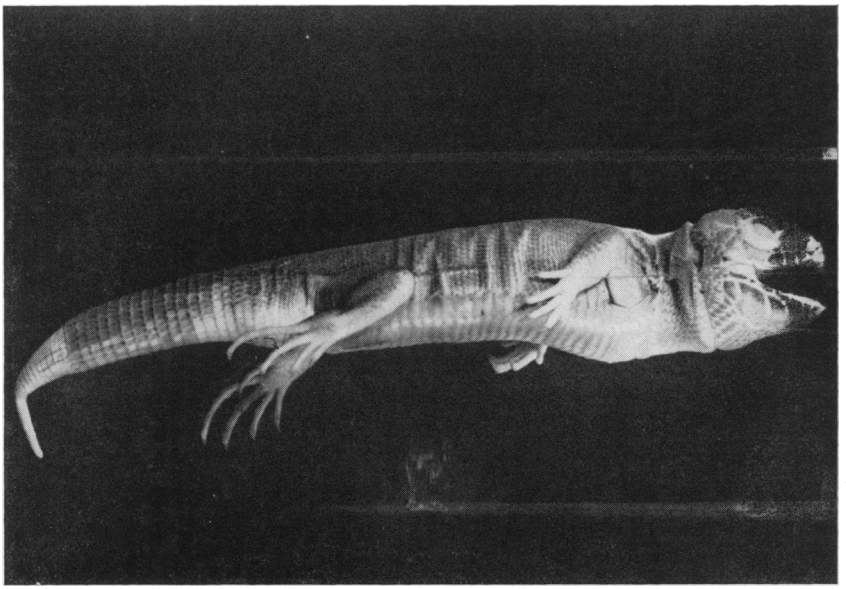

Fig. 1. Physiological Series No. 2859.91. A lizard showing the regeneration of the tail.

on Geology," and collected material for his work " On the Blood, Inflammation and Gunshot Wounds "—all this in addition to his duties as surgeon to the Expeditionary Force.

Some of the earliest of his museum preparations were those that he made to illustrate the natural history of the teeth. To these specimens the late Sir Frank Colyer devoted an illustrated monograph entitled " John Hunter and Odontology " in which he speaks of them " as a lasting testimony to Hunter's great skill as a practical anatomist." Fig. 2 is a reproduction of one of the illustrations of Hunter's work on the Natural History of the Human Teeth and is a side view of the human jaws with the outer plate of the alveolar process removed to show the teeth in their sockets. According to Hunter's bitter critic, Jesse Foot, a " professional coalition " was entered into with Spence, the barber-dentist, whose shop Hunter is said to have visited three times weekly as a consultant. It was at this time that Hunter became interested in grafting, especially the grafting of teeth, which I will discuss later in this talk.

The summer of 1765, then, still found John Hunter coaching and dissecting in Covent Garden but now resolved to have a place for experiment and observation in the country. At this time the busy thoroughfare now known as Earl's Court Road was a country lane, opening from Cromwell Road some three-quarters of a mile west of the site where the Natural History Museum now stands and running in a southward direction for half a mile to reach the Old Brompton Road. Hunter's

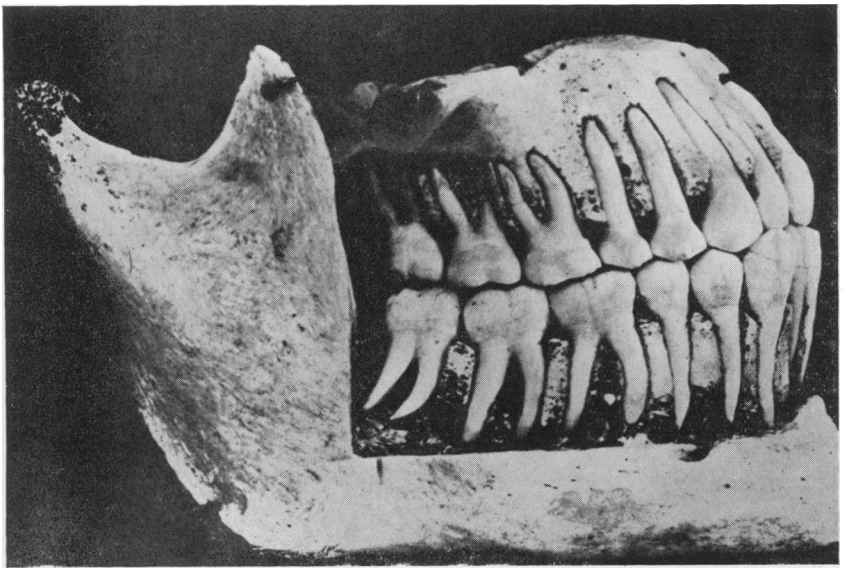

Fig. 2. Fig. I, Plate 6 from John Hunter's "Natural History of the Human Teeth." London. 1771.

choice fell on a piece of land bordering this lane ; this is almost opposite the place where Earl's Court Station of the District Railway now stands, the houses in Barkston Gardens being actually on the site of Hunter's meadow. The area of land that he bought measured about three and a half acres : the entrance from Earl's Court Road was by " a large iron gate " ; from the entrance, the meadow stretched away towards the east where there was a wall and in it a gateway leading to a field beyond. Hunter bought a 90 years leasehold of this land ; how much he paid is not known but a little more than a year later he raised £150 by mortgaging this leasehold to William Jones, his landlord in Covent Garden, showing how embarrassed he was at this time for money to equip his new quarters.

In 1766, he left Covent Garden and took a house in Golden Square, off Piccadilly Circus and not far from Windmill Street where his brother William was beginning to build his new school. The house in Golden Square was rated at £45 per annum, an additional expense. In 1768, the year that saw his election to the staff of St. George's Hospital at the age of forty, matters at Earl's Court had progressed and the " square brick house " was completed. This meant that the rates were then raised from £5 per annum to £15. Apparently, John Hunter was still in need of money for, although he paid off the mortgage held by his old landlord, he immediately remortgaged the Earl's Court property for £350, this time to Mr. Charles Bembridge whom Peachey identifies as the " Deputy-Paymaster to the Forces at Belle Isle."

As far as we know, the house erected at Earl's Court was of Hunter's own design. All round the house was a covered area about six feet below the level of the ground, where the smaller animals were kept in cages, the entrance to it being a sunken passage large enough to admit a small cart or truck. Near here were the stables where there were stalls and kennels for all kinds of animals and a room with a large copper boiler that was used for the preparation of skeletons—including that of Charles Byrne, the Irish Giant. The residential apartments were on the first and second floors. Such a design required an enormous preliminary excavation and it has been suggested that the earth from the foundations was heaped near the wall at the eastern end of the field and formed the mound where Hunter had his " Lion's Den." His study was at the back of the first floor and looked out on to the " Lion's Den " and also on to a pond where he kept for experiment his fishes, frogs, leeches, eels and river-mussels. In later years, wings were added to the north and south aspects of the original square brick building.

A letter written by Hunter in 1775 to his brother-in-law, James Baillie, Professor of Divinity in the University of Glasgow and father of Matthew Baillie, throws a cheerful light on his life at Earl's Court. This letter was written four years after he had married Anne Home and had become father of two children. He tells his brother-in-law : "As to myself, I am pursuing business, and pursuing my studies. As to my business it is very nearly what I want, because it very nearly gets me what I want ; beyond which I have no ambition. As to my studies, I am following my business as a student, pursuing my comparative anatomy ; for two or three months in the year, pretty much in the country making experiments upon animals and vegetables and it appears to be Anny's enjoyment in seeing me please myself ; while all these concurring circumstances go on, I must continue to be one of the happiest men living." It was in 1775 that Hunter first earned more than a thousand pounds by one year's practice and this fact possibly explains his remark that his business was " very nearly what I want, because it very nearly gets me what I want." Almost certainly, his income was spent as soon as he got it, for we have it on the authority of Everard Home, his brother-in-law, that he always purchased some addition to his collection so soon as he had saved 10 guineas in fees.

In 1768, Hunter had moved his home from Golden Square to Jermyn Street, formerly his brother's home, and on a Sunday morning little more than a half-hour's walk took him to his " country box " at Earl's Court, for the distance to be covered was little more than two miles. In the autumn months he moved his whole household there for recreation and for work. Presently we shall glance at the multifarious subjects that Hunter made the objects of enquiry. Meantime, let us follow the growth of the establishment there. His last apprentice and assistant, William Clift, who gave devoted service to the care of the museum for 50 years, gives a list of those employed at the time of Hunter's death in 1793, at

the age of 65, at what we may now call the Farm. They were as follows :—

Peter Shields, gardener, and his wife, housekeeper and dairy-maid.
Tom Barton, carter, and his wife, assistant laundress.
Betty, laundry-maid.
Scotch Willie, half-witted, employed in the fields.
Old David, head under-gardener.
Alexander, out-door gardener.
Woman to weed in the garden and fetch the cows.

Besides these there were in almost constant employment at Earl's Court a carpenter, piper, bricklayer and mason, painter and glazier, cart, harness and collar maker and a farrier, as well as occasional extra workmen in the gardens and grounds.

The modest beginning which Hunter made at Earl's Court in the summer of 1765 had, by the time of his death in 1793, grown into :—

" A singularly elegant villa with stabling, coach house, innumerable offices of every description, pleasure ground, elegantly disposed in lawn walks, rich shrubbery, etc., greenhouse, menagerie, ice-house, excellent kitchen garden with lofty walls, well planted with a selection of choice fruit trees in a full state of bearing. Pinery, fruiting and succession houses, and containing within a lofty wall near seven acres, together with a good farmhouse, adjoining barns, and about 45 acres of rich arable meadow and garden ground."

Such is the description of the property as given by the auctioneer in his announcement of the sale. Starting in 1765 with a modest three and a half acres, Hunter had increased his holding to 52 acres at the time of his death. At some unknown date he added another three and a half acres to his original purchase and only four months before his fatal attack in St. George's Hospital in 1793 he acquired the adjacent farm of 45 acres. His income at this time was over £5,000 a year, but so hard was he pressed for ready money to keep his establishments in Leicester Square and at Earl's Court going that he immediately mortgaged his estate at Earl's Court for £4,000, paying 5 per cent. interest on the money thus raised. In addition, he had borrowed other sums amounting to £3,800 at the same rate of interest. Earl's Court at the sale brought in £10,000. It was no wonder, therefore, that Clift found that, when all the debts were paid and the museum was still awaiting a purchaser, all that was at the executors' disposal to provide for Mrs. Hunter and her son and daughter was a little over £1,500.

As we have seen, Hunter made the teeth the chief subject of his study on his return from Portugal, particularly the practice he had introduced to Spence's patients, that of transplanting or grafting sound living teeth to replace those destroyed by disease. Hence some of the earliest experiments he carried out at Earl's Court were designed to prove what the surgeon could accomplish by grafting. The " success of his operation " he believed

" is founded on a disposition in all living substances to unite when brought into contact with one another, although they are of a different structure, and even if the circulation is only carried on in one of them. . . . Taking off the

spur of a young cock and fixing it in his comb is an old and well known experiment . . .''

From first to last, Hunter harboured the belief that life in all animals was of the same nature ; no matter how far apart they might be in the zoological scale, if even divergent parts were brought together in a living state, they would unite. He illustrates his belief by the following experiment :

"I took a sound tooth from a person's head ; then made a pretty deep wound with a lancet into the thick part of a cock's comb, and pressed the fang of the tooth into this wound, and fastened it with threads passed through other parts of the comb. The cock was killed some months after and I injected the head with a very minute injection ; the comb was then taken off and put into a weak acid, and the tooth, being softened by this means, I slit the tooth and comb into two halves in the long direction of the tooth. I

Fig. 3. Pathological Series No. 532.1. The head of a cock into the comb of which a spur has been transplated. In its new position the spur grew to a length of 4 inches.

found the vessels of the tooth well injected and also observed that the external surface of the tooth adhered everywhere to the comb by vessels, similar to the union of a tooth with the gum and socket."

Hunter confesses, in a footnote, that he " had succeeded but once out of a great number of trials " with this experiment. The specimen which has come down to us shows the pulp cavity filled with vascular tissue (Fig. 4).

From the knowledge he had gained from these preliminary experiments, Hunter proceeded with the venture of transplanting teeth from one person's jaw to another. Some idea of his method of procedure and the degree of success he achieved may be gained from a paper published in Philadelphia in 1827 by James Gardette, a native of Paris who settled in America in 1777. He refers to two cases of teeth transplanted under the supervision of John Hunter. The first case refers to a resident of Philadelphia who, while staying in London in about the year 1784 had three upper front incisors transplanted. These, says Gardette, " remained very firm about

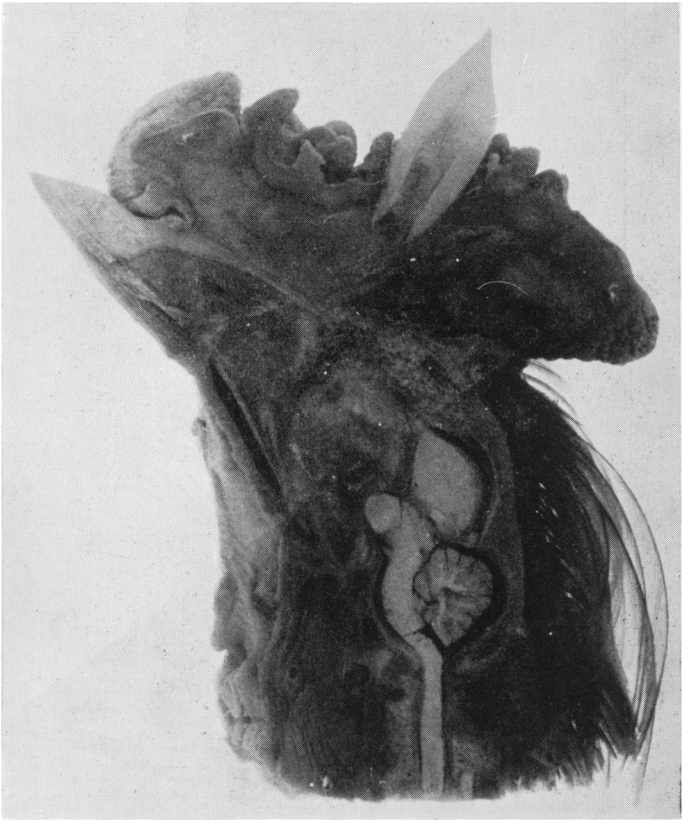

Fig. 4. Pathological Series No. 540.1. A section of the head of a cock and of a human canine tooth that was transplanted, immediately after its extraction, into a puncture in the comb.

Fig. 5. Sir Frank Colyer, Honorary Curator of the Odontological Collection from 1909 until his death in 1954.

five or six years and lasted about as long in a loose state." The second case was that of a lady who had had the operation done in the year 1780. Two years later, owing to an infection of the gum, the transplanted tooth was removed by Dr. Shippen who, as we have seen, had been a pupil of Hunter, and it was found that the root was perfectly adherent to the socket on the right side. Sir Frank Colyer (Fig. 5), in commenting on these two cases, states that " the degree of success which attended these two Hunterian cases compared with that attending operations performed by others was possibly due to the care Hunter employed in the selection of his cases for transplantation." In Hunter's own words: "Although this operation is in itself a matter of no difficulty, yet, upon the whole, it is one of the nicest of all operations, and required more chirurgical and physiological knowledge than any that comes under the care of the dentist." Hunter did not claim to be the originator of this operation, for Ambrose Paré in the sixteenth century had made mention of the transplanting of teeth.

Hunter's work on the " Natural History of the Human Teeth " appeared in two volumes ; the first in 1771, the year of his marriage, the second in 1778. The whole work was republished by James Palmer in 1835 and forms the second volume of this edition, the superb illustrations being included in the Atlas of Plates. Thomas Bell (1792-1880), the author of " The Anatomy, Physiology and Diseases of the Teeth " published in 1829, was invited by Palmer to prepare the notes to this section. Here is Bell's opinion as expressed in his own work of Hunter's experiments in tooth-grafting :—

> " It was Mr. Hunter who first proposed to remove a diseased front tooth, and instantly extracting from another person a corresponding sound one, transfer it to the socket from which the former had been removed. . . . I cannot avoid denouncing the operation as dangerous, and, in the present state of our information, the operator who performs it is either grossly ignorant or unprincipled."

In his notes in Palmer's edition, Bell modifies his criticism and says :—

> " The frequent failures that occurred, even in the operation itself, and still more the severe results which very often succeeded its performance at different periods, have very properly induced almost all subsequent practitioners to abandon its employment. Nothing but the sanguine expectations created in an ardent mind, by the interesting results which followed his first experiments, could account for a man of so sound a judgment having followed up a practice so obviously objectionable."

How far Hunter's critic was in the right I will leave undecided for the moment in order to note that this Thomas Bell is an interesting link between Hunter and Darwin. In the year 1837, just after Bell's comments on Hunter's work on the teeth had been published, Darwin, recently landed from the " Beagle," was searching for experts to describe the collections he had brought home and he found Thomas Bell most helpful : he says :

> " I became acquainted with Mr. Bell, who to my surprise expressed a good deal of interest about my crustacea and reptiles, and seems willing to work at them."

Bell described the reptiles for the zoology of the " Beagle " voyage and became a friend of Darwin.

In his treatise on the Blood, Hunter declares that :—

> " The mere composition of matter does not give life, for the dead body has all the composition it ever had."

Therefore, says he, " life is a property we do not understand," a statement that is as true to-day as it ever was. In another passage, dealing with Inflammation, he admits that what happens in " one animal does not implicitly direct to the mode of action in another." Nevertheless, he proceeded in all his experiments on grafting under the conviction that " all flesh is the same flesh," whereas more recent experience has tended to show that each individual has its own constitution and that the only tissues that survive transplantation are, with a few exceptions such as cornea and cartilage, those derived from the individual's own body.

Previous orators have been inclined to dwell on Hunter's successes but often we learn more from a man's failures and Hunter is no exception to this rule. " To be puzzled," he says, " is the first step to knowledge " and elsewhere he observes :—

> "I believe that such as have a lively imagination move quickly from object to object. This I believe to be a state of half-delirium: I have felt this when much affected. Whatever I conceived in my mind became, at such a time, almost a reality."

The lively imagination which Hunter acknowledges in the quotation just given and the " sanguine expectations " and the " ardent mind " ascribed to him by Bell, were sources of his strength as well as of his weakness. He confessed that it was " pardonable to fall into error but not to follow it." Nevertheless, we find him pursuing an erroneous conviction with great pertinacity. This is exemplified by the last series of experiments he conducted before he sailed for Belle Isle. His brother William, who was then both his master and his patron, held that all absorption was carried out by the lymphatic system and none by the veins, in contradiction to the belief then accepted. The experiments that John performed in 1759 were aimed at proving that his brother's doctrine of absorption was true and for this purpose he made use of the sheep and the ass for, he observes :—

> " If any animal could be supposed a fitter subject for such experiments than the sheep, it would be an ass. He is not so large nor so strong but that he may be managed ; he is patient in the greatest degree ; his mesentery and vessels being larger, it is so much more easy to fix injecting pipes, make ligations etc. and what is a very great advantage in making such experiments, his mesentery is very thin, without fat, so that the vessels are conspicuous and distinct."

It was obvious that if Hunter were to continue such investigations, a place such as Earl's Court was necessary for their performance since it was essential that he should have adequate and suitable accommodation if his experiments were to be conducted successfully.

Only a year after he purchased this property, he ruptured his Tendo Achillis, he being then in his thirty-ninth year. He gives the following account of the accident in his " Cases in Surgery " :—

> " On Thursday morning at four o'clock the 20th February, 1766, I broke my Tendo Achillis. I was jumping and lighting upon my toes without allowing my heels to come to the ground, by which means I supported the whole weight of my body joined with the velocity of it in falling, upon the gastrocnemii and solei muscles—these two joined was too much for the tendon, which gave way at once, by which means my heel came to the ground. The snap (or report) made by the breaking of the tendon was heard all over the room. I stood still without being able to make another spring ; and the sensation it gave me was as if something had struck the calf of my leg ; and that the noise was the body which had struck me falling on the floor, and I looked down to see what it was, but saw nothing, I walked to a chair but could not throw myself forwards on my toes on that foot ; the calf of the leg was extremely painful and was in the state of a cramp. I endeavoured to take off the cramp by bending the foot, but found that that motion had no

effect upon the contraction of the muscles of the calf of the leg and upon further examination I found that the Tendo Achillis was broken."

After this accident, Hunter studied the process of tendon healing at Earl's Court in the dog, the ass and in deer. He cut the Tendo Achillis, either by open operation or by subcutaneous tenotomy, and several specimens illustrating the results of these experiments are still preserved in the museum. Of these experiments, William Adams (1820-1900), an experimentalist and pioneer in orthopaedic surgery, wrote in 1860:

"Hunter pointed out as a great fundamental principle, in reference to the healing of wounds, the difference between those two forms of injuries, of which one is subcutaneous, and the other open to the air. . . . That John Hunter practically applied this principle in reference to tenotomy is also established by the fact placed on record, that about the year 1767 he divided the Achillis tendon in dogs, the ass and deer, subcutaneously for the purpose of investigating the nature of the reparative process."

Adams claimed that Hunter was the first to practise subcutaneous surgery.

Soon after things had been set in motion at Earl's Court, Hunter began experiments to elucidate the manner in which bones grow. To demonstrate this, he used two methods. The first was by the insertion of lead shot or by cauterising the young growing bone to show the rate and direction of growth; and the second was by feeding animals on madder root which revealed the site of deposition of new bone. The property of madder in staining bone had been noted as early as 1584 by Antonio Mizaldus. John Belchier also observed this and published a note on the subject in the Philosophical Transactions of 1736. It was Henri-Louis du Hamel du Monceau who made use of this knowledge to demonstrate the growth of bone and the method was further tested by the celebrated Swiss anatomist, Albrecht von Haller (1708-1777). Haller's influence was dominant in the school of William Hunter and it was his ideas rather than those of du Hamel that inspired John Hunter. He accepted Haller's opinion that new bone was laid down by the finer arteries; arteries were bone-masons, but the opinion that bone was absorbed by the open mouths of lymphatic vessels was his own. He used to tell his students:—

"I really believe the absorbants have mouths and swallow the substances they take hold of."

Readers of Hunter's lectures have always been inclined to smile on reading the explanation he gives of how and why a useless piece of bone is absorbed:—

"The remote cause of absorption of whole and living parts implies the existence of two conditions, the first of which is a consciousness in the part to be absorbed. . . . The second is a consciousness of the absorbents of such a state of the parts. . . . Both these concurring, they have nothing to do but fall to the work."

Now, although we now know that bone is laid down by osteoblasts and not by arteries and is absorbed by osteoclasts and not by open-mouthed lymphatics, we do not yet know why some living bone cells should act as osteoblasts and others as osteoclasts. But we must postulate a species of

consciousness—a susceptibility to stimulus of some hormonic sort, in living bone cells which turns them either into osteoblasts or osteoclasts.

When Hunter cut a section of the bone of a madder-fed pig and examined it minutely, he made an observation of great moment :—

> " But in the full grown state, it would appear from the circumstances of reddening a whole bone by feeding the animal with madder, that a bone, although completely formed, yet is changing its earth, and probably every other part. This effect, however, is much slower than in the growing bone. The new matter that is deposited in an old bone is to make up for the waste that is daily going on in it ; but in a very old bone the waste is more than the repair."

Unfortunately, madder-stained bones lose their colour in the course of years and the many preparations that Hunter made at Earl's Court to illustrate the processes of growth and absorption now show very little

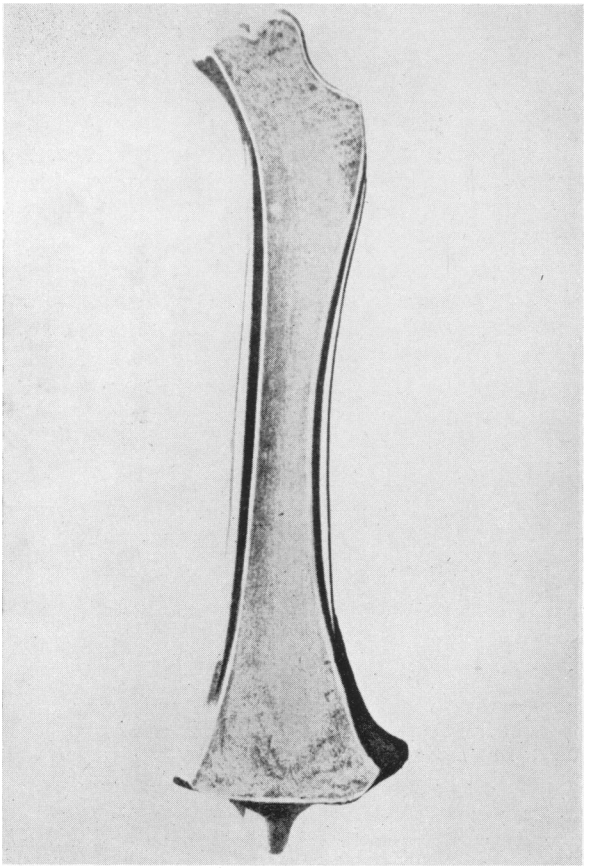

Fig. 6. Physiological Series No. A 105.1. Drawing by William Bell, John Hunter's assistant, of a section of the femur of a Hog that had been fed on Madder.

trace of the red colouration (Fig. 6). In 1912, Mr. R. H. Burne, F.R.S., who died in 1953 after half a century of service to our museum, made a further series of specimens using the procedure followed by Hunter. As we then had no Earl's Court of our own, Captain Mee, a farmer, very kindly permitted the experiments to be made on some of his stock. Ten years later, it was found that the colour had faded even from these specimens and Mr. Burne took the trouble to prepare a further series in 1923. The madder method of demonstrating bone growth has been employed many times since, notably by Professor J. C. Brash of Edinburgh University.

Linked up with the question of bone deposition and bone absorption is the problem of how the antlers of the deer are formed and shed. In our Museum are no less than 25 preparations that Hunter made during his investigation of this process. His chief interest was the " call " that the growing antler could make on the body for a vastly increased supply of blood ; he noted how the branches of the external carotid artery grow in number and size as the antlers begin to form. He regarded the " stimulus " which gave rise to this arterial increase as being similar to the " stimulus of impregnation " which gave the pregnant uterus its ten-fold blood supply. He appealed to his doctrine of " sympathy " to explain what we now seek to account for by our theory of hormones. On the other hand, although the blood supply is increased and the vessels become proportionately enlarged and though, as Hunter says, " there appear to be more actions taking place . . . the nerves do not seem to undergo any change."

It was in the early part of the year 1785 that he was engaged on this study of the growing antlers and he came to the conclusion that in the animal body there was a power that would summon a new supply of blood to an actively growing part or to one suddenly deprived of its normal blood flow. This could be accomplished by an increase in the volume of the collateral arteries and an increase in the number of anastomoses between terminal vessels. Hunter remarked :—

> " All the uses arising from the anastomosing of the vessels are, perhaps, not yet perfectly understood ; general reasons can, I think, be assigned for them, but these will not apply to all cases : there is something, therefore, more than we are yet acquainted with."

Obviously, Hunter suspected that there was still much to be learned about vascular anastomoses and it was his studies of this problem and his belief that anastomoses would be formed and a collateral circulation opened up when operating on a sound piece of artery that led to his successful operation for aneurysm. It was therefore in this same year, 1785, that Hunter performed his first operation of tying the femoral artery for treatment of popliteal aneurysm. It is interesting to note that one of his American pupils at this time, Dr. Wright Post, was the first to perform this same operation in America, following the method advocated by John Hunter. He carried the idea still further and successfully ligated both the common carotid and the subclavian arteries. Abernethy and Astley Cooper had both tried unsuccessfully to perform the latter operation.

Thus far, nothing has been said of Hunter's inborn gift of devising experiments to prove the truth or falsity of his opinions. In the following passage he reveals how his mind worked :—

> " In pursuing any subject most things come to light, as it were, by accident, that is, many things arise out of investigation that were not at first conceived, and even misfortunes in experiments have brought things to our knowledge that were not, and probably could not have been previously conceived ; on the other hand, I have often devised experiments by the fire-side or in my carriage, and have also conceived the result ; but when I tried the experiment the result was different, or I found that the experiment could not be attended with all the circumstances that were suggested."

Of Hunter's many pupils, one of the few who possessed his gift and love of experimentation was Astley Cooper (1768-1841), of whom Sir Russell Brock has published so excellent a biography. From Sir Russell we learn :—

> " Although Hunter was the first to suggest and practise simple proximal ligation, there is no doubt that Astley Cooper did more than any other surgeon to expand, extend and consolidate the application of the principle. His first animal experiment was a study of the effect of femoral and brachial ligation on a dog and was done when he was still a student (1786) ; the dog was afterwards sacrificed and injected so that the collateral circulation could be studied."

Some of the specimens prepared by Sir Astley Cooper during these experiments are still in the Museum. When he was appointed lecturer to Guy's at the age of 23 he emptied his classroom by expounding the principles he had learned from Hunter ; he filled it to overflowing when he first reported a clinical case and then applied it to Hunter's teaching. He was a brilliant lecturer, perhaps equalled in more recent times by Frederick Treves (1853-1923) who, however, lacked his originality. In earlier years, Astley Cooper carried out his dissections and his experiments in convenient outhouses near his London residence ; in 1811, at the age of 43, he acquired a large farm, Gadesbridge, near Hemel Hempstead in Hertfordshire, where he spent weekends on research. Gadesbridge was, for him, an Earl's Court.

It would take 20 lectures, not one, to do justice to the experiments carried on at Earl's Court during the 28 years Hunter was occupied there. But there is one set which has a current interest which I must briefly note, namely his investigations on the subject now known as Hypothermia. Hunter tried to discover whether animals exposed to extremes of cold recovered completely when the temperature was raised again. Here again we meet with an instance which illustrates Hunter's fervid and romantic imagination. His freezing experiments must have been amongst the earliest he did at Earl's Court, for his first was done in 1766. Of the 44 experiments he has described, it will be sufficient to confine our attention to the first :—

> Two carp were put into a glass vessel with common river water and the vessel was put into a freezing mixture. The water surrounding the fish froze very rapidly on the inside of the glass all round. When the freezing process

approached the fish it became as it were stationary ; and the remaining water not freezing fast enough, in order to make it freeze sooner I put in as much cold snow as made the whole thick. The snow around the carp melted. I put in more snow, which melted also. This was repeated several times, till I grew tired, and I left them covered up to freeze by the joint operation of the mixture and the atmosphere. After having exhausted the whole power of life in the production of heat, they froze ; but that life was gone could not be known till we thawed the animals, which was done very gradually. But with their flexibility they did not recover action, so that they were really dead.

As with so many of his experiments, Hunter was not concerned solely with the results as affecting the particular subject of the experiment but was anxious to apply the same principles to the solution of other problems and particularly those affecting mankind. He was disappointed in this particular investigation for he hoped to find that life would not be destroyed even after long and appreciable reduction of body temperature. He observes :—

" Till this time, I had imagined that it might be possible to prolong life to any period by freezing a person in the frigid zone, as I thought all action and waste would cease until the body was thawed. I thought that if a man would give up the last ten years of his life to this kind of alternate oblivion and action, it might be prolonged to a thousand years ; and by getting himself thawed every hundred years, he might learn what had happened during his frozen condition. Like other schemers, I thought I should make my fortune by it ; but this experiment undeceived me."

It is said that while his friends William Lynn and Benjamin West were keeping themselves warm by enjoying a bout of skating on the Serpentine, Hunter stayed at home freezing his fingers in pursuit of this, his philosopher's stone. It is to be assumed that he was too drastic in his freezing experiments for it is well known that animals can recover normal action after material reduction of temperature and, of course, freezing as an anaesthetic has long been used in minor surgery and, more recently, to a limited extent in cardiac surgery. Hunter, however, did not regard the experiments as being entirely profitless for from them he made many interesting observations on animal heat, one of which was that :—

" . . . the living powers of the animal will not allow their heat to be diminished much beyond 32 degrees. Whenever the surrounding cold brings them so low, the power of generating heat takes place ; and if the cold is continued, the animals exert this power till life is destroyed ; after which they freeze, and are immediately capable of admitting any degree of cold."

And elsewhere he says :—

" The act of freezing, simply, does not kill either vegetable or animal ; it is the quantity of cold that kills. A vegetable that cannot bear the cold of 50 degrees (Fahr.) dies, although it is not frozen . . . but a vegetable that can live in a cold of 10 degrees may freeze at a cold of 15 degrees but will not die."

At an early stage of these experiments, Hunter had a special thermometer made, very similar in size and make to the modern clinical instrument and graduated on the Fahrenheit scale. The maker was Jesse Ramsden (1735-1800), a Fellow of the Royal Society and Copley Medallist, a practical optician famous as an instrument-maker throughout Europe.

When he was urging Edward Jenner to carry out experiments on the heat of vegetables and animals, particularly the hedgehog, Hunter sent him one of these thermometers so that his readings would be accurate and comparable with his own. Hunter regarded 99 degrees as the normal temperature of man, though his own temperature, taken under the tongue, he found to be 97 degrees. Although there are constant references to his use of this small instrument, so similar to the modern clinical thermometer, in testing the temperature of his trees in winter and in summer, of the hedgehog and the bat in their various states of dormancy, and on all his experimental animals, there is no record of his ever having used it as a clinical instrument either in hospital or on his private patients. Clifford Allbutt (1836-1925) is usually given the credit of introducing it into English practice but it is almost certain that such an instrument was used almost a century earlier, as for instance that of John Aikin of Warrington (1747-1822), an example of which we have in the surgical instrument collection in the College.

Hunter never deferred an experiment on the ground of expense. He kept a flock of geese for 15 years because the goose egg, when incubated, gave better opportunities of studying the development of the embryo than the fowl's egg ; he vainly spent money in trying to get a supply of ostrich eggs for this purpose. He kept bees, not for honey, but in order that he might study their habits ; his goats, she-asses, sows and ewes, after they were served by the male, were sacrificed at stated intervals in order that he might trace the resulting modification of the generative organs. He made prolonged experiments on his sows to see whether, if one ovary is removed, the other undergoes an increase of function. He gives the result of this experiment, which he estimated had cost him £200, as follows :—

> " From this experiment it seems most probable that the ovaria are from the beginning destined to produce a fixed number, beyond which they cannot go, although circumstances may tend to diminish that number ; but that the constitution at large has no power of giving to one ovarium the power of propagating equal to both . . ."

He notes, however, that :—

> " . . . the constitution has so far a power of influencing one ovarium as to make it produce its number in a less time than would probably have been the case if both ovaria had been preserved."

When he was interested in the structure and oeconomy of whales, he engaged a surgeon to accompany the whalers to bring back specimens he was in need of. It is suggested that this surgeon was John Sheldon, Professor of Anatomy to the Royal Academy and a pioneer in ballooning, who had a notion of capturing whales with poisoned harpoons. Whoever it was that Hunter engaged—at considerable expense—he was greatly dissatisfied with the results for, he says : " the only return I received was a piece of whale's skin with some small animals sticking upon it." This specimen is still preserved in the Museum and Stephen Paget notes that it

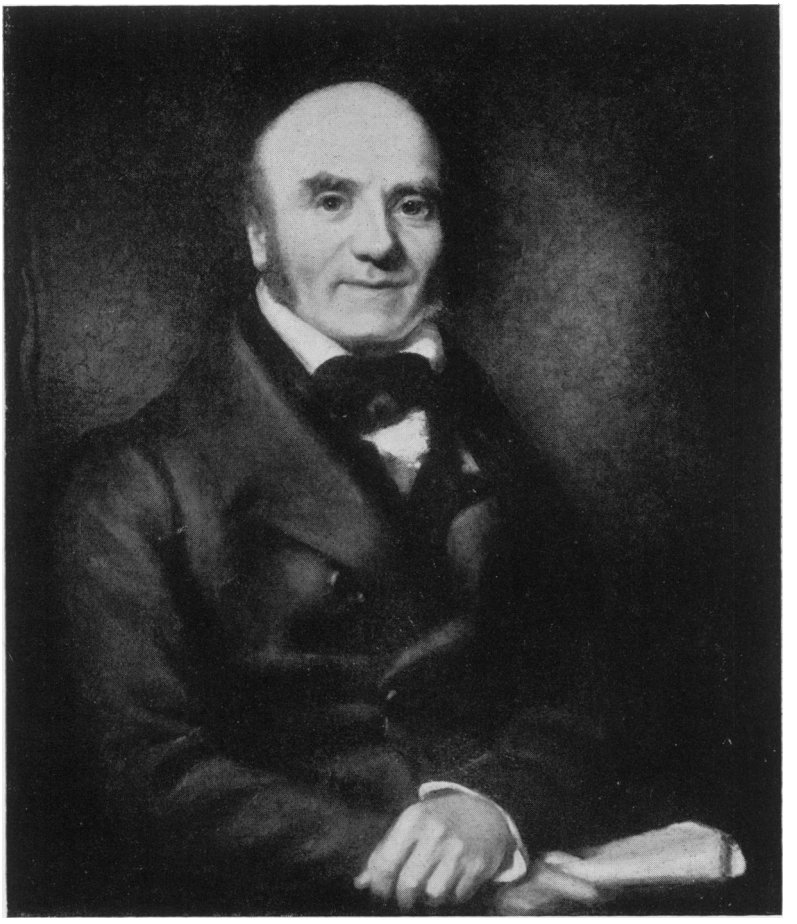

Fig. 7. An oil painting of William Clift, by Henry Schmidt.
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is said to have cost £500—the same sum as that paid to obtain the body of the Irish Giant, which was conveyed to Earl's Court in Hunter's own carriage.

Were John Hunter to reappear in our midst, there is no doubt that his first concern would be the fate of his Museum. We need no further evidence of his realisation of the value of this collection than the fact that he desired that it should be preserved intact and not sold piecemeal as were so many other fine museums of that period. During Clift's (Fig. 7) brief apprenticeship, so unfortunately curtailed by his master's death in 1793, he too had become so imbued with the unique nature of his precious charge that he spared no efforts during the rest of his working life—no less than 50 years—in maintaining and extending it, keeping always in

Fig. 8. Professor Frederic Wood Jones, Sir William Collins Professor of Human and Comparative Anatomy from 1946 to 1952 and subsequently Honorary Curator of the Hunterian Museum.

mind the fact that the Museum should be preserved in the order and with the aims that Hunter had laid down in his original arrangement. It is interesting to note that it is only during the last year that Clift's life, written by Miss Jessie Dobson, has been published. We have been fortunate to have as conservators during the 150 years during which the Museum has been in our charge those who have striven to uphold this ideal and the College has reason to be abundantly grateful to these faithful guardians, William Clift, Richard Owen, William Henry Flower and, in more recent years, Sir Arthur Keith and his " first and best pupil," Professor Wood Jones, whose death a few months ago we still mourn (Fig. 8). Professor Wood Jones's association with the Museum began when he was a student and we still have many hundreds of specimens that he has presented to us during the last 30 years. Of the succession of distinguished conservators

from whose loyal service the College has derived such benefits, there has never been a more fervent upholder of the Hunterian tradition nor one who has achieved as much and contributed so materially to our knowledge of comparative anatomy. Of him, as of John Hunter, it may well be said " He sought for truth, for truth's sake alone : is there a nobler aim in life ? " Many of you may not know that he visited the College on the morning after the bombing of May 1941, and he returned to Manchester sadly distressed by the havoc that he had seen here. It was indeed fortunate for us that he was willing to accept the invitation of Sir Hugh Lett to undertake the reorganisation and restoration of the Museum and we must express our indebtedness to Sir William Collins and Lord Webb-Johnson for making his continuation of this work possible. Impaired though his health was during the last two years, he devoted all his energies to this task. The last lecture that he gave in this College—" John Hunter as a Geologist "—was in essence a Hunterian Oration and it is the duty of those who remain to see that his ideals no less than those of John Hunter are preserved.

Hunter's next enquiry might well be to know the provision we have made in our laboratories for the kind of research in which he believed. Especially would he welcome the " Earl's Court " which the beneficence of Sir Buckston Browne (1850-1945) made it possible for us to establish at Downe, in Kent. As it was my privilege to enjoy the intimate friendship of that public-spirited man, I welcome this opportunity of paying a tribute to his memory.

George Buckston Browne was born in Manchester in 1850, the only son of a well-known medical man, Dr. Henry Browne, Physician to the Manchester Royal Infirmary and Lecturer in Medicine to the Manchester Medical School. Dr. Henry Browne represented the fourth generation of a medical dynasty where son had succeeded father, the founder of the family having been Dr. Theophilus Browne, of Derby, who was a fellow townsman and contemporary of Dr. Erasmus Darwin, grandfather of Charles Darwin. One of Theophilus Browne's sons was Frederick Browne who was a pupil of John Hunter at St. George's Hospital in 1778 and died four years later at the age of 24. Mr. Buckston Browne continued the family tradition, representing the fifth medical generation. In 1866, at the age of 16, he matriculated as a student of London University, entered University College, was awarded medals in Anatomy, Chemistry and Midwifery, gained the gold medal for practical chemistry and the Liston Gold Medal in Surgery. He became a member of the Royal College of Surgeons in 1874, and gained in open competition the house-surgeoncy to his hospital where he served under Sir John Erichsen. He also taught anatomy under Professor George Viner Ellis. No one ever trained himself more thoroughly for his profession. After his term in hospital, Mr. Buckston Browne was invited by Sir Henry Thompson, one of the most distinguished and accomplished surgeons of the Victorian era,

to become assistant, and afterwards collaborator. In 1884 he began practice on his own account, and became very closely, and very successfully, engaged in work. Indeed, his application to his profession was such that in 27 years, in the earlier period of his career, he had neither a free day nor holiday. Mr. Buckston Browne contributed important articles to the literature of his profession, including the Harveian Lectures delivered before the Harveian Society of London in 1901. But it was his practical ability, unerring insight, and skilled hand which gained him his success and the esteem of his colleagues and of his patients. In 1926 the Council of this College conferred upon him the Diploma of Fellow in recognition of his services to surgery.

In 1928 Mr. Buckston Browne purchased Down House and grounds (23 acres), restored and endowed them, handing all over to the custody of the British Association for the Advancement of Science. In making Down House a national gift the donor had two aims in view : (i) that it might be perpetuated as a memorial of Darwin ; (ii) that it might be used for the advancement of knowledge ; Darwin had so used it. There was an idea at one time that the College of Surgeons might obtain permission to build an " Earl's Court " on the grounds of Down House. In a small way this idea took root in the autumn of 1930. A need had sprung up in the tissue-culture laboratories of the College for eggs and fowls of known parentage. To meet this demand the Conservator, Sir Arthur Keith, obtained permission from the Council of the British Association to erect two fowl houses and stock them. These were financed from the " Conservator's Fund," which represented a donation of £105 given by Lord

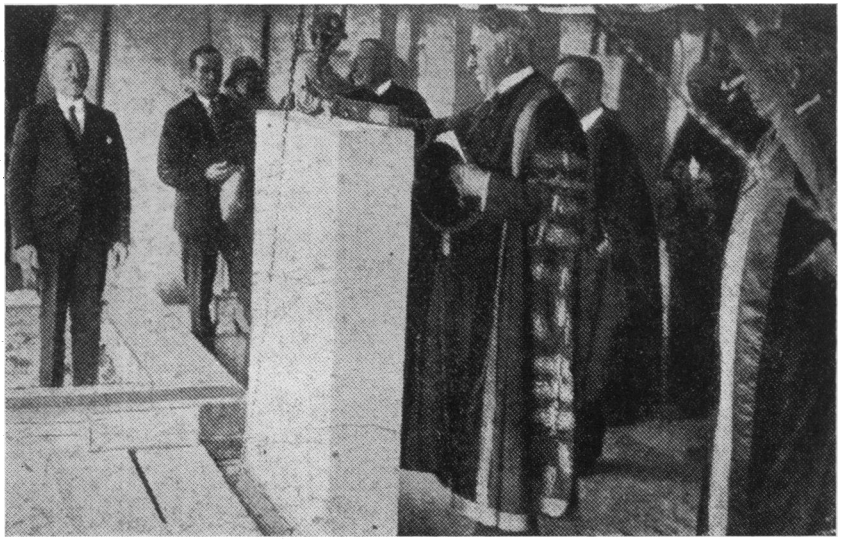

Fig. 9. Lord Moynihan laying the Foundation Stone at the Buckston Browne Farm on July 8 1931.

Moynihan in 1929 to be spent by the Conservator on minor purposes connected with the welfare of the Museum. This fund being nearly depleted when the purchase of fowl houses had to be made, Sir Arthur Keith appealed to Mr. Buckston Browne, who added £50 to it. The next event happened at Christmas time, 1930. Two fields, flanking the western side of the Down House property, came into the market to be sold as building sites. The larger of these fields, 11 acres in extent, lay along the western side of Darwin's sand-walk ; the smaller field, measuring two and a half acres continued the sand-walk field northwards until the road leading from the village of Downe to Leaves Green is reached. As the

Fig. 10. Sir Holburt Waring, P.R.C.S., with Sir Arthur Keith and Sir Buckston Browne on the occasion of the opening of the Buckston Browne Farm in July 1933.

smaller field lies alongside the orchards attached to Down House, it is known as the Orchard Field. When these fields came into the market Mr. Buckston Browne purchased them, believing they would afford an excellent site for the " Earl's Court " of which this College stood in need. He wished also to preserve the amenities of Darwin's home and maintain the sand-walk field as an open space. These fields he conveyed as part of his gift to the Royal College of Surgeons, hoping that they might prove suitable as a site for the proposed Biological Station. Nor was he unmindful of the fact that if the new station was built near to Down House the name of Hunter would become linked to that of Darwin.

Early in 1931 Mr. Buckston Browne informed the President of the College, Lord Moynihan, that he desired to confer a benefit on his profession, that he was in sympathy with those who wished to advance the art of surgery by biological enquiry, that the scheme of erecting and equipping a Biological Station in the country in connection with the Museum of the College made a strong appeal to him, and that he was prepared, should the Council of the College so desire, to convey to the College a large part of the fortune he had acquired in the practice of his profession in order that such a station might be built, equipped, and endowed. When the Council met on February 18 1931, the President read a letter from Mr. Buckston Browne in which he offered to give £50,000 at once for the building and endowment of a Biological Research Station,

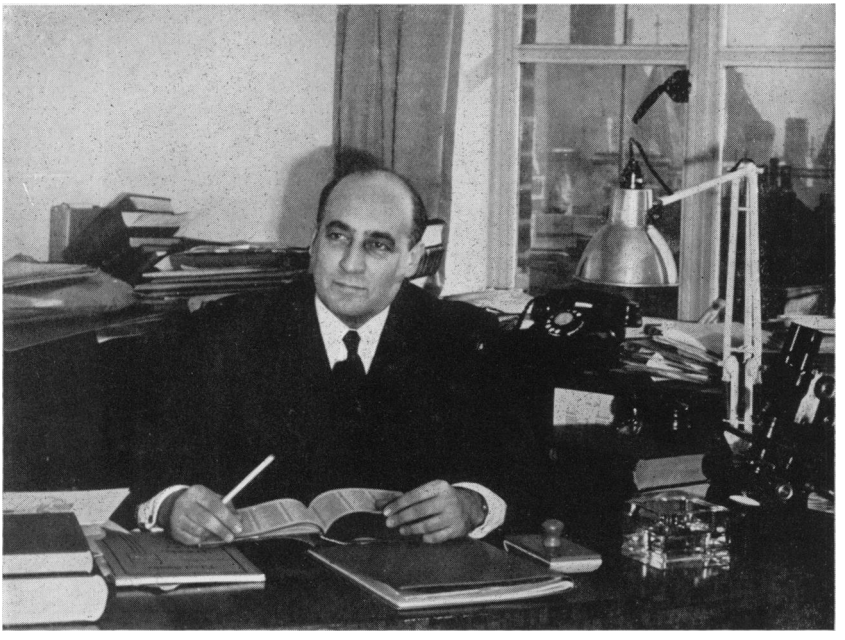

Fig. 11. Professor David Slome. 1954.

with a promise that his gift would ultimately reach a sum of £100,000. The Council warmly accepted Mr. Buckston Browne's munificent gift—certainly the most beneficent which any surgeon has ever made for the advancement of his own profession.

The foundation stone of the Buckston Browne Farm was laid by Lord Moynihan on July 8 1931 (Fig. 9), and the Farm was opened by Sir Holburt Waring, who was President of the College, on July 12 1933 (Fig. 10).

In 1932 Sir Arthur Keith was appointed Master of the Farm, a position that he held until his death on January 7th of this year. We have abundant cause to be grateful to him for his invaluable service to the College as Conservator of the Museum from 1908 until 1932 and as Master of the Buckston Browne Research Station; a full appreciation of his life and work appears elsewhere in this issue. Sir Arthur was assisted in his duties at the Farm by Professor David Slome, Bernhard Baron, Research Professor, a most able exponent of the true "Earl's Court" traditions (Fig. 11).

On this confident note, then, I will close, knowing that Hunter would fully approve our efforts to preserve his two most precious treasures, his museum and his ideal of research.

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