The Hunterian Oration

ON

JOHN HUNTER (1728-1793): HIS AFFAIRS, HABITS, AND OPINIONS.

DELIVERED AT THE ROYAL COLLEGE OF SURGEONS,
FEBRUARY 14TH, 1923,

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My knowledge of John Hunter began in a curious way. In my ninth year I was taken to his famous house at Earl's Court and shown the den in the garden where he kept wild beasts in order to study them. Being fond of animals, this made a deep impression on my mind. In the simple religious exercises of my childhood, the story of Adam and Eve, the first keepers of a zoological garden, and the famous exploits of Noah, collector and preserver of wild animals, had great charm for me. Some years later the visit came vividly to my mind on finding a dilapidated copy of Otteley's *Life of Hunter*, which I read eagerly. Ever since I have been deeply interested in all that relates to this extraordinary man, and the preparation of this Oration has been to me a delightful and engrossing occupation.

LONG CALDERWOOD (1728-1748).

John Hunter was born at the farmhouse Long Calderwood, near Glasgow. The house bears a tablet to the effect that he was born February 13th, 1728. In his lifetime the birthday was kept on February 14th, and this College drinks to his

FIG. 1.—The nerves on the nasal septum. (Hunterian.)

memory in "Solemn Silence" on the 14th. Like myself he was probably born so late at night that in the hurry-scurry the midwife failed to notice whether he appeared just before or shortly after the clock struck twelve.

John, or Jockie, as he was called at home, the youngest of a family of ten, petted by his mother (his father died in 1741, aged 78), disliked school and hated books. He preferred to lead an out-of-doors life, looking after nests, insects, and animals, whilst his brothers got the same education as country gentlemen.

At the age of 17 he spent some months with a brother-in-law, a timber merchant and carpenter in Glasgow, and we can well believe he tried his hand with tools; his mother noticed that the "lad showed neatness of hands and quickness of perception in anything that regarded mechanism." What inquisitive boy has not meddled with awls and gimlets, mallets and chisels, hammers and nails, saws and planes?

Sharp boys can learn much that is useful in workshops, and a training in joinery teaches neatness and precision. Looking back it is instructive to consider how the farm life fitted John Hunter for his subsequent career. The practical surgeon is a craftsman; Greek and Latin are useful to him for polish, but think of the natural knowledge a smart boy can collect on a farm about sowing, sprouting, and the

ripening of crops; the breeding of animals, gelding of colts, spaying of pigs, caponizing of cocks, fattening and slaughtering of animals for food; farriery—shoeing and doctoring of horses; the wild life in ponds and ditches, fields and hedgerows, trees and heather. In the village he can watch the wheelwright, smith, tinker, glazier, cobbler, and cooper, all experts with simple tools.

Practical knowledge of this kind was useful in that state of life unto which William Hunter called his youngest brother.

HUMAN ANATOMY (1748-1760).

At the age of 20 John Hunter came to London with the object of assisting his brother William, who had a school of anatomy at the back of his house in Covent Garden. John showed unusual skill in dissecting, worked hard, liked the companionship of men of his own age, and was fond of the theatre. There can be no doubt that he was an example of the medical student skilfully described by Dickens in *Pickwick Papers* (1836) and Albert Smith in *Punch* (1841).

Human anatomy appealed to this uncouth Scot, and William Hunter, a cultured man, moulded John's character and "bred him to anatomy" in its widest significance, with astonishing results.

In the summer of 1754 Hunter was busy studying the routes by which the branches of the fifth nerve leave the

FIG. 2.—Section of a rabbit's nose exposing Jacobson's organ. (Klein.)

skull—a fascinating exercise. He unravelled the branches of the olfactory nerve, traced the course of the naso-palatine nerve, and the rambling nerve known as the nasal branch of the ophthalmic division of the fifth. A specimen (Fig. 1) he dissected to show these nerves exists in the museum, in excellent condition.

Hunter's attention was arrested by the uniformity in the course and distribution of nerves. Even now, few grasp the problem presented by the branches of the olfactory nerve which run down the anterior border of the nasal septum. In 1811 Jacobson, a surgeon in the Danish army, discovered a curious organ lodged in a scroll of cartilage situated on the anterior part of the base of the nasal septum (Fig. 2).

Jacobson's organ—a vestige in man, apes, and whales—is well developed in many mammals. Little is known of its function, but the specialized cells lining its cavity receive the olfactory twigs detected by Hunter. Jacobson's organ is well developed in mammals with long snouts, especially insectivora that find food at dusk; rodents whose young are born blind and live in deep burrows; and kangaroos, whose young must find their way into, and pass many weeks snugly ensconced in, the mother's warm pouch.

The prime service of olfaction is the quest for food, and is of first-rate importance to mammals born blind—it enables

them to find the teats of the mother. The vomero-nasal is subsidiary to the olfactory organ.

The morphology of the canals and foramina by which the cranial nerves leave the skull has always fascinated me, and many delightful hours of my life have been spent in unraveling the secrets connected with their methods of exit, re-

FIG. 3.—Segment of an eel showing the ovary. The bristle marks the end of the rectum and the abdominal pore. (Hunterian.)

entrance, and final escape from the skull. The study interested Hunter, apart from its morphological aspect. In his day vestiges were merely anatomical curiosities. How much greater the interest for us to unravel these curious courses in the light of man's evolution!

For Hunter morphology was a gleam in the intellectual sky. We revel in the sunshine; Morphology has become the Soul of Anatomy.

Many regard the dissection of the human body as a repulsive exercise. Many begin to dissect with disgust, but overcome the distaste and continue the study because it fits them for the medical profession. Some

who have found difficulty in retaining or appreciating the facts of anatomy have shone in other professions. On the other hand, men unable to grasp mathematics or the principles of physics have become proficient anatomists. In a few instances men working at a humdrum calling turned to anatomy more or less accidentally and pursued it with zeal and success.

It is easy to understand that the unschooled, apparently idle, Jock Hunter, when introduced to the dissecting-room, became interested in the structure of the human body and found it an absorbing study.

Verily the gunpowder of genius is stored in many minds, but—it needs a match!

BELLEISLE AND MARINE ZOOLOGY (1760-1762).

Hunter during the first period of his life in London (1748-1760) acquired a practical knowledge of human anatomy, but this was mainly a study for the winter months. During the summer he studied surgery, following Cheselden for a season, also Pott, but St. George's Hospital offered better chances, and he joined as surgeon's pupil, and later had the good fortune to serve as house-surgeon for two years—an invaluable experience.

Whilst engaged in the routine of dissecting and teaching he developed a taste for comparative anatomy, which became an absorbing passion, enhanced by a change of locality. In the spring of 1759 he had some lung trouble, which made it necessary for him to seek change of climate. In 1760 a force was sent from England to take Belleisle, near the mouth of the Loire. Hunter applied for an appointment with the expedition and served as staff surgeon. This gave him the chance of obtaining practical knowledge of gunshot wounds.

Belleisle, well named, is a pretty island, now almost treeless. It is a plateau of 33 square miles about 130 feet above sea-level; here and there slopes give access to beautiful tracts of white sand. The coast has many grottoes. The most remarkable is La Grotte de l'Apothicaire, a sanctuary for sea birds; their nests in rows on ledges of the rocks are supposed to resemble bottles on the shelves of a pharmacy.

I spent a week on this lovely island and realized what a change it proved for a man from London ardently pursuing

comparative anatomy, a country new to him in flora and fauna. He took advantage of it by observing, collecting, dissecting, experimenting, preparing and preserving specimens. Hunter had no knowledge of marine zoology until he landed on this island, which afforded him access to barnacles, sea squirts, sea nettles, sea stars, sea anemones, sea cucumbers, sea urchins, huge spider crabs, tunny fish, and conger eels.

While studying and dissecting these animals the idea came into his mind that living things could be arranged in a physiological series, but he was puzzled to ascertain the use of strange organs he met with in marine invertebrata.

Like Cuvier he had to rely on naked-eye dissection, but dissection, however skilful, does not enable anatomists to determine minute structure of soft organs, which is the key to function. These difficulties are shown in Hunter's studies of the reproductive organs of eels. He truly observes, "the production of animals out of themselves excites wonder and curiosity." The precise manner in which it is carried out has required centuries of observation for its demonstration. The eggs of flies, butterflies, fishes, frogs, turtle, crocodiles, snakes, and birds appeal to the simplest mind.

It was difficult to prove that mammals came from eggs, for their small eggs require a microscope to make them visible. This is true of mice and men.

In London he got eels every month of the year from a fishmonger and examined the parts he expected to be the ovary with a magnifier, but without result. In the summer of 1761 there was a vast number of conger eels in the sea around Belleisle; he dissected many and satisfied himself that the ruffle-like organs he regarded as ovaries in the common eel were indeed ovaries (Fig. 3), but he did not solve the mystery of the propagation of eels.

In 1896 Grassi discovered that eels need salt water for the development of their reproductive organs, and the deep

FIG. 4.—Drawing showing the change from a yellow eel with thick lips, small eyes, and compact fin, into the large-eyed silvery eel which migrates to the ocean, where it becomes mature, spawns, and dies. (From models in the Natural History Museum.)

sea is their spawning place. In autumn they migrate to the sea and the dull yellow of their skin changes to silvery glitter; the eyes enlarge, the pectoral fins become black and change in shape, and the ova ripen (Fig 4). Mature eels cease to feed, and after spawning die.

Recently hatched eels, called leptocephali, are as transparent as glass, and the eyes shine through the water like black beads. When about 7 cm. long, leptocephali cease to

feed and change into elvers, which in spring find their way up the rivers in enormous numbers and in fresh water change into eels. These in their turn descend the rivers, seek the depths of the sea, where, decked in glorious sheen, they spawn and die.

Although Hunter did not get on well with his senior colleagues at Belleisle, he was comfortable on his pay, and enjoyed the opportunities for studying natural history, but in 1762 a British expedition to Portugal was the topic of conversation; he was keen to go, and his brother William helped him with the authorities in London to do so.

PORTUGAL AND GEOLOGY (1762-1763).

One of the last episodes of the seven years' war was an attempt on the part of France and Spain to invade Portugal. The French and Spanish forces were collected at Ciudad Rodrigo with the object of advancing on Lisbon.

England decided to support Portugal, and sent an expeditionary force of 7,000 men. The British and Portuguese troops, under the command of Count Schlaumburg-Lippe, an able officer trained in the school of Frederick the Great, assembled on the banks of the Tagus near the Spanish border. The outstanding feature of this almost forgotten campaign was the use for the first time of light cavalry, which General John Burgoyne was instrumental in introducing into the British Army. Under Burgoyne the cavalry rendered distinguished service at Valencia d'Alcantara, and in some sharp fighting at Villa Velha. The campaign was concluded by the peace of Paris 1763. Mr. Robert Boyne Home was the surgeon attached to the regiment of light horse.

John Hunter, transferred from Belleisle to Portugal, was in charge of a hospital; he landed at Lisbon in July, 1762, and in November was at Portalegre, near the Spanish frontier, 140 miles from Lisbon. General headquarters was at Estremoz, thirty miles south of Portalegre, on the direct road to Lisbon. Little is known of his doings in Portugal, and it has been supposed he made additional observations on gunshot wounds; for this there was not much opportunity, but with a force of 7,000 men there would be accidents and sickness incidental to a campaign in a foreign country.

It is certain that in Portugal Hunter made observations of natural history and collected specimens, some of which are preserved in the museum, but the most important gain was an inspiration to study geology. The hill on which Portalegre is built belongs to a remarkable plateau called Alemtejo (spelt Alentejo in 1763). In an extraordinary tract published about fifty years after Hunter's death, under the title *Observations and Reflections on Geology*, he refers to the extensive plateau called Alentejo, which shows evident signs of its surface being covered by the sea, and to the enormous heaps of granite so frequent on the plain. The tract not only contains remarkable observations on geology but some ideas on the distribution of animals in relation to the antiquity of the world inconsistent with the creation as described in Genesis. He abstained from publishing them on the advice of friends.

Recently I visited Portalegre, the Alemtejo, and the sur-

rounding country, and satisfied myself that Hunter while living on the plain had many inducements to study botany as well as geology, for he was among a subtropical flora, and at Lisbon had excellent opportunities for collecting specimens and adding to the knowledge of marine zoology he had acquired at Belleisle.

Hunter's domestic life was influenced in an important manner by the affairs of Portugal, for Home, surgeon to Burgoyne's regiment of light horse, became his friend. Returning to England, he got engaged to Home's daughter Anne. It was a long engagement, for they were not married till 1771. Mrs. Hunter's younger brother Everard became Hunter's house-pupil, then his assistant, and finally executor. Sir Everard Home and Matthew Baillie founded the Hunterian oration in 1813, and Everard Home was the first orator (1814).

EARL'S COURT.

On the conclusion of peace Hunter returned to London, a staff surgeon and deputy purveyor on half-pay. He took a house in Golden Square and started to practise. His half-pay, probably half a guinea a day, helped to pay the rent. He opened a room for dissecting, made teaching preparations, and, while waiting for patients, like many of us taught human anatomy for capital and comparative anatomy for interest. The classes were neither large nor lucrative, for he was not a good lecturer.

In 1765 he bought the lease of three pieces of land at Earl's Court, built a house, established a small menagerie, and made observations and experiments—

On gizzards of gulls,
hawks and owls,
The heat of lizards, spurs
of fowls;
Bones of pigs, air sacs
of eagles,
Moaning dingos, barking
beagles;
Sleek opossums, prickly
hedgehogs,
Buffaloes, dormice,
wolves and dogs.

Leopards and jackals
lived in the den; stallions,
sheep, goats, and rams
occupied the stables. A

mulberry-tree furnished leaves for the silkworms, and St. John's wort supplied pollen for the bees. There was a pond for ducks and geese which laid eggs for the table and for embryological study.

Hunter made observation hives for the bees, discovered that their wax was a secretion, and left some excellent notes on the relation of vegetables to animal fat. With the aid of Ramsden's delicate thermometers he discovered the significance of the terms "hot-blooded" and "cold-blooded" animals. He would have been astonished to learn that muscular action is the main source of animal heat. Hunter failed to grasp the importance of measuring the temperature of the body for clinical purposes. Indeed, the value of the clinical thermometer was not appreciated until the middle of the nineteenth century.

Earl's Court remained a bachelor's residence for seven years. In 1771 John Hunter, aged 43, married Anne Home, aged 29, a charming, amiable, and accomplished spinster, who in due course added to the physiologist's paradise the most delightful of all objects of natural history—children. Mrs. Hunter had a brother, Robert Home, an artist, who painted a portrait of Hunter which eventually came into the possession of the Royal Society. In 1787 Hunter read a

Fig. 5.—John Hunter, by Robert Home. The dog is supposed to be the offspring of a half-bred wolf bitch and an English mastiff.

paper before that society on some observations "tending to show that the wolf, jackal, and dog are all of the same species." The odd dog in the picture is supposed to be the offspring of a half-bred wolf bitch and an English mastiff. The dog died in 1782. The portrait represents Hunter about the age of 45. He describes himself at this period in a letter to James Baillie, his brother-in-law, as "one of the happyst men living" (1775), in spite of the fact that he had to raise money on the Earl's Court property, a fact concerning which Dr. G. C. Peachey has found unimpeachable documentary evidence.

Hunter was a resident at Earl's Court for thirty years. In 1877 the Royal College of Surgeons, and a few friends, placed a window to his memory in the north transept of St. Mary Abbot's Church, Kensington. One of the principal lights represents St. Paul in the island of Melita casting a viper off his hand.

THE MUSEUM.

Nothing is known of the time Hunter began to collect specimens with the definite object of establishing a comprehensive museum of comparative anatomy. The Museum owes its origin to the peculiar conditions under which medical education was carried on in London in the eighteenth century. Schools of anatomy were private ventures. It was necessary for a surgeon who owned and managed a school to illustrate his lectures with skilfully prepared specimens. Such preparations are more useful than diagrams, wax models, or drawings on blackboards, even when made with skill and coloured chalk.

Hunter made many preparations for his brother, and some exist in the Hunterian Museum at Glasgow, but when he returned to London in 1763 he brought with him specimens of natural history from Belleisle and Portugal, and they formed the nucleus of the comparative anatomy series. It is a fair inference that such specimens were collected for teaching purposes connected with his lectures, but the collection grew until it became a museum that could be regarded as a discourse on the human body in relation to the animal kingdom. Gradually its founder's ideas expanded, and he conceived that it would be an ample illustration of life exhibited in the vast chain of organized beings, living and extinct, by a display of the various organs in which the functions of life are carried on.

In 1783 the lease of the house (42, Jermyn Street) which he had acquired from his brother William expired. He then took premises in Leicester Square and built his famous Museum. Sir Joshua Reynolds lived in the square, and the two men subsequently helped each other to what artists jokingly call immortality—one as subject, the other as painter. When Baron Grant furnished Leicester Square and laid out the garden in 1874 a colossal bust of Hunter was placed in one corner and a bust of Reynolds in another.

Hunter's example in collecting specimens was contagious. Blizard, Astley Cooper, Heaviside, and other surgeons formed museums, but the specimens are dispersed. The care entailed in the upkeep and supervision of such museums is very great. Hunter's collection nearly perished. His executors, Matthew Baillie and Everard Home, when struggling young practitioners, with sound judgement retained the services of William Clift, who preserved the specimens from decay by the judicious use of two gallons of spirit occasionally. He had no books, so he read and made extracts from Hunter's manuscripts. The transcripts were made from some of the notes afterwards destroyed by Everard Home. They were published as *Essays and Observations* by Owen (1861). For seven years Clift received seven shillings weekly and meekly as wages. In return for these services he was made first Conservator when the Government bought the collection and entrusted it to the College in 1800. The Museum contains in orderly array big and little of every living thing Hunter could obtain: shrimps and sharks, tits and ostriches, shrews and whales; of the human kind dwarfs and giants. Animals

now living on the earth were not enough—he must have fossil forms. When John White returned to England (1790) from New South Wales "the nondescript animals, Kangaroo, Tapua Roo, and Potoroo" were handed to Hunter for investigation. It is now so rich in specimens illustrating the anatomy of vertebrates, living or extinct, normal and abnormal, that no one who is prudent ventures to publish anything he thinks new without examining correlated specimens in the Museum. It abounds in surprises, and is in a sense an anatomical Valhalla.

PATHOLOGY.

Specimens illustrating "diseased action" were preserved in the museum. Pathology is a department of Biology. Hunter's ideas of many pathological processes were crude; without the aid of a compound microscope, section-cutting and staining methods, his knowledge of tumours was not above that of the farrier. Shepherds talk of corns, warts, blains, wens, and blemishes. The slaughterhouse supplied him with melanotic tumours from oxen, and from the knacker's yard he got similar things from horses. Graveyards yielded calcified fibroids and tumours of bones.

In Hunter's day, and for many years afterwards, pathological specimens were mainly spoils from the dead-house; to-day they are prizes from the operation theatre. The history of surgical progress during the last fifty years can be traced in the Museum catalogue. The hall in the Museum that enshrines Hunter's statue is a temple of pathology, admirably arranged and catalogued by Shattock. It should stimulate surgeons to study the science as well as practise the art of surgery.

EMBRYOLOGY.

Hunter's keen interest in monsters was not mere curiosity, but part of a great scheme for showing the phases of Life. The collection of Malformations in the Museum is the most comprehensive in the world. He was aware of the importance of a knowledge of the developmental stages of animals, and applied himself to study the chick. He studied geese because their embryos are bigger than those of fowls. He tried swans, but could not get eggs enough. He tried to obtain ostrich eggs, but only got two in thirty years, and made nothing out of them. The flock of geese for embryological work was kept at Earl's Court for thirty years.

Although he obtained much first-hand knowledge from this work, and some excellent drawings, he discovered little of importance, but left among his notes, awkwardly expressed—for masters of science are rarely masters of style—

Embryology indicates the steps by which the higher forms in a group of animals have been evolved from a lower.

Thirty years after Hunter's death von Baer discovered the human ovum, and realized that embryology is the key to the knowledge of the human body.

Hunter collected books but read little. Probably he never read the *System of Philosophy* written by Lucretius, although both men reasoned on inexplicable things:

LUCRETIVS: "Before the horns of a calf appear and sprout, he butts when angry and pushes passionately. But the cubs of panthers and lions' whelps already fight with claws, and biting, when their teeth and claws are scarcely yet formed."

HUNTER: "A duckling runs into the water the moment it sees it. A hen with ducklings seeing them run into the water is unhappy."

"A duck with chickens tries to induce them to enter the water; they run about the bank."

In relation to these paragraphs it may be stated that incubators and serial sections aided by the most exquisite stains throw no light on instinct. Though dogs and pigs do not interbreed, maternal instinct may be so strong in a bitch that she will suckle a sow's orphans (Fig. 6).

Pity is not an exclusive attribute of gods and men.

FIG. 6.—Alsatian bitch, whose pups had died, suckling six little pigs. (*Veterinary Journal*, 1920.)

FEATHER-THICKETS.

In March, 1778, Hunter requested Jenner, his former pupil and friend, to watch a blackbird's nest, and remove the nestlings one by one on different days and preserve them in spirits in order to show the manner in which their feathers grow. He wrote details of the way in which the birds were to be treated, and Jenner carried out the instructions admirably, and the preserved nestlings are in good condition to-day (Figs. 7 and 8).

Forty years after Hunter's death Owen found among the MSS., transcribed by the faithful Clift, some notes on the situation of feathers:

Although the feathers of birds appear to be an entire and uniform covering, they do not arise equally from every part of the body, but only from such parts of the skin as are least likely to be affected by the motion of the contiguous parts, such as the motion

of the limbs. The feathers arise pretty equally on the head where there is no motion; and along the back, on the wings between joint and joint, and also on the thighs and legs, the whole making the bird a partial coat of mail. As they do not arise from every part of the skin equally they must be proportionally thickest where they do arise. The places of origin of feathers are very observable in a bird that has been plucked; but still more so in young birds just feathering, more especially of such as have little down, and of which the clump of feathers, from their colour, as in young blackbirds, present a great contrast with the skin. In the interstices of the clumps of feathers there are others disposed irregularly, but so sparingly as not to interfere with the motion of the part.

Hunter named each feather-thicket according to its situation. In 1883 Nitzsch, unaware of these observations, published a study of the distribution of feathers. He called the thickets pterylae—feather forests—and the featherless spaces apteria.

The arrangement of feather-tracts (pterylosis) is now used as an aid in the classification of birds. Oken cast ridicule upon it; he could not refrain from laughter when he looked in Nitzsch's book, since the plates reminded him of plucked fowls in a poulterer's shop! We must admit that the idea is comic. Newton, referring to this joke, adds: It might as well be urged as an objection to the plates in many anatomical books that they call to mind a butcher's shop!

Hunter had his gibe at the systematists, for in his opinion natural historians are more pleased if they can class an animal than they would be if they could find any use such an animal would be to society.

The value of pterylosis in classification depends on the fact that feather-tracts, like beaks and feet, are modified by the habits of the bird.

These callow blackbirds are as instructive as a parable. They prove Hunter's skill as a museum expert. The contrast in colour—black and white—is excellent, and the skill shown in mounting them undeniable. They were prepared in 1788, and remained in obscurity until Owen found them nearly fifty years later.

Hunter had great power of observation, but lacked the gift of exposition. His discovery was like a lighted candle under a bushel. Half a century later Nitzsch detected the value of pterylosis and urged its importance in spite of ridicule. It is one thing to make a discovery, but it is another to make con-

temporaries accept it, or appreciate its value. It is as hard to establish a truth as to eradicate an error.

THE HORSE.

Hunter studied the horse carefully as an anatomist and as

a surgeon. It was natural that he should study an animal that can walk quickly, amble easily, trot gracefully, or gallop with exceeding swiftness on limbs

each of which ends in a modified toe, or finger, and in spite of many anomalies be so useful to man. He was thoroughly familiar with equine anatomy, the teeth especially; left a careful description of the curious guttural pouches connected with the pharyngeal ends of the Eustachian tubes, and discovered the con-

jugal ligament, which connects the heads of the ribs or opposite sides of the spine. This ligament, well developed in the seal (Fig. 9), is homologous with the thick transverse ligament that not only keeps the odontoid process of the axis in position, but excites curiosity in every student when he sees it for the first time.

Hunter helped to found the Royal Veterinary College (1791); he was a vice-president, and with Cline served on a committee that approved of the appointment of Vian St. Bel as the first professor of the College. Among the first operations performed by St. Bel was one for the removal of "two accessory feet which grew from the fetlocks of the two forelegs." Hunter assisted and gave him some useful and friendly hints.

St. Bel died in 1793 from glanders. His early and unexpected death led to some difficulty, and Hunter, in order to help in the emergency, arranged for the students to have admission to the lectures of the leading teachers in the hospitals. The names mentioned in this connexion were Dr.

Fordyce, Dr. Baillie, Cruickshanks, and Everard Home. The directors of the College sent Hunter a letter of thanks for this help, which he acknowledged in a letter from Leicester Square, October 2nd, 1793, exactly two weeks before he died. This letter long remained a treasured possession of that College but it has been lost.

Hunter's coach was drawn by a pair of bay stone horses. Jesse Foot, his detractor, saw these horses in Piccadilly returning from the funeral at St. Martin's Church. The circumstance recalled to his

mind Virgil's account of the war-horse Aethon, in the funeral procession of young Pallas, shedding tears!

WHALES.

Whales are the biggest animals that exist or have existed on the earth, and their skeletons are the most impressive things in the Museum. Hunter recognized that whales are land mammals modified to live in the water. He dissected them when he got the opportunity and discovered their semicircular canal.

The organ of hearing in these huge mammals is modified in a remarkable manner. The pinna is absent; the meatus is narrow and, in some species, nearly obliterated. The tympanic is a shell of bone; the ossicles—malleus, incus, and stapes—are present. The tympanics are so loosely attached to the skull that when the bodies of whales decompose these bones

FIG. 7.—Callow blackbird. (Owen.)

FIG. 8.—Nestling blackbird. (Owen.)

FIG. 9.—Conjugal ligament of a seal.

fall away. In the central Pacific detached tympanics, petrosals, and shark's teeth litter the floor of the ocean. Hunter studied the semicircular canals of fishes before he went to Belleisle, and it is reasonable to believe that the structure of the internal ear interested him for thirty years.

Lillie in 1910 and 1915 made some dissections of the internal ear of whales, and explains the vestigial character of the external auditory meatus by suggesting that whales hear through their nasal passage, which opens on the top of their heads. The nostrils collect the sound waves to be conducted through the blow-holes to the huge guttural pouches and the Eustachian tubes, thence to the tympanic bullae, which act as sounding boxes and transmit the sound waves to the chain of ossicles.

The shell-like tympanic probably intensifies the sound waves in the water. There is no doubt that whales rely on the sense of hearing, and appreciate the pulsations caused by waves striking rocks, or the approach of an enemy. These shell-shaped bones are often kept as curiosities. One of them here is seen in Fig. 10; it was used as a paper-weight by a lady of fashion, yet it collected sound waves that enabled a mighty whale to move through unfathomable waters with the same certainty that the compass enables mariners to guide ships across the trackless ocean.

Intrepid whalers who have watched whales in the solitary ocean regard them as timid and inoffensive, with large brown eyes and affectionate in disposition to their young. This character does not apply to the toothed whale. The killer whale has a large dorsal fin, and there has been much speculation in regard to its use. Herman Melville in *Moby Dick* states that the flukes of whales are tactile organs of great delicacy. I believe that the median fin of a killer is a tactile organ. On watching a killer rise to the surface, this dorsal fin is seen to rise like the periscope of a submarine (Fig. 11).

Captain Wild has described to me tricks of *Orca* worthy of a crocodile. It is not easy for a killer to seize a seal on the edge of the ice, but he swims under it, and rising suddenly, breaks off a piece with the object of dislodging the seal. If the seal retreats, crafty *Orca* follows the animal as it lumbers over the ice and breaks off successive pieces in his endeavours to seize the creature. In such tricks the dorsal fin may be a reliable tactile organ like the whiskers of cats and the feelers of catfishes. Killer whales have formidable teeth, insatiable appetites, hunt in packs like wolves, and attack the biggest whales.

When Hunter died in 1793, and for many years afterwards, his skeletons of whales were the only examples existing in a museum in England. Imagine the enthusiasm of a surgeon actively engaged in practice, finding time for dissecting such huge animals, mounting their skeletons and housing them!

OPOSSUMS AND KANGAROOS.

Hunter kept opossums at Earl's Court, and about 1790, when he was studying the marsupials which John White brought from New South Wales, he wrote: "There is something in the mode of propagation in the opossums that

deviates from all others." He kept many alive, "yet never could get them to breed."

The manner in which the foetus gets into the pouch, after puzzling naturalists for more than a century, has received a simple explanation for opossums and kangaroos. Goerling of Perth, Australia, discovered in 1906 that when the embryo is extruded from the vagina it is blind, but the arms are well developed, the fingers furnished with claws, and it can open and close its hands like the paws of a cat. The foetus, which makes its way through the fur to the opening of the pouch, enters, finds a teat and fastens itself on with the powerful lips (Fig. 12).

The little wanderer travels through the mother's fur, moving the arms alternately as in swimming, and leaves a track in the fur which lasts some hours. In the pouch the little fellow finds protection, warmth, and nourishment, and remains there till the eyes are opened and it has donned a fur coat; then, as many have seen with delight at the Zoo, the little kangaroo looks over the rim of the pouch and gazes with curiosity on the world at large, and in a way that would

FIG. 10.—Tympanic of a whale.

have amused John Hunter.*

FOSSILS AND OWEN.

Belleisle and Portugal had much the same influence on Hunter as South America on Darwin, especially in relation to geology, and with unexpected consequences, for few suspected his interest in fossils, although they were often sent to him, especially by Jenner. The discovery of Hunter's collection of fossils is one of the romances of the Museum.

When Richard Owen in 1826 started practice as a surgeon near the College, Abernethy, concerned at the neglected condition of the Museum, induced his old pupil to assist in cataloguing it. In this way Owen became acquainted with Clift

and the collection. A few years later he married Clift's daughter, was gradually weaned from medical practice, and devoted himself to comparative anatomy. Whilst busy with the catalogue he unexpectedly found Hunter's store of fossils and displayed them in the Museum when it was rearranged in 1837. Startled by the number and variety of the specimens, he worked at them seriously. Nothing illustrates more thoroughly the parable of the sower than these fossils. Nearly all the seed sown by Hunter fell on stony ground, but

FIG. 11.—*Orca gladiator*. Though killer whales are evil-looking, they glide gracefully through the sea impelled by their powerful flukes.

some fell and grew in Owen's fertile brain. He dissected animals to enable him to study fossils, and became essentially a palaeontologist, revelling in the reconstruction of extinct creatures.

The Museum contains reconstructed skeletons of huge ground sloths; the gigantic armadillo with "an osseous coat in compartments," and the huge bird, the moa, towering over all. Skeletons of sloths, armadillos, turtles, crocodiles, ostriches, and emus stand in rows to demonstrate the truth of Owen's deductions. When these skeletons were "mounted" "evolution" and "mammalian descent" had not become the stock phrases of zoological zealots.

* C. G. Hartman discovered that the foetuses of the opossum (*Didelphys virginiana*) find their way into the mother's pouch in the same manner as the foetal kangaroo (*Anatomical Record*, 1920, xix, 25).

To-day zoologists include extinct as well as living animals in their lists. Before Darwin classification was a mania, since Darwin zoologists persistently endeavour to bridge gaps.

FIG. 12.—Young kangaroo hanging on the teat by its lips. (Museum, Royal College of Surgeons.)

Hunter's fossils turned Owen's thoughts to palaeontology and led men to take an interest in animals, huge and weird, that once moved about the earth and then passed into the twilight and silence of the past.

THE ORATION.

A man who achieves greatness in any calling inspires others to follow his example. No man retains prominence unless he has impressed others to believe in him and magnify his name. Those who have been closely associated with a masterful teacher and speak well of him are often mockingly called disciples by his contemporaries. Many who during the lifetime of a great investigator or a reformer were detractors are often loudest in appraising him when dead. When our friends are alive we hesitate to say much about them in their presence—except in after-dinner speeches. As soon as they are dead we are apt, in a paroxysm of sympathy, to overpraise their work. Hunter was in advance of his time; his contemporaries could not appreciate the value of his work, and some of his later admirers overrate it.

The delivery of the Oration is justified. It is necessary to remind men of their benefactors; even the holiest saints require to have their names preserved by shrines, chantries,

cathedrals, or festivals. Are there not saints' days in the calendar of every church—Protestant, Greek, or Roman?

Aesculapius had two famous sons: of these Machaon healed injuries, and Podalirius could recognize what was not visible to the eye and tended what could not be healed. They served with the army in the Trojan war.

Podalirius, returning from the war, was wrecked at Caria, Asia Minor. He had the good luck to cure a princess of falling sickness (probably hysteria), and in consequence acquired a great reputation. The Carians, after his death, built him a temple and paid him divine honours. This temple has long since disappeared, but his effigy survives on the College seal.

FIG. 13.

The essential work of Hunter's life was the useful specimens he prepared and left for successors. These specimens, safeguarded by faithful Clift, catalogued by sagacious Owen and Paget, and such able curators as Flower and Shattock, are now in the care of Keith, who lacks none of Hunter's enthusiasm but totally eclipses him in the art of exposition. The Museum was never in safer custody.

If I could believe the soul of man survives the dissolution of his body, I would believe the spirit of John Hunter haunts the galleries of this wonderful Museum, but I do believe his influence is a quickening spirit among surgeons to-day.

THE PROPERTIES OF CERTAIN "COLLOIDAL" PREPARATIONS OF METALS.

BY

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CONSIDERABLE attention has been paid during the past decade to the therapeutic action of metals in the colloidal form. The clinical literature associated with this subject is very extensive, and the results recorded are extremely remarkable; indeed, a cursory survey of the subject leaves the impression that colloidal metals act as specific cures for every known disease. The full claims of colloidal therapy will be found in the works of Searle.^{1,2} Unfortunately the quality of this literature does not correspond to its quantity. Dale,³ in a review of Searle's book, points out that the claims made there regarding the action of colloidal metals violate most of the known laws of physiology. The *Journal of the American Medical Association*¹⁷ criticized Searle's report as follows:

"In a style as bombastic and verbose as the usual house-organ write up, the report recklessly details all sorts of conditions in which the so-called colloids—and particularly the Collosol brand—have been recommended, but derogatory findings are conspicuous by their absence."

An examination of the clinical literature further shows that the great mass of it is wholly uncritical, and that the few animal experiments and therapeutic observations which have been made with proper controls have mostly given negative results. Since the "scientific" literature on this subject is so uncritical, it is only natural that the manufacturers of colloidal preparations should have made rather startling therapeutic claims in advertising these preparations.

The author, at the invitation of the BRITISH MEDICAL JOURNAL, has investigated the properties of certain of the colloidal preparations advertised. The preparations investigated were certain of the collosols (The Crookes' Laboratories) and of the oscols (Messrs. Oppenheimer and Son, Ltd.). The preparations were bought in the open market, but care was taken to ensure that they had come recently from the manufacturers. The retail price of collosols varied from 2s. to 6s., and that of oscols from 2s. to 15s., a 4-oz. bottle.

Chemico-physical Properties.

The preparations contain in most cases 1 in 2,000 of metal, together with 0.6 per cent. of sodium chloride, and from 0.5 per cent. to 5 per cent. of organic matter. The organic matter in collosols is in some cases stated to be arabinic acid derived from gum arabic, and in other cases to be glutaminic acid derived from gelatin; in the patent specifications peptones are said to be used as the suspending agent. The organic matter acts as a protective to the colloidal metal and keeps it in suspension. Ultrafiltration showed that the organic matter was partly in colloidal form and partly in true solution, for the greater part of it passed through collodion membranes, but a part of it was retained.

The chief point to be determined was whether all or any of the active principles in the various preparations were in true colloidal suspension. The following are the chief tests by which colloidal solutions are distinguished from true solutions:

1. *Ultramicroscopic Examination*.—The ultramicroscope shows colloidal solutions to be full of microns, which appear as bright points undergoing rapid Brownian movement.
2. *Tyndall's Beam*.—A beam of light passed through a colloidal solution illuminates its path, just as a beam of sunlight in a darkened room is visible when the air contains dust or smoke.
3. *Kataphoresis*.—An electric current passed through a colloidal solution contained in a U tube causes the solution to move towards one of the electrodes.
4. *Dialysis and Ultrafiltration*.—Colloidal particles do not pass through such membranes as parchment or collodion.
5. *Diffusion*.—Colloidal particles diffuse into water much more slowly than do molecules or ions. Colloidal particles do not diffuse into gelatin.

These tests can easily be applied to pure solutions of colloidal metals, but the presence of a considerable quantity of organic matter in the preparations tested made them much more difficult to test.

The manufacturers apparently rely upon ultramicroscopic examination for determining the state of suspension of the metal, for they emphasize in their advertisements that the preparations show Brownian movement under the ultramicroscope, and state that this is evidence of the colloidal nature of the preparations. The absence of particles on ultramicroscopic examination is evidence of the absence of colloidal