the three gyri are marked off, the upper being broad and the lower narrow.

The temporo-sphenoidal lobe presents nothing remarkable; the parallel fissure is continuous and simple, running up behind into the angular convolution, where it is cleft, one branch extending downwards parallel to the lower part of the external parieto-occipital fissure, and cutting off the middle temporo-sphenoidal gyrus from the descending ramus of the angular and the second annectent convolutions. The upper convolution is simple; the middle is broader and more folded, the inferior is separated by a well-marked sulcus from the middle.

The first external annectent gyrus is seen issuing from under cover of the operculum, and passing forwards and inwards to the parietal lobule; this is an approach to the orang, in which the gyrus is normally superficial, and an advance on the chimpanzee, in which it occurs only at times. The second does not appear at all; the third is to be recognised nearer the lower margin of the hemisphere and below the lower end of the external parieto-occipital fissure, but the extension of the parallel fissure separates it superficially from the middle temporo-sphenoidal convolution; below this the small fourth appears, uniting the lower occipital and third temporo-sphenoidal convolutions.

Inner Surface of the Hemisphere.—The calloso-marginal fissure pursues its usual course and turns upwards opposite the hinder end of the corpus callosum, sending a branch backwards between the convolution and the quadrate lobule; it is interrupted opposite the anterior extremity of the corpus callosum by a small gyrus, a very frequent condition in human brains; from it a few small indentations pass up into the marginal convolution. The callosal convolution is simple: at the fore part there is a hint of the longitudinal division which obtains here sometimes in man, and it is more broken up when it passes under and is joined by the quadrilateral lobule. The marginal convolution is larger and more divided, but both of these are simpler than in the orang. The quadrate lobule is divided into about four small gyri, and is much larger than in the orang, where the calloso-marginal fissure opens into the surface very near the parieto-occipital, and the lobule is almost obliterated. The internal parieto-occipital fissure does not join the calcarine below, so that a distinct inferior internal annectent convolution is present, and at the upper end the upper internal annectent convolution can be seen coming out of the fissure and joining the upper posterior angle of the quadrate lobule. The calcarine fissure is usual, so also is the fissure of the hippocampus. The occipital lobule is divided into three gyri transversely by two furrows running the upper from the parieto-occipital, and the lower from the calcarine fissures nearly across; this is in marked contrast with the arrangement of the human brain where the gyri run from apex to base, being subject, however, to great variety. The gyri on the under surface of the occipital and temporo-sphenoidal lobes cannot be seen.

The resemblance between this brain and the chimpanzee's is striking both in its shape and the arrangement of the convolutions, so much so that Gratiolet's description of the latter would serve also for many parts of the gorilla's brain. The chief points of difference between the two are mainly in favour of the gorilla, *e.g.*, the greater length and breadth of the frontal lobe, a greater development of the middle and lower frontal and of the parietal convolutions, especially of the supra-marginal lobule and the appearance of the first external annectent gyrus. On the other hand the chimpanzee appears to have some advantage in the important point of greater vertical height. On the whole, the comparison seems to indicate a development of the chimpanzee type of brain and to give it a higher rank than that.

In one particular character it approaches the orang, the partial appearance of the annectent convolution, but the differences in shape, the more perfect operculum, the lesser complication of the frontal and occipital convolutions and the greater symmetry far outweigh the resemblances and denote its proper position as with the chimpanzee, although somewhat nearer the orang than that.

Gratiolet placed the gorilla with the baboons by reason of its elliptical form and the supposed want of development of the frontal and great excess of the occipital lobes; but we see now that of all the anthropomorpha the gorilla is characterised by the most extensive frontal lobe and smallest occipital; in addition to which the richness of the convolutions and the breadth of the frontal region also separate it farther from the baboons than the chimpanzee.

It is certainly open to great doubt whether this diminution of the occipital lobe is at all an ascensive step in the cerebral conformation, in fact, the comparison of the respective proportions in the bushwoman and the European points distinctly in the opposite direction; and it is to be noticed that the great relative length of the frontal lobe is entirely due to this dwarfing of the occipital, for the proportion of the frontal to the parietal is no greater in the gorilla than in the others; and the highest type is to be sought rather in the co-ordinate development of all the lobes and not in the predominance of any one; so that regarded by this standard the gorilla's brain shows one marked feature of inferiority.

It should be remarked that Dr. Pansch, whose judgment must carry great weight, is disposed to regard the divergences from the chimpanzee as sufficient to establish a distinct type of brain in the gorilla.

In the comparisons above instituted, the brain of the bushwoman so carefully and elaborately described by Mr. Marshall in the *Philosophical Transactions* for 1864, that of the chimpanzee described with photographs by the same author in the *Natural History Review* for 1861, and that of the orang in the same journal by Prof. Rolleston have been taken as standards, supplemented by reference to the specimens in the Hunterian Museum.

G. D. THANE

MUSEUM SPECIMENS FOR TEACHING PURPOSES[1]

IT is now generally admitted that a thorough and practically useful knowledge of the form and other properties of natural bodies can only be acquired by an examination of such bodies themselves. The difference between knowing a thing by description only and knowing it from personal acquaintance need scarcely be insisted on.

All teaching, therefore, of the physical properties, especially the form, texture, colour, and relation to one another of the component parts of any natural object, whether organised or inorganic, should be illustrated by reference to the object itself. The more completely the student is enabled to examine it, the more thorough will his knowledge of it be.

In the Department of Biology, which is that to which my remarks must now be limited, very much valuable and practical teaching can certainly be given without the possession of a museum or a single permanent preparation. The commoner and easily accessible animals and plants furnish materials for study and demonstration, which, when done with, can be thrown away and replaced as occasion requires. But it is often desirable to preserve specimens for a considerable time or permanently, either on account of their intrinsic rarity, causing difficulties in procuring them when needed, or on account of the labour and skill which may have been expended upon their proper display, and which it is not desirable to have wasted.

Hence the necessity for museums as most important adjuncts in connection with all establishments for teaching biology.

[1] Lecture at the Loan Collection of Scientific Apparatus, South Kensington, July 26, 1876, by Prof. W. H. Flower, F.R.S., Conservator of the Museum of the Royal College of Surgeons of England.

It has been suggested to me on this occasion to give a few hints as to the class of objects best adapted for display in such museums, and the best method of preserving them, especially illustrated by the specimens contributed to the Loan Collection, and having been a collector of specimens and a curator of some kind of museum all my life, at all events since I was nine years old, I do not speak without some experience. As the time at my disposal will be limited, I shall say nothing of the preparation and preservation of specimens intended for microscopical investigation and demonstration, as that is a special branch of the subject, on which there are numerous excellent treatises, and which is considered in other lectures of the present course. I shall therefore confine myself to objects visible to the unassisted eye, and mainly to those derived from the animal kingdom, as having come most fully within the scope of my own experience.

Whether it has arisen from a mistaken impression that museum specimens are scarcely legitimate objects for this exhibition, or whether from the too general neglect on the part of those in charge of collections, of expenditure of labour, ingenuity, skill, and taste, in effecting improvements in arranging, displaying, and preserving the objects under their care, this department of the Exhibition is, on the whole, not very satisfactorily represented, and, compared with some others, puts in rather an insignificant appearance. And yet properly preserved and displayed specimens are essentially "scientific apparatus;" the preparing of such specimens is a most valuable aid to the cultivation of biology, and it is to be regretted that such an opportunity as that now presented of comparing the merits of different processes and of different materials used in the art, has not been more fully taken advantage of.

In considering the subject of museum specimens, it will be convenient to treat, first, of the methods of preservation in a dry state, afterwards of the methods of preserving animals or parts of animals in some kind of fluid, and lastly, to speak of the reproduction, by means of casts and models, of such objects as cannot be conveniently preserved in other ways.

The first method is applicable only to certain parts or tissues of the animal body; either those like the bones of vertebrates, shells of molluscs, chitinous integuments of articulata, &c., which are in their natural condition so hard and dry, that they undergo no material change when completely deprived of all the water contained in their substance, or those like skins, hollow viscera, &c., which may be kept in shape until they are dry by filling them with some stuffing material, or distending them with air. Attempts have frequently been made to preserve soft and fleshy tissues, as the muscles, in a dry state, but by all the processes hitherto adopted they eventually lose so much of their form and substance as to be of little value as representations of actual and natural objects. Such parts of the body, and the whole of the soft-bodied invertebrates, can only be successfully preserved in a fluid medium.

The best known and most generally practised method of preservation in a dry state is that intended to give an exact idea of the whole animal when living, by means of its skin, and the various tegumentary appendages, as fur, feathers, scales, horns, &c., attached to it, removed from the body, and then mounted by means of internal supports and paddings, or "stuffed," as it is familiarly called. The art of preserving animals in this manner is called "taxidermy." Although an art of really great importance for the study of natural history, and one essential, in fact, to its proper diffusion among the masses, it is almost unrepresented in the present collection, the only exceptions being among the "Apparatus for Instruction in Physical Science, contributed by the Committee of the Pedagogical Museum of Russia." The examples sent by this committee, though extremely interesting as illustrations of an admirable system of practical school teaching, and quite equal to the average level seen in most public museums, are of no especial merit as works of art, or as showing improvement over the ordinary methods. That this level should be so low is extremely to be regretted; but as long as curators of museums are contented to fill their cases with wretched and repulsive caricatures of mammals and birds, out of all natural proportion, shrunken here and bloated there, and in impossible attitudes, it will be difficult to get it raised. There may be seen occasionally, especially in continental museums and in private collections, where amateurs of artistic taste and good knowledge of natural history have devoted themselves to the subject, examples enough to show that an animal can be converted after death, by a proper application of taxidermy, into a real life-like representation of the original, perfect in form, proportions, and attitude, and almost, if not quite as valuable for conveying information on these points as the living creature itself.

The injurious effect of a low standard of perfection in one branch of art upon another is curiously seen in the drawings of birds often introduced into pictures by some of our most accomplished artists. I could point out in the present Royal Academy exhibition several examples of birds introduced into landscapes, and therefore evidently intended to be representations of living and moving creatures, carefully copied from miserable specimens of "stuffing" of the lowest order. The fact is that taxidermy is an art, resembling that of the painter, or rather the sculptor; it requires natural genius as well as great cultivation. One of the obstacles to its improvement seems to be that few people have knowledge enough of the subject to judge of the execution of the taxidermist as they do of the painter or sculptor. And yet to curators of natural history museums this knowledge should be indispensable. But then they must give up the conventional low standard of payment for "bird stuffing" which now prevails. The artist should be able to devote far more time to the manipulation of each subject than at present, and, moreover, be able to compensate himself for the time he must spend in the study of the anatomy of the dead, and of the form, attitudes, and manners of the living. I have often thought that if a Landseer or a Wolf could have devoted himself to taxidermy, what glorious specimens we should have, and how different then would be the effect of a visit to the "bird gallery" of one of our great museums to that which it now produces. How much of nature would then be learned while admiring the art! And why should this not be? Simply because no one, at least no one in charge of a public museum, thinks of paying for a stuffed bird more than some ridiculously inadequate sum. It may be said that our natural history museums have not funds for such a purpose. If so it is of course a subject to be regretted, and ought to be remedied; but it is not exactly the case. A few really good specimens are far better than an infinity of bad ones. Let the same amount of money, judiciously laid out on skill and labour, now expended on a hundred specimens be concentrated on ten, and a far more valuable and instructive museum will be produced. The remaining specimens for completing the series for advanced students of the subject, should be kept as skins in drawers, in which state they are in every respect preferable to badly-stuffed specimens. They can be handled or examined without damage, and they do not mislead or disgust.

Next to the skin, the part of vertebrate animals most commonly preserved is the skeleton, the bones being, in fact, the most imperishable and easily preserved of all the tissues. The facilities, therefore for the study of osteology are very great, and it has especial importance in comparison with that of any other system, inasmuch as large numbers of animals, all in fact of those not at present existing on the earth, can be known to us by little else than the form of their bones.

These remarks, however, only apply to the skeleton in its *ossified* state, when the bone-tissue is so strongly impregnated with salts of lime, as to resemble, in its properties, rather a mineral than an animal substance. Many of the most important problems of anatomy relating to the skeleton, either the adult skeleton of the lower vertebrates, or the developing skeleton of higher forms, can only be worked out on fresh specimens or wet preparations. The ossified bones, which alone constitute what is popularly called the skeleton, can be studied best from dried specimens.

An osteological collection for teaching purposes should contain a certain number of mounted skeletons of the most characteristic types of vertebrate animals; *i.e.*, skeletons with all the bones joined together in their natural relations, and placed in such an attitude as the animal ordinarily assumes when alive.

In this way the student acquires a general idea of the construction of the framework of the body, the proportions and relative positions of the various parts. But in such skeletons much that is important to know is inaccessible to examination. One bone more or less overlies and hides another, and the articular ends, or those parts that come in contact with each other at the joints, are entirely concealed. Although general comparisons of form and proportion can be made with other skeletons, detailed comparisons of bone with bone are impossible. This applies more especially to skeletons articulated upon the plan almost universally adopted until the last few years, in which all the parts are immovably fixed to each other. It is to a large extent obviated by the method I shall refer to presently, but still, for the complete study of osteology, it is very desirable indeed essential, to have at hand separate parts of skeletons, or individual bones, which may be kept in boxes, drawers, cases, or in any way found to be most convenient. Entire skeletons with the bones separated occupy very little space in boxes, and the most characteristic parts may be selected and mounted in the way I shall presently indicate.

Everyone in charge of a biological museum, however small, should be familiar with the mode of preparing skeletons. I can only indicate the outlines of the process, for in this, as in every other part of the work of making anatomical preparations, a few practical lessons from a person already an adept, and a little experience and observation will do more than any description. When the principles are known, the details can be carried out with such modifications and improvements for each individual case, as the skill and ingenuity of the operator can suggest. With regard to museum specimens generally, the question is frequently asked how such or such a preparation is made, and an answer is expected in a few words, which will enable the questioner to do the same himself. This is much as if a novice who had never handled a brush were to ask an artist how he had painted his picture and expect that a few simple directions would put him on a level with the master. Preparation-making is an art which can only be acquired by labour and perseverance, superadded to some natural qualifications not possessed in an equal degree by all.

To return to the bones, as in many respects the simplest kind of preparations. There is a popular notion that skeletons are made by putting animals into ant-hills. So I have been told over and over again ever since I was a child. I must, however, say that I have never actually seen, or even heard of a skeleton really made in this way, though ants, doubtless, especially in hot countries, will make short work of the flesh of an animal's body, leaving at least all the larger bones untouched. But we must adopt some safer and more universally applicable method of proceeding. Another common idea is that some "chemical" substance is necessary to steep them in for dissolving the soft parts, and I am often asked "What acid do you use for this purpose?" when a little reflection would have shown that the bones would be the first parts to disappear under the influence of such a menstruum. No—water—pure water, is the only thing required in preparing bones and skeletons in the great majority of cases, and in the proper use of the water the art of "macerating," as it is called, chiefly consists.

This process is nothing more or less than placing bones in water and leaving them undisturbed until putrefaction of all the flesh and blood remaining on and around them and within the hollows and small cavities of their interior, takes place, and these soft parts entirely lose their form and structure and become converted into liquids and gases mingled with the water or escaped from its surface; so that when the bones are removed and well washed, nothing remains but the comparatively indestructible true osseous tissue, which, when dried, is hard, clean, and without smell.

Maceration consists, then, essentially in the destruction of the soft tissues by putrefaction, and certain circumstances are essential or favourable to the success of the process. In the first place, the water should not be too abundant in proportion to the amount of animal matter to be destroyed. Then it should never be changed or disturbed until the process is completed. The surface should be exposed to the air, and the loss from evaporation supplied from time to time. The temperature should be uniform and elevated. Cold checks the process; freezing arrests it altogether. If the heat is too great the bones are often greasy and discoloured, as when they are prepared by boiling. It is to the fact that the process varies in rapidity according to so many circumstances that the chief practical difficulty, which is to know when it is completed, is due. If the bones are taken out too soon, unless they are returned immediately to the same water, a check takes place in their preparation. To estimate the necessary time is a matter acquired only by practice and knowledge of the surrounding circumstances. Much will depend upon the size of the bones, small bones macerating much more rapidly than large ones; also upon their condition, if fresh, they macerate far more quickly than if they have been previously dried (as is the case with skeletons sent from abroad in a rough state), or if they have been kept in spirit or any other preservative solution.

When the bones are to be removed, the water must be carefully poured off through a hair seive, and all the solid matter which remains at the bottom of the jar must be carefully searched from any of the smaller bones which might otherwise be lost. They are then removed to clean water, frequently changed for several days, well washed with a brush if necessary, and dried, if possible, in the sun.

The process of maceration is necessarily attended with disagreeable smells. As long as it continues the surface of the water slowly emits gases; but the worst is when the water is stirred up by pouring it off to remove the bones. Hence it should be carried on in the open air, or what is far better, in a building isolated for the purpose, and in which the temperature may be kept uniform. When maceration has to be conducted among dwellings, it is necessary to be very careful not to disturb the vessels, and to put some disinfectant, as chloride of lime, into them the day before the contents are taken out. This will obviate most of the usual disagreeable effects, and if not used in too great a quantity, will not cause any material damage to the bones. But chloride of lime, when used too freely, is a dangerous agent; it destroys the gelatinous portion of the osseous tissue (which of course is not removed in maceration) and leaves the bones white, chalky, and friable. After proper maceration no chemical bleaching is required. Exposure to sunlight or alternate sun and rain for some months is generally good, especially for large solid bones, though this may be carried too far, as the intensely white, cracked, porous and fragile condition of osseous fragments which have been lying long on moors or hill-sides, shows. Bones are not naturally of a pure white colour, but have a delicate yellowish or creamy tint like that of ivory.

Several substitutes for the process of maceration in water are occasionally adopted under special circumstances.

1. Boiling. This process has the advantage of rapidity, but is seldom resorted to except when absolutely necessary (as in the case of the celebrated skeleton of the "Irish giant" in the Hunterian Museum), as the fatty matter in the medullary cavity is melted and pervades the whole osseous tissue, and generally leaves the bones discoloured and greasy, as may be seen in most of those that have been cooked for the table.

2. Burying in the ground may be resorted to when there are no conveniences for maceration, but it is even a slower process. The effect upon the bones is the same, but they are nearly always stained brown by the colouring matter in the soil, and the small ones are apt to get lost.

3. It has lately occurred to me, following out a suggestion of Mr. Seymour Haden's in his excellent letters, entitled "Earth to Earth," relating to the best mode of disposing of the dead, to clean bones by burying them in a basket of charcoal, and though the experiments are not quite complete, they promise excellent results, especially as all the disagreeable odour of maceration is entirely obviated, and the process may even be carried on in inhabited rooms without any inconvenience.

(To be continued.)

OUR ASTRONOMICAL COLUMN

A New Star in Cygnus.—On November 24, at 5h. 41m. P.M., the director of the Observatory at Athens, Prof. Schmidt, remarked a star of the third magnitude not far from ρ Cygni, which was not visible on November 20, the last clear evening previous. Its position from observations with the refractor was found to be in R.A. 21h. 36m. 50·5s., N.P.D. 47° 40′ 34″ for the beginning of the present year. At midnight its light was more intense than that of η Pegasi, which is rated a third magnitude by Argelander, and very yellow.

Direct intimation of this discovery was given by Prof. Schmidt to M. Leverrier, and the Paris *Bulletin International* of December 6 contains the few particulars concerning this star which the generally unfavourable weather up to that date had permitted to be put upon record. M. Paul Henry estimated it of the fifth magnitude, so that as in the cases of the similar suddenly-visible stars of 1848 and 1866, it would appear to have remained but a very short time at a maximum. He considered the colour "greenish, almost blue" by comparison with Lalande 42,304, not far distant. M. Cornu examined it on December 2 with a spectroscope applied to the great equatorial, though only during a short break; the spectrum was chiefly formed of bright lines, and consequently proceeded probably from a vapour or incandescent gas. On the same evening, but under conditions equally unfavourable, M. Cazin made similar observations with a spectroscope on the 9-inch Foucault equatorial, and with the