exposures are still made. On account of the patch on the forehead no proper protection could be given to the hair which became considerably thinned.

The distance of the tube was varied from seven to three inches and the length of exposure from five to 15 minutes. It is somewhat difficult to account for the action of the rays

FIG. 1.

Condition of patient on July 15th, 1900.

FIG. 2

Condition of patient on July 20th, 1901.

in lupus; probably it is a dual one, on the one hand by excessive stimulation of the bacilli, causing "over population" and consequent dearth of food, and on the other producing an inflammatory reaction in the healthy tissues on the margin of, and below, the diseased portion, causing them to put on an increased resistance.

Sunderland.

ROTATION OF THE FOREARM.¹

By RICHARD J. ANDERSON, M.D. R.U.I., M.R.C.S. ENG.,
PROFESSOR OF NATURAL HISTORY, MINERALOGY, AND GEOLOGY,
QUEEN'S COLLEGE, GALWAY.

PROFESSOR HEIBERG of Christiania has called attention to the fact that the movements of supination and pronation are commonly attributed to the motions of the radius alone. He has shown that in addition to the movement of the lower end of the radius round the ulnar styloid process (the pit at the root of the styloid process) the ulna moves too; both bones near the wrist move along curves. Heiberg made his views clear by models and made experiments to confirm the results. His conclusions were embodied in a paper read before the Copenhagen International Medical Congress. The presumption that the humero-ulnar articulation does not admit of any movement except flexion and extension led to the suggestion that the humerus rotated and not the ulna. The movement of the ulna, however, took place after the humerus had been clamped. Then it was shown that the forced twisting of the hand was not necessary to establish the facts. Dr. Cathcart of Edinburgh showed by means of a ring that the ulna moved under the bracelet as clearly as the radius. A demonstration was given at a meeting of the British Medical Association. A frame with an upper and a lower clamp with an intermediate graduated circle was used to test the amount of rotation at any part of a limb for a given displacement at the distal end. The latter, being determined by means of a graduated circular scale, was read off and the corresponding number on the intermediate graduated circle was noted.² The degree of rotation was ascertained in the anterior limb of several animals. Rotation becomes less and less conspicuous as we proceed to examine the forearm nearer and nearer the elbow-joint, and in man a slight displacement of the bones indicates what remains of movement at the limit. The following method may be used to show the rotation of the arm. An elastic band with a buckle is attached to a mirror three quarters of an inch wide. This band is fixed over the lower end of the forearm with the mirror over the styloid process of the radius first and afterwards over the styloid process of the ulna. Except in extreme supination and pronation the mirror may be made to follow the rotating wrist. A beam from a lantern with reflector allowed to fall on the mirror will show the nature of the rotation. The band can be gradually moved upwards, and at each stage the rotation tested; where the mirror rests on a bone the tilt will render more conspicuous the movement. This contributes chiefly to produce the deviation of the reflected beam when the mirror is placed over the olecranon. The roll here, though slight, is felt by the mirror.

The intimate connexion between movements, ligaments, and articulations has long been established, indeed, since the time of the appearance of the works of Henle, Cruveilhier, and C. Krause. Leaving out all those articulations in which surfaces are difficult and in which the movements are correspondingly complex, there still remains an assortment of articular surfaces which anatomists have tried to group and classify, and to which nature has assigned certain varieties of ligaments and has associated certain movements. Inter-articular cartilages and ligaments render joints confusing, and it is only by referring to the conditions in the lower animal forms that one can hope to get an explanation of the odd conditions in man. The peculiarity of the hip-joint was only understood after comparative anatomical investigation (W. Krause). The condition of the ulna is only understood after referring to the development of the articulation and its condition in other animals. The fixed radial head in the sheep is seen to supplement the coronoid portion of the ulna in rendering more secure the elbow-joint; the elongated hollow of the articular head of the radius in the badger is intermediate in form, but the head of the radius in man is not strictly circular.

The joints in the forearm are somewhat varied. Leaving out the wrist-joint, the lower radio-ulnar articulation is made up of surfaces of the second order (hyperboloid). The same holds for the upper radio-ulnar joint. The articular hollow in the upper end of the radius is apparently a hollow sphere,

¹ A paper read before the British Medical Association, Surgery Section, on August 1st, 1901.

² Anatomische Anzeiger, 1892.

but in all probability rarely so simple, and it may be limited to a portion of the head, whilst a portion becomes flat or slightly convex. The convex articular surface of the humerus, limited to the anterior and lower part, passes internally into the ulnar articular surface. This capitular surface registers the imperfect attempt of nature to make a ball-and-socket joint. The easiest form of glass lens to make is, we are told, a spherical one, but the conditions are different where the surfaces are living. The ulna has really two humeral joints which were at one time separate in man, the interval being occupied by fibrous synovial processes; at birth there is a simple joint. The surfaces are hyperboloid running into spherical externally and paraboloid or ellipsoidal internally; the surface is sometimes called helicoid or screw surface.³ The olecranon articulates above behind and below, the coronoid process in front and below. The surface is not a hyperboloid of one sheet as a straight wire does not lie in the surface. The hollow inner part of the coronoid articulation is greater than the hollow inner part of the olecranon (a well-known fact). The shapes of the bones which give us a key to form, as the joints give us a key to motions, are in their constitution influenced apparently by the part they take in bearing strains and by the vascular supply. It is not easy to say whether the lines of the trabeculae in the cancellous tissue are chiefly the cause of the shapes of the articulations or are altogether the result of the intermittent pressure produced by the bones. The radiating fibres suggest a response to the lines of pressure.

The motions of the bones concerned in rotation of the forearm are that of the radius on the ulna, that of the ulna in relation to the radius, and that of each in relation to the humerus. The radius would describe a cone-like surface if the ulna were fixed and the head circular. The radius follows, however, the moving ulna as a satellite follows its planet. The ring of fibrous tissue above and the triangular fibro-cartilage below limit the movements. The apex of the cone alters its position owing to the head not being circular and the movement of flexion which the head experiences. The ulna in pronation is extended, abducted, and rotated. The radius is flexed and adducted as well as rotated; so far as the ulna is concerned, this act is aided by the movements of the ulna. The action is easier and a strain less necessary than if the ulna were fixed. The movements of the radius on the humerus are flexion or extension, a shifting inwards or outwards and rotation of the head. The ulna moves backwards or forwards on the trochlear surface, and rolls in or out; extension of the ulna is attended with motion of the lower end out. It may here be mentioned that the methods by which ellipsoidal, hyperboloidal, spherical, or paraboloidal curves are produced physically, suggest to one that similar conditions may prevail in the construction of similarly curved joints.

Rotation of the forearm is rarely a simple action. It is commonly associated with movements of flexion and extension of the elbow-joint. To this the character of the muscles in the forearm bears witness. There are apparently varying degrees of inter-association of these actions in animals. Leaving out the intrinsic muscles, one may easily gather from a study of the pronator teres how the association arises. This muscle draws the forearm towards the arm and at the same time turns the radius over the ulna. If two half-discs of cardboard be taken and so placed that the circumference of one will represent the course of the upper part of the humeral attachment of the teres as the humerus moves towards the forearm, whilst the other disc is so placed that its circumference will represent the course of the attached end of the teres in movements of the radius inwards, then, by attaching threads to each disc to represent the muscle band at each stage of movement a surface may be constructed. This surface is of a complex nature and illustrates the direction of the muscle band at any particular part of the excursion.⁴ It may be urged that the articular surfaces show variations. Professor Lesshaft's classification is an attempt to deal with a subject which the addition of numerous facts has rendered difficult. Although complex for the student who wishes to have his attention riveted upon the shape, ligaments, lines of pressure, and connexions of joints, it will be regarded as a thankworthy attempt to deal with a great difficulty. It

is now proved that the articular surfaces, formerly regarded as very simple, are more complex, but are still within the scope of the mathematician who deals only with the simpler relations. The more difficult surfaces and forms are appropriately referred to the artist who may give us a key to the complex conditions which nature presents.

Queen's College, Galway.

ON A NEW METHOD OF PRESERVING MUSEUM SPECIMENS.

By HUGH GALT, M.B., F.F.P.S. GLASG., D.P.H. CAMB.,
PATHOLOGIST TO THE GLASGOW SAMARITAN HOSPITAL FOR WOMEN;
PROFESSOR OF FORENSIC MEDICINE AND PUBLIC HEALTH,
ST. MUNGO'S COLLEGE, GLASGOW, ETC.

It will be admitted by all who have had any considerable experience in the matter that the methods at present in use for preserving gross pathological specimens in such a way as to enable the latter to be employed as illustrations are very far from perfect in many respects, and that finality has been reached in this direction few will venture to assert. Until quite recent years the almost universal method of preservation was by keeping the specimens in a large relative bulk of spirit of wine, after preliminary washing with water and soaking in several changes of spirit of wine. This method, while satisfactory enough with regard to the prevention of decomposition and the retention of the structural relationship of the parts, had three serious defects. Firstly, it was costly, particularly where a large number of specimens had to be dealt with; moreover, the alcohol evaporated unless the jars were almost hermetically sealed and had to be replenished or even entirely renewed at intervals. Secondly, the final result of the alcohol was to cause considerable shrinkage of the specimen and thus greatly to destroy its illustrative value. This result, of course, is particularly evident in the case of succulent tissues or organs such as the liver, spleen, &c. Thirdly, the colour of the specimen in the fresh state, except in the case of pigment insoluble in alcohol or carbonaceous matter, was soon completely, or almost completely, lost, the tissues taking on a uniform yellowish white colour, so that, for example, a cancerous nodule in the kidney could not be distinguished by its colour from the surrounding renal tissue. This is, perhaps, the most serious objection. There is no scientific objection on the ground of cost, and as to the shrinkage of the specimen accurate original measurement will to some extent minimise this disadvantage; but no minute description of the original colours (in the absence of colour-photography or the costly and often unfaithful painting in colours) can overcome the last defect.

On the properties of formaldehyde as a preservative of decomposable organic tissues partly depends a more recent method of preserving museum specimens, although the final preservative fluid chiefly employed in conjunction with formaldehyde is essentially diluted glycerine. For some time it was thought that in a solution of formaldehyde in water, containing about 40 per cent. of the gas and commercially known as formalin, we had a liquid which would be free from the disadvantages attaching to alcohol as a preservative. As it prevents decomposition even when very largely diluted with water the first objection to alcohol is surmounted, for the cost of a solution of formalin sufficiently strong to prevent the decomposition of animal tissues is comparatively trifling. With regard to the second objection, however, there is little if any gain, as even in a very dilute solution formalin not only causes shrinking of the tissues, but hardens them and renders them brittle. On the third objection there is again little real gain, for while formalin does not bleach the natural colours like alcohol, it gradually approximates the various shades until the specimen becomes ultimately of a slate colour. All the foregoing applies equally to formaldehyde vapour. In addition, formalin has inherent objections. Its vapour is irritating to the air-passages; it acts deleteriously on the hands; being volatile it slowly evaporates; while it is occasionally unstable even in diluted solution.

Perhaps the best-known modification in the employment of formalin in the preservation of specimens is Kaiserling's. Here the tissue is really only fixed in a solution of formaldehyde with acetate and nitrate of potassium; after treatment with 80 per cent. and 95 per cent. alcohol the

³ Chomitzky, quoted by Lesshaft.

⁴ Report of the meeting of the British Association at Southport.