enzyme, and (5) the physical state of the medium in which the enzyme is to act.

Uniformity of enzyme action means that under a certain set of experimental conditions a given specimen of gastric contents will give the same results on repeated analyses. By proportionality is meant the relation existing between the amounts of material digested by varying quantities of gastric contents; *i.e.*, in the method here described 2 c.c. of the diluted gastric contents will digest one and one-half times as much edestin as will 1 c.c. of the same dilution. Stability of an enzyme is a term used to express the length of time an enzyme will remain active. The physical conditions under which an enzyme acts are important because in order to obtain uniformity of action the physical conditions must be constant. One essential reason for this is the fact that the size of the surface area of material exposed to enzyme action is a governing factor in the amount of the latter which will occur. Other factors are temperature, and the buffer conditions determining hydrogen ion concentration.[9]

In classes 1 and 2, under description of previous methods, the solid state of the protein to be acted upon allows for great variation in the surface areas of different preparations. In none of the three classes of methods was an attempt made to find hydrogen ion concentrations and buffer conditions which would bring about uniformity of enzyme action, nor was considered the effect of adding the gastric contents on the pH and buffer conditions of the medium in which the pepsin was to act. Furthermore, in most of the methods the technic used does not permit an accurate estimation of the end-point of digestion. From these remarks it is obvious that methods previously proposed for the estimation of peptic activity of gastric contents have not fulfilled the five conditions described above, observance of all of which are considered essential for a method whose use is designed to give information concerning relative quantities (concentration) of pepsin present in different specimens of gastric contents.

While devising the new method here described an attempt was made to find pH and buffer conditions which would give uniformity of peptic activity of gastric contents. During this attempt results were obtained which indicated that a sodium citrate-hydrochloric acid mixture modified the action of pepsin. Further investigation led to the mixture described under the technic of the method; and under the experimental conditions outlined uniformity of peptic activity is obtained. The proportionality obtained is 1: 1.5; *i.e.*, 2 c.c. of diluted stomach contents will digest one and one-half times as much edestin as will 1 c.c. of the same dilution. Under the experimental conditions outlined it has been found that pepsin remains stable for a considerable number of hours. The physical condition of the edestin is that of a solution, so that the factor of surface area is constant; and the possibility of disturbances in hydrogen ion and buffer conditions on the addition of the gastric contents has been obviated by sufficiently diluting the latter. This brief discussion shows that the new method is in harmony with the factors generally accepted as determining enzyme action, and which are considered essential for the estimation of enzymatic activity. Further, it is directly applicable to determining this factor in the gastric secretion, and permitting the possibility of an interpretation of results for physiologic or pathologic purposes. The procedure for digesting the filtrate, given in the description of the technic of the method, allows the determination of widely varying degrees of peptic activity. This makes easier the application of the method to the study of pathologic gastric physiology.

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FRACTURE-DISLOCATIONS OF THE HUMERAL HEAD.

BY WELLER VAN HOOK, A.B., M.D., CHICAGO.

IT is time for surgeons to recognize that a revolution has taken place in the open treatment of joint-injuries and diseases through the knowledge that subcutaneous fat-tissue can be excised from its seat, even without pedicles, and replanted successfully in injured joint-cavities. For this artifice makes it possible safely to leave in the joint-cavity bone surfaces not covered by periosteum or cartilage, and synovial membrane but covered by fat-tissue. Even defects of joint-capsules and ligaments result in minimal disturbance of function if the space is filled in with fatty connective tissue.

The mode of action, the meaning of this effect of fat transplantation needs a moment's thought for its full comprehension. Fat-tissue is areolar connective-tissue having a tendency to the storing of oil in the cell-bodies. This tissue has an abundance of lymphatic spaces and channels and a fair degree of vascularity. It is probably not exceeded in adaptability by any other tissue in the body. Everyone knows how easily the areolar tissue retracts when illness occurs, how the eye-ball stands out, the cheeks shrink, and wrinkles appear, and how, in certain diseases, such changes as those just mentioned become relatively permanent. A laborer, exhausted by a day's activity, shows

the lack of water in his tissues in the same way; next day he is himself again. After typhoid fever the areolar-tissue is emptied of the fat which was stored in the cell-bodies. Over-feeding for some weeks is required to restore the fullness. In the first case the lymphatic spaces and channels are more drawn upon, in the second case the cells themselves are deprived of their store of fat.

Again, when this tissue is subjected to recurrent pressure, as about the ischial region and back, it undergoes a sort of thickening or condensation. *Per contra*, the fat about the female mammary gland is soft and loose. So when areolar-tissue is transplanted, it must soon conform, in some degree, to the new physiologic local requirement. In joints, if subjected to recurrent pressure, it becomes thinner, tougher, and more resilient; and it loses much of its oil and lymph-space distention. It becomes resistant to traumatism, yet it retains much of its resilience.

J. B. Murphy thought that the transplanted fat-tissue became hygromatous in character. But Lexer discredits the idea, with apparent justice, and shows how the transplanted tissue adapts itself to the new situation. He thinks that the fat-tissue, having undergone regressive changes, becomes vascularized in its new location by ingrowth of blood-vessels from the neighborhood, and that then a true but slight regeneration of fat-tissue can occur.

Moreover, by rapidly healing into gaps in other connective-tissue structures, transplanted fat-tissue prevents these structures from contracting adhesions to neighboring tissues, and leaves them free.

And this provision of surfacing tissue makes possible the growth of the endothelial cells lining the cavity over the engrafted structures, completing the capsule of the joint. Of course the foundation structure of the part is incomplete. Fat-tissue cannot replace wholly the lost bone, cartilage or fibrous connective tissue. The surgeon must bear this in mind and act accordingly. He must provide fibrous tissue and bone for support and muscle attachment where needed.

He who could successfully use this wonderful addition to our resources in joint-surgery must understand its principles and apply them. It is not to be forgotten that pedicled flaps, carrying with them their own blood and lymph supply, are superior to free flaps, for the latter cannot become as freely vascularized as the former. It is necessary to attach the flap where it is to grow, and the neighboring structures must not unduly interfere with it. And the joint must be dressed in such a position that relaxation is maintained until healing has occurred.

Then it must be remembered that functional management is most important. Massage and both passive and active motion are of supreme importance in gaining a functional success.

In carrying out this work dead spaces must be avoided, the distance between joint ends must be as small as possible. The most important structures are to be preserved (Lexer) and the re-establishment of muscular activity must be cared for.

The proper application of these general principles profoundly modifies all our previous conceptions of joint-surgery. Into other fields of their application we cannot now go; we are concerned with fracture-dislocation of the shoulder.

Fractures of the tuberosities of the humerus, whether extensive displacement has occurred or not, may well be treated as Speed[1] suggests, by open attack. The detached tuberosity may be held in place by a nail, screw or other mechanism. In such cases I would recommend raising a flap of areolar (fatty) connective-tissue from the side of the wound and suturing it to the capsule so that its body covers the bone-wound. Of course if the muscles could be attached otherwise to the humerus, the tuberosity could be sacrificed at once. Its value lies chiefly in supplying a point where the muscles can grasp the bone. If the small mass were removed, pedicled or free flaps of fatty connective-tissue would still need to be applied.

Where the whole head of the humerus has been broken off at the surgical neck, or separated at the epiphyseal line, or where a large part of the head is split off, healing takes place well enough if impaction has occurred, if reduction is effected or if aseptic re-attachment has been brought about by open operation. Incomplete reduction tends to much disability (Stimson's Work on Fractures).

But where dislocation of a comparatively small fragment, without muscle attachment, has occurred at the moment of fracture, the difficulty of replacement is usually great.

McBurney *(Annals of Surgery)* advised drilling a hole in the side of the loose body, and inserting into it a handled hook, which would give the operator a powerful grasp of the fragment that would enable him to draw the detached piece back into its place. In elderly, fat or feeble patients, the manipulations required may be so severe, so compromising to the neighboring structures that their desirability in opposition to the removal of the fragment may well come into question.

Tanton[2] reminds us of some of the older ideas as to treatment. He recalls the old, fabulous notion of letting the shaft unite to the fragment, and then reducing the dislocation with the aid of the shaft as a lever, the surgeon comfortably forgetting that, in the interim, the connective-tissues of the part would have suffered many deep-seated changes.

He recounts the method of Riberi, in which the head is left in its dislocated position, and effort is made, by early and prolonged mobilization, to produce a "humero-glenoidal neathrosis." Despite the fact that the method has

been followed by some successes it is not to be recommended, for obvious reasons.

And he mentions simple reduction, which, even when successful (as reported by Buchanon, Lambret and Hitzrot), does not seem to him to give results superior to that of excision of the small fragment. Indeed, Tanton, agreeing with Buchanon, regards excision as the method of choice. Sir Robert Jones seems to have been successful in reducing many cases with good functional results, using bloodless methods.

Hennequin and Loewy[3] assert that intra-capsular fractures at the shoulder heal as well as extra-capsular, in opposition to the conditions at the hip. They state that full recovery of function cannot take place in them beyond middle age in less than six months or a year, if at all, unless reduction is complete.

On the other hand, J. B. Murphy[4] has reported a brilliant result after nailing the small fragment in place.

Pool presented before the New York Surgical Association a woman, fifty years of age, upon whom he had performed an open reduction of a subglenoid dislocation, fracture having occurred at the anatomical neck. A practically perfect result followed. Tilton advocated attempts at reduction if there were periosteal attachments. Mathews found it impossible to reduce after three to five weeks, the glenoid seeming to be practically obliterated. Lilienthal had had four cases of fracture-dislocation with the best result in the case in which he was obliged to remove the head.

So there are not a few surgeons who prefer excision of the fragment, while some attempt closed reduction or effect bloody replacement and add some form of osteosynthesis.

This paper is written to contend that, with the use of a flap of fatty connective-tissue, the preference should be given to excision of the fragment, except in unusual cases, where reduction can easily be effected in comparatively young people or where the displacement of one of the tuberosities, with attached muscle, necessitates reattachment.

For what is to prevent the shaft of the humerus from resuming its function if properly brought into the empty glenoid cavity after the removal of the segregated head? It would be, I think, the filling and contraction of the glenoid in delayed cases, the shrinking of the capsule, and particularly the formation of adhesions about the denuded, fractured end of the humeral shaft. And, if operation is done early this need not occur.

The following case presents a cogent argument for the propriety of this choice of procedure.

A lady of fifty-two years, with medium skeletal development, fat, flabby and of pronounced sedentary habits, was struck by an automobile and thrown upon the right shoulder. I did not see her until four weeks later, when Dr. E. A. Doepp called me in consultation. The very imperfect x-ray picture showed a saucer-like piece of bone knocked off the head of the humerus and lodged downward below the glenoid cavity. In view of the patient's condition, replacement with osteosynthesis seemed inadmissible; excision appeared necessary.

The joint was opened by an incision that separated the pectoralis muscle fibres, and the detached piece was removed. The upper end of the shaft entered the glenoid cavity without trouble. And the arm was dressed in a position of extreme abduction, after a large pedunculated flap of fatty-areolar tissue had been raised from the soft parts of the neighborhood, accurately pushed down through the joint cavity, and fastened with catgut in place between the injured humeral head and the glenoid cavity.

Recovery took place slowly, although wound healing was ideal. A very skilled masseuse kept up slight motion and promoted the general nutrition of the parts. But after several months, even a pronounced paresis of the deltoid, due to the original trauma, was overcome, and motion is now almost perfect at the shoulder-joint in every direction.

In this aseptic case the interposed flap of fatty tissue filled in empty spaces, hastened coagulation, and prevented all injurious adhesions.

Conclusions:

(1) Where wounds of the bony surfaces of any joint or of its capsule have occurred, and especially where loss of substance has taken place, fatty tissue (usually subcutaneous areolar tissue) should be implanted to cover the defect, whether or not the injured tissue lies between articulating surfaces.

(2) Since transplanted fat-tissue must become vascularized before it can be permanently stable in its new histological and functional relations, pedicled flaps are better, *caeteris paribus,* than free flaps which must acquire entirely new blood and lymph vascular associations.

(3) The removal of fragments of the humeral head, after simple fracture, gives excellent results under aseptic healing. But muscular attachments must be re-established, capsular rents and bone surfaces deprived of endothelium should be covered with transplanted fascia and fat, dressing should be maintained in full abduction, and massage and passive motion must be instituted and kept up until the maximum of function is restored.

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The two extremes, the retarded pupil and the very bright pupil, have received a major share of consideration during the last two years from educators who are working on problems in primary education in psychological clinics and departments of research in city school systems.