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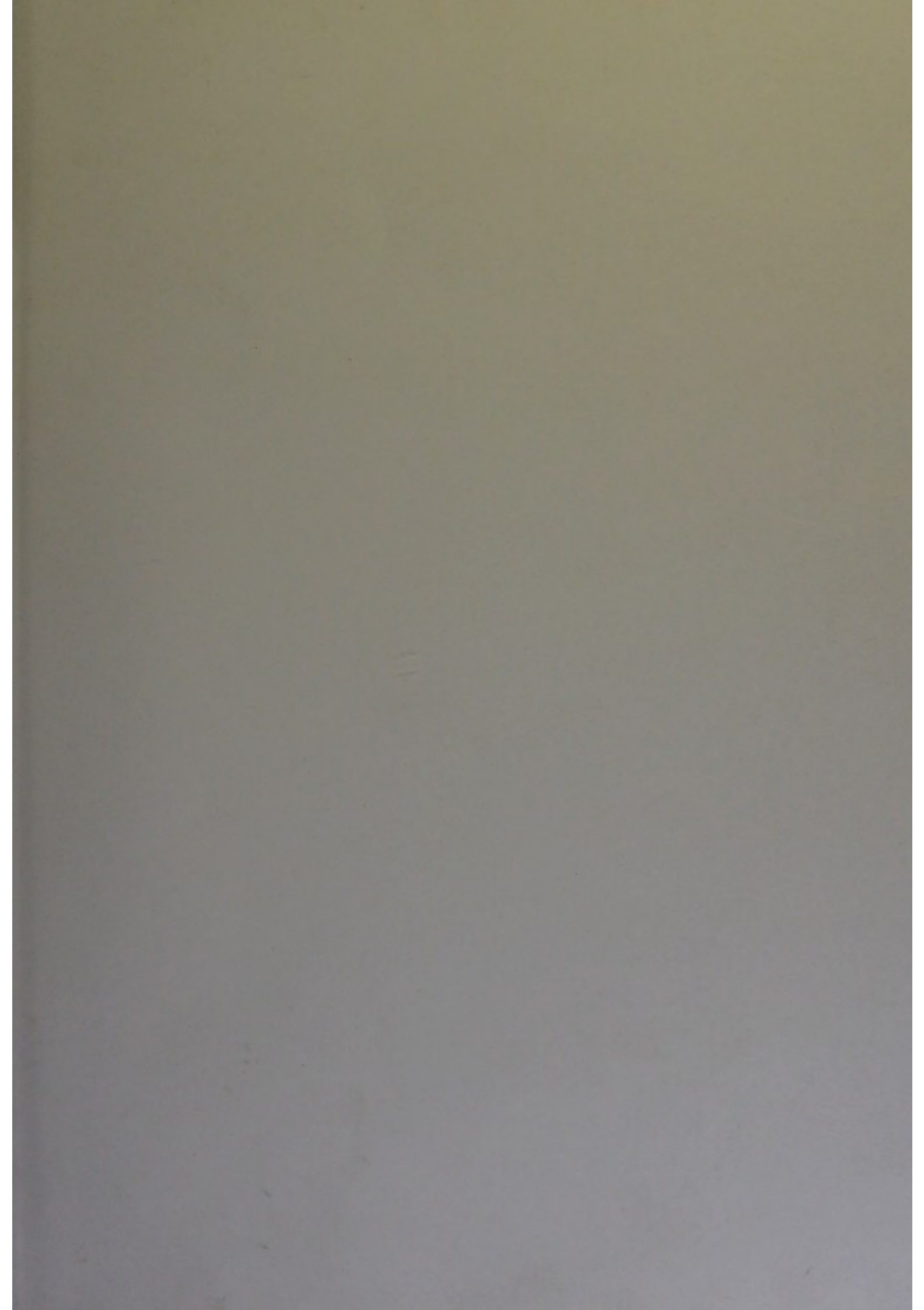
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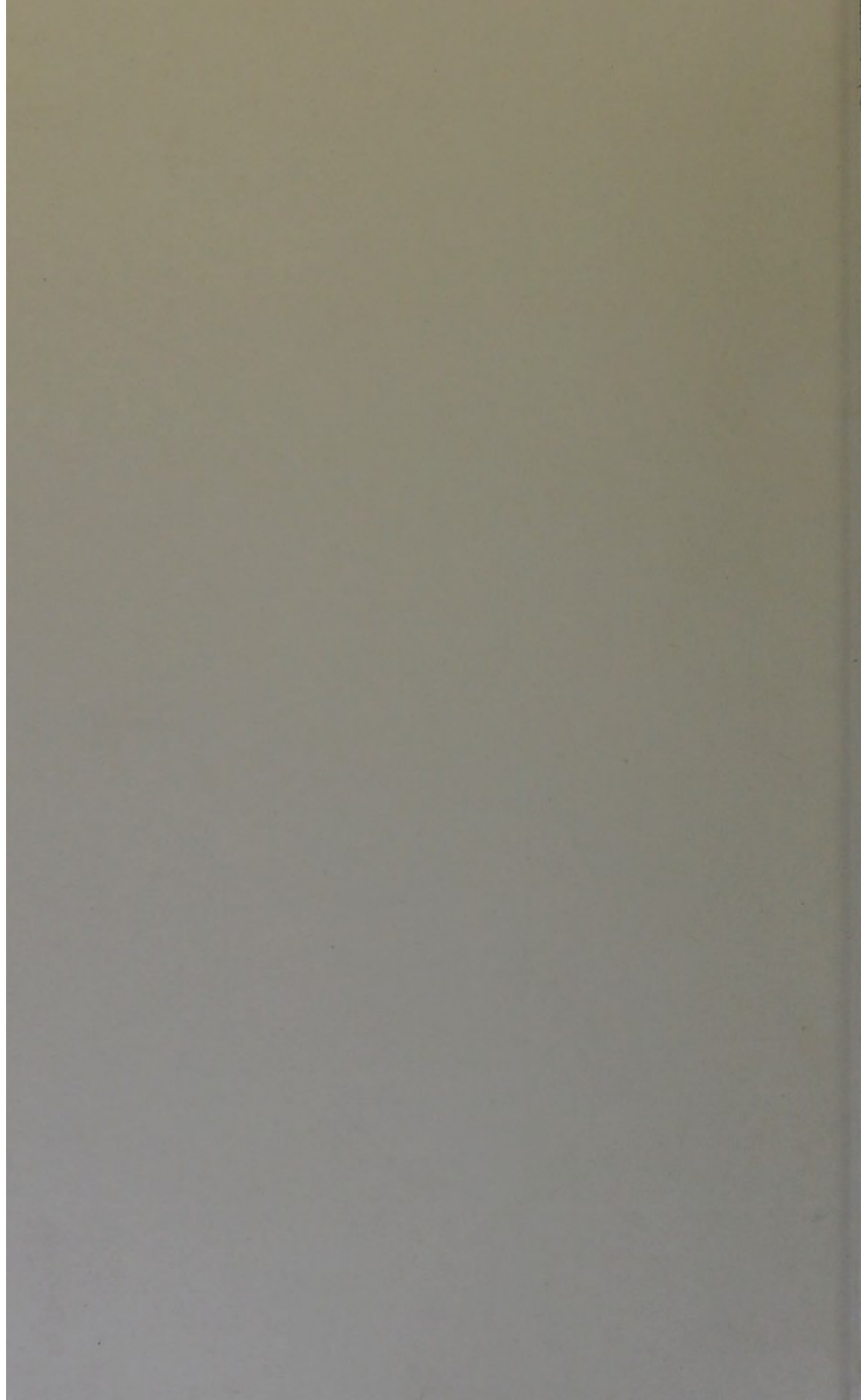
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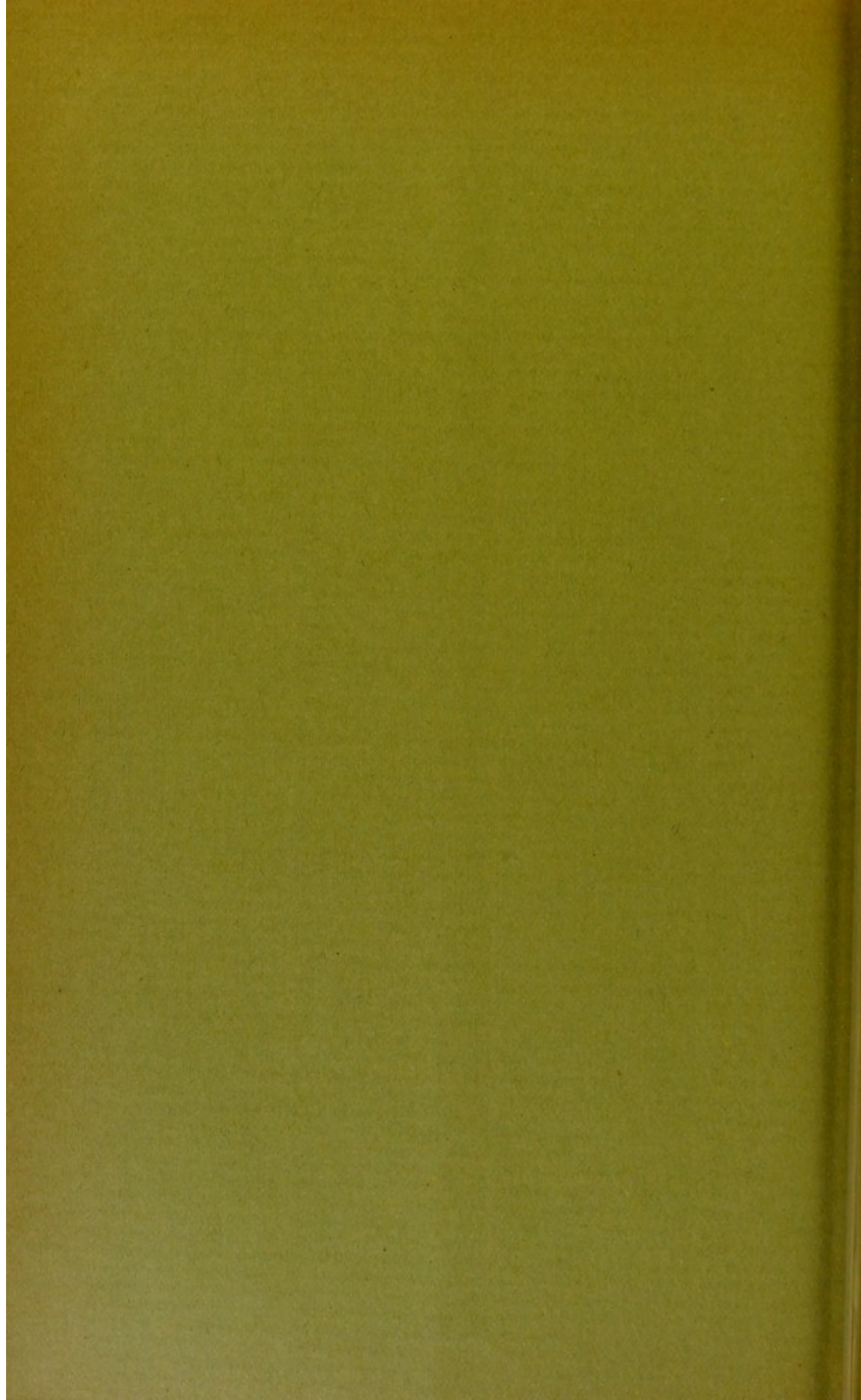


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SUBCUTANEOUS NAILING,
EXPLORATORY INCISION, AND
THE EXTENDED ELBOW IN
CONDYLOID FRACTURES OF THE
HUMERUS.

BY
JOHN B. ROBERTS, A.M., M.D.,
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FROM
THE PHILADELPHIA MEDICAL JOURNAL
1898.



SUBCUTANEOUS NAILING, EXPLORATORY INCISION, AND THE EXTENDED ELBOW IN CONDYLOID FRACTURES OF THE HUMERUS.¹

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(A contribution from the surgical laboratory of the Philadelphia Polyclinic and
College for Graduates in Medicine.)

IN accepting the invitation to take part in the discussion on Injuries of the Elbow, it is my desire to present in a succinct manner such personal opinions as will lead to a similar expression of views from other surgeons. That which I shall contribute to the debate, will advocate no very striking novelty in procedure and will record no conspicuous discovery in surgical pathology. It will simply show the conclusions in regard to certain problems in practical surgery at which I have arrived, after thoughtful consideration of personal experience, combined with a limited amount of experimental work and more or less familiarity with surgical literature.

These conclusions are, for the sake of brevity and clearness, formulated as definite propositions:

1. *Ankylosis of the elbow-joint after condyloid fractures is usually due to imperfect reduction of fragments or incomplete restitution of structural relations.*

The interference with mobility results largely from distinct alterations in shape of the articulating surfaces, due to the incorrect coaptation, though overgrowth of

¹ Read by invitation at the meeting of the British Medical Association in Edinburgh, July 27, 1898.

bone from stripped-up periosteum, and ossific depositions in the sero-ligamentous capsule aid in its production. Experience seems to show that mobility of the joint is, as a rule, promptly regained when the play of the olecranon and coronoid processes around the trochlear surface is not obstructed by bony displacement or new deposits. In persons of an arthritic diathesis intra-articular and pararticular adhesions may undoubtedly restrict motion, but these are not the usual cause of ankylosis after fractures of the humeral condyles. To hemorrhagic effusions into the joint have been attributed adhesions of newly formed connective tissue and thickenings of the synovial membrane; but these causes of ankylosis are relatively unimportant.

Powers, of Denver, has reported² an interesting instance of ankylosis in extension, after fracture at the elbow, in which exploration disclosed a broken-off coronoid process situated *behind* the joint. This was removed, part of the broken condyle chiselled away and the patient finally given almost perfect mobility of the elbow. This case is valuable in showing that displaced bone causes ankylosis, and that incision at the time of the reception of the injury would probably have permitted restoration of bony contour and prompt recovery of functional activity.

2. *Conservation of the normal angle between the axes of the humerus and the ulna is desirable.*

Much attention has been given in recent years to the possibility of fractures of the lower end of the humerus causing cubitus varus or "gunstock deformity" of the arm, thereby interfering with the so called "carrying function" of the upper limb. This deformity has been supposed to result from ascent of a detached internal condyle; descent or rotation forward and inward of a detached external condyle; and rotation forward and

Medical Record, 1896, vol. i, p. 615.

toward the middle line of the body of the condyloid mass, after transverse or comminuted fracture.

H. L. Smith, of Boston, believes³ that this deformity

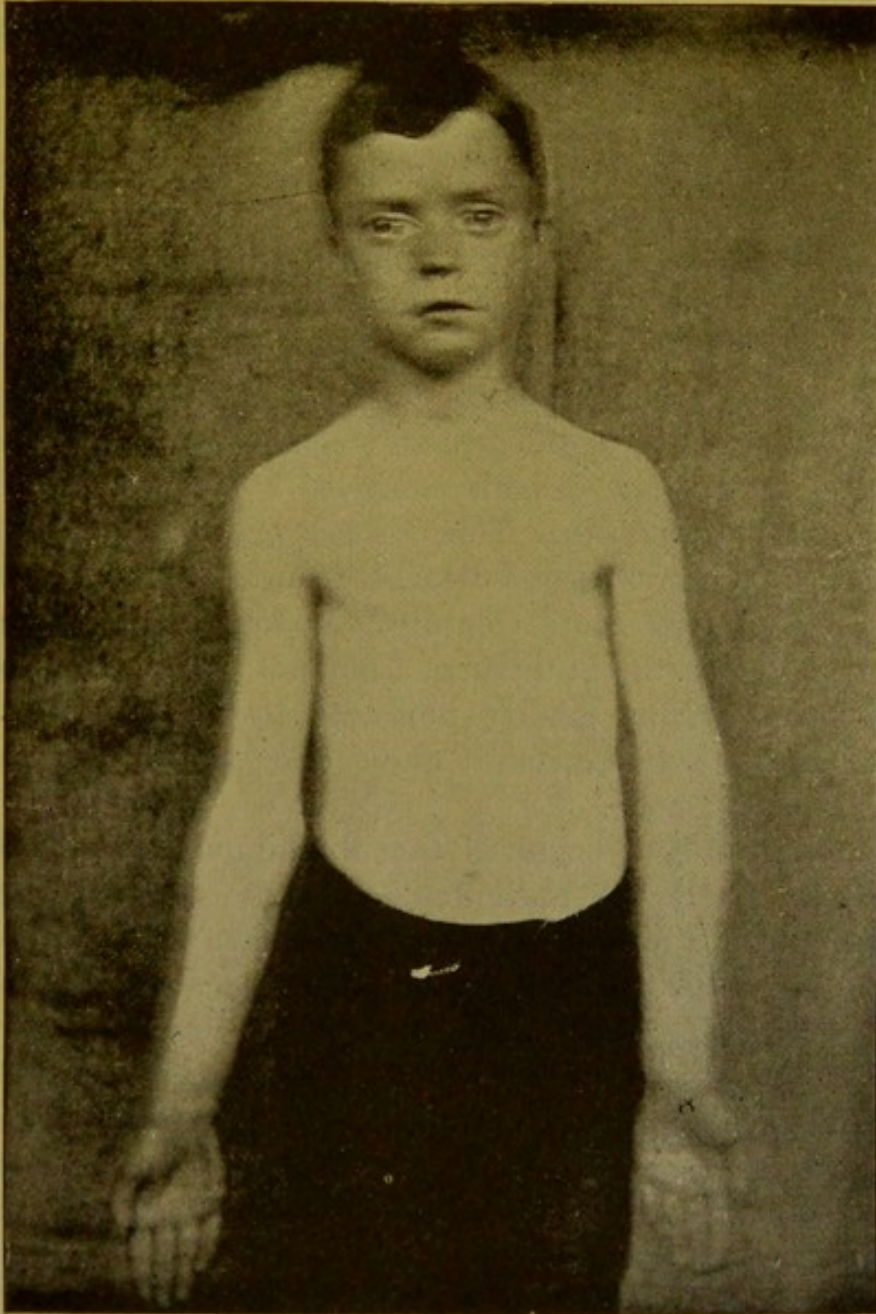


FIG. 1.—Gunstock deformity of the left elbow after fracture of the lower end of the humerus.

³ *Boston Medical and Surgical Journal*, October 18, 1894, p. 389.

is not likely to occur from fracture of a single condyle, but after a break traversing the entire width of the humerus; and he considers that the deformity has been given unnecessary importance in the determination of the best posture in which to treat fractures at the lower end of the arm-bone. Stimson, of New York, on the other hand, has asserted⁴ that displacement of a condyle, not exceeding $\frac{1}{4}$ inch or $\frac{1}{8}$ inch in amount, may effect a change in the humero-ulnar angle. The analogous displacements produced intentionally, by Ogston's condyloid and Macewen's supracondyloid osteotomy, for the relief of knock-knee, suffice to explain the mechanical factors in the production of gunstock deformity of the arm and convince me that fractures of one or of both condyles may produce the unsightly deformity. This I have proved by experimental fractures; some detaching the internal condyle, others causing more complicated bony lesions of the lower end of the humerus. I am not so certain of the deformity being readily produced by descent of the external condyle, when it alone is separated from the shaft of the bone.

It must be recognized that the humero-ulnar angle differs greatly in individuals. I have found it less conspicuous in children and women than in men; and believe it to be most marked in those of well-developed muscular power. Smith has found it to vary between -5° and $+30^{\circ}$, and he states that even in the same person the two uninjured arms may differ as much as from 10° to 15° . He also found that the width of the condyloid portion of normal arms differed on the two sides of the same person. The average variation in 50 cases measured was 3.1 mm. He investigated 75 cases of united fracture of the elbow, treated according to traditional methods, to find that

⁴ *Trans. American Surgical Assn.*, IX, 1891, p. 270.

the average difference on the two sides was 5.5 mm. The increased width was, if I correctly understand him, on the side injured. He makes the important statement that in 20 cases treated by *acute* flexion, the average difference in width after union was 4 mm., and

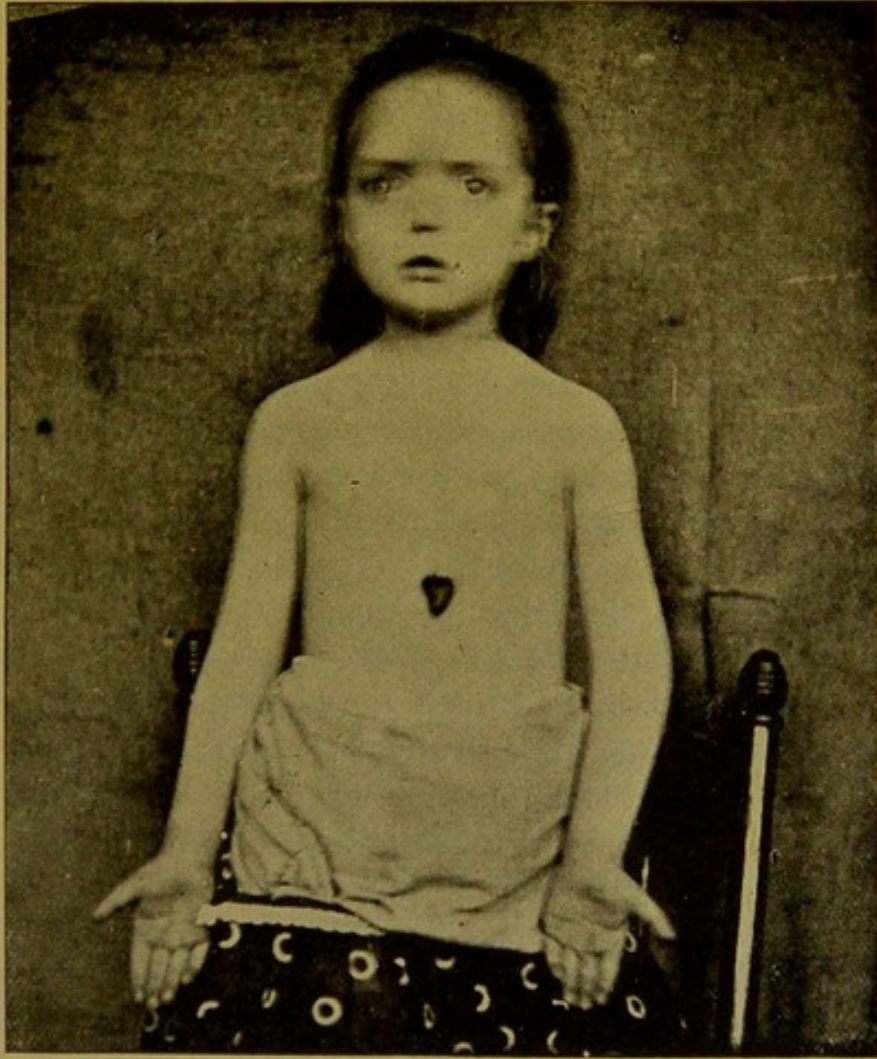


FIG. 2.—Gunstock deformity of the left elbow after fracture of the lower end of the humerus.

that in these same cases the carrying angle was unchanged in 40%. In the 75 cases treated by various persons in the ordinary ways the carrying angle was unaltered in 10%.

It is probably true that the conversion of the humero-ulnar angle into a straight line, or its change to an angle in the opposite direction, has little effect on the wage-earning capability of the patient; but it certainly produces an unsightly deformity, and impairs the symmetry and integrity of the human mechanism. It does not, of itself, interfere with the mobility of the joint. I recently saw a young lady who, about 15 years ago, when a child, broke the condyloid portion of the left humerus. I took part in the treatment of the injury, which was by means of a rectangular, trough-shaped posterior splint. She has marked gunstock deformity, as a result of the defective treatment, but has perfect mobility of the joint. The hand is, of course, brought nearer the thigh when the limb hangs vertically, but this defect brings no special inconvenience. It might, perhaps, be a disadvantage to a woman in the lower walks of life, who was compelled to carry burdens in the dependent hand. I refer to this patient because it was my dismay at the deformity remaining after the treatment adopted that first forcibly directed my attention to the disadvantage incident to right-angled flexion in the management of these bony lesions; and because she by chance came into my office, after many years' absence, while I was preparing this paper.

It is an acknowledged duty of the surgeon to restore, after injuries, the anatomic symmetry, as well as the functional usefulness. Hence, no extended argument is necessary to prove that it is best to adopt that line of treatment which will attain both ends. Retention of the normal humero-ulnar angle of a broken elbow is, therefore, not only desirable for cosmetic reasons, but is demanded by anatomic and surgical considerations.

3. *Fixation is satisfactorily obtained by nailing the fragments together with long nails driven through the skin.*

The occasional deformity and limitation of motion

resulting from fractures of the condyloid portion of the humerus are doubtless due, not only to incomplete reduction of the broken bone, but to imperfect fixation, which has allowed the properly readjusted fragments to slip again into abnormal relations. Stimson is, probably, not alone in his belief⁵ that, in "intercondyloid fracture with marked separation, there is no practicable means surely to maintain reduction." He says, further, that the impossibility of direct control of the fragments, the contraction of muscles, and the pressure of fascia combine to make the result largely a matter of chance. This opinion was confirmed, he states, by seeing and feeling in open fractures the difficulty caused by the shiftings of the fragments.

I have been making some experimental observations during recent months on the use of nails for direct fixation of fractures, having been led to the investigation by my success at the Philadelphia Polyclinic Hospital in nailing together the fragments of a metacarpal bone. I have found that fractures of the condyles of the humerus, made in the cadaver, can be satisfactorily fixed after reduction, by driving wire nails through the skin into the bone and across the lines of separation.

The accompanying skiagraphs show the method better than a verbal description.

I became convinced by this experimental work of the efficiency of fixation by means of slender nails, and of the wisdom of adopting the procedure in the comparatively *few* severe fractures of the humeral condyles needing direct fixation. I have had, however, no personal clinical experience of such operative treatment in elbow-injuries, and my opinion was based on inductive reasoning alone and the use of similar means in resection and osteotomy.

A few days ago I came upon Stimson's statement that

⁵ *Trans. American Surgical Assn.*, IX, 1891, p. 272.

in an open fracture of the condyles he had "felt constrained to pass a long steel pin transversely through both condyles and the long projecting end of the upper fragment, for in no other way could they be kept in apposition."⁶ I had undoubtedly seen this statement

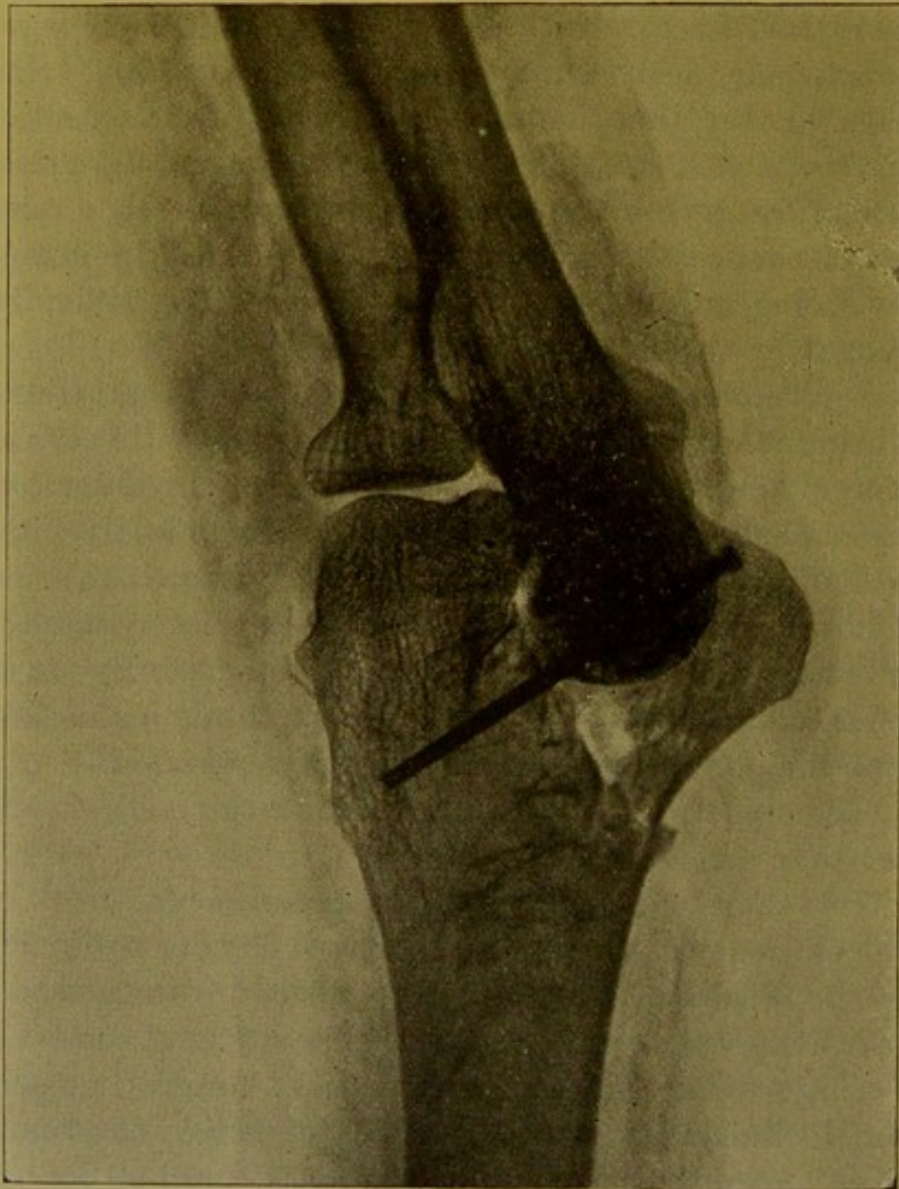


FIG. 3.—Experimental fracture of internal condyle (made with osteotome). Fragments kept in position with wire nail driven through skin. Skiagraph taken with dorsum on photographic plate.

⁶ *Trans. American Surgical Assn.*, IX, 1891, p. 272.

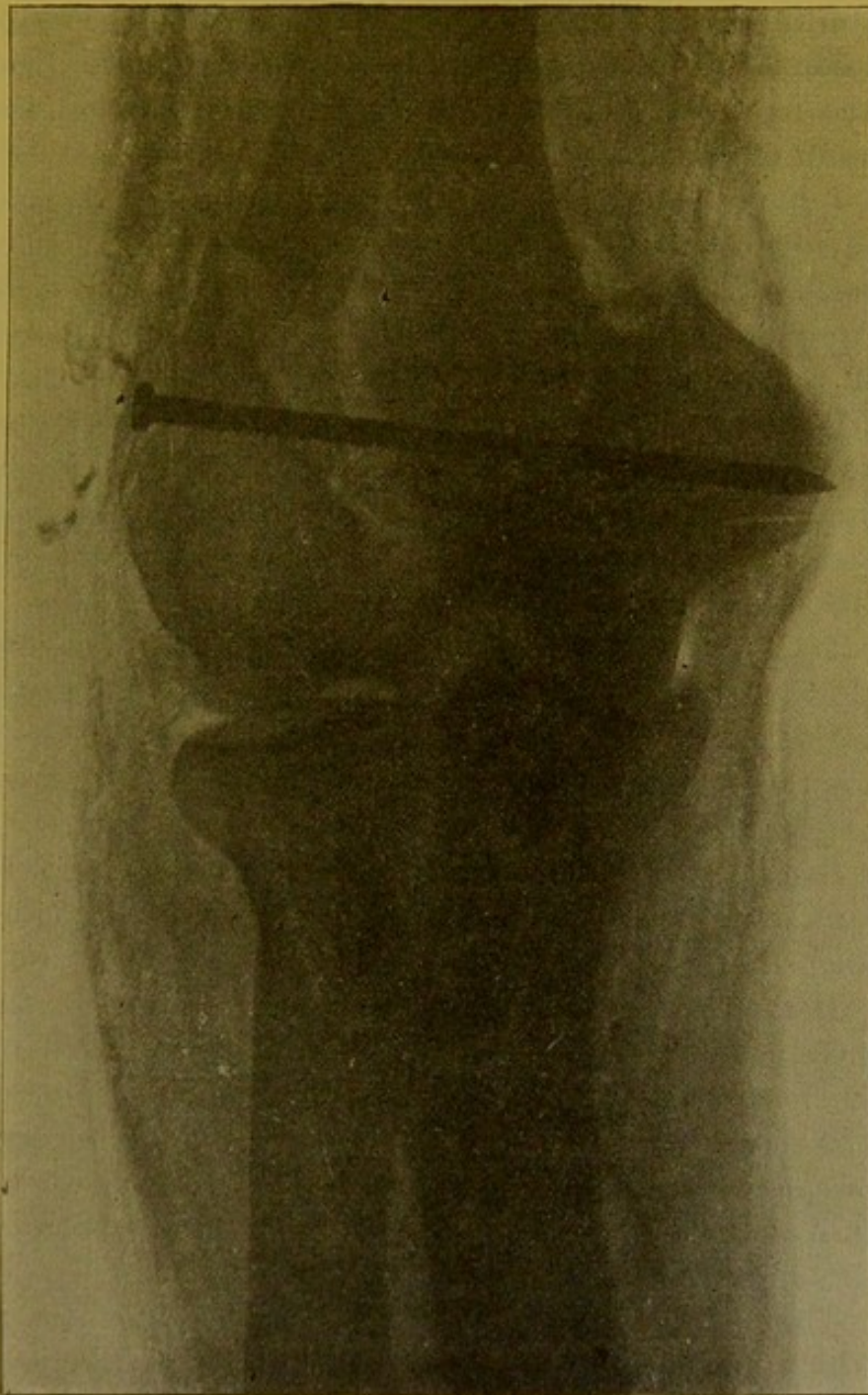


FIG. 4.—Experimental V-shaped fracture of condyles (made with osteotome). Fragments fixed with wire nail driven through skin. Skiagraph taken with anterior surface on photographic plate.

before, but had forgotten it. Stimson does not give the result, but I can see no reason to doubt that the coaptation continued satisfactory. If the operative field was free, and kept free, of septic contamination, the result ought to have been good.

I have had made special "fracture-nails" of tempered steel, with a drill-shaped point and a long, square head. These are readily pushed through the skin, muscles, and compact exterior of the bone by means of a handle that fits the head. The handle is then detached and the nails are driven into the deeper portions of bone with a hammer. After two, three, or four weeks the nails are pulled out with clawlike forceps. For convenience I have had a hammer-head made upon one side of the forceps.

During the driving of the nail or nails the fragments, already adjusted, are held by the fingers of the operator or assistant; and after fixation is accomplished an aseptic dressing and a light splint of wood, metal, paper, or gypsum may, or may not, be applied.

Ordinary wire nails and a hammer may be used with satisfaction, but the want of temper and point makes them rather less convenient.

If the nail first inserted does not effectively fix the pieces of broken bone, it should be withdrawn and re-inserted, or one or two additional nails should be used. The placing of the nails will be found much more easy in open than in closed fractures; and will require more skill and patience in comminuted fractures than in those in which there are but two fragments.

There will be but a limited number of fractures in which this operation is demanded, but it will, I believe, be found valuable in a certain proportion of cases. No one should attempt the operation unless he is a believer in asepsis and a conscientious exponent of modern aseptic surgical methods. Careless or incomplete aseptic

sis is not permissible. It is as reprehensible as in abdominal or cerebral surgery.

4. *Previous skiagraphs may be needed to aid in determining the point at which the nails should be introduced and the direction in which they are to be driven.*

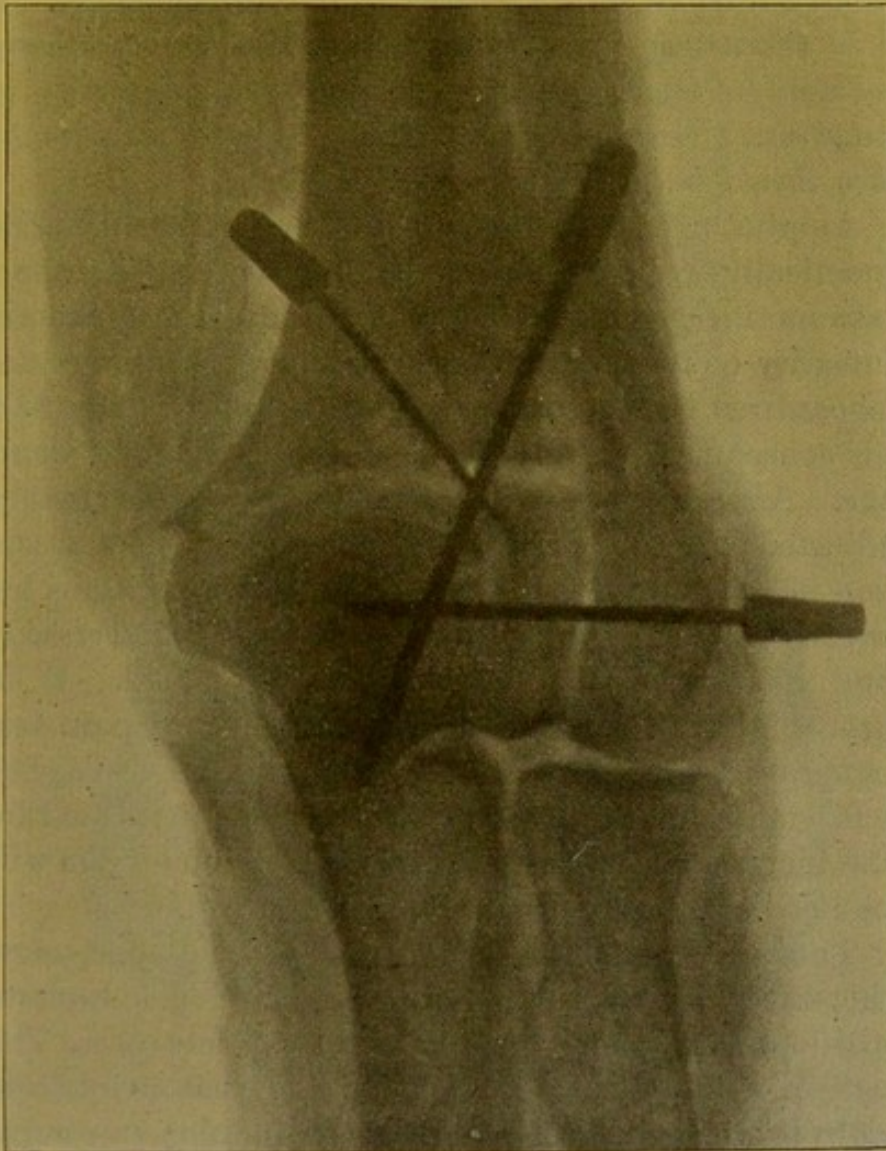


FIG. 5.—Experimental T-shaped fracture of condyles (made with osteotome). Fragments fixed with three "fracture-nails" driven through skin. Skiagraph taken with anterior surface on photographic plate.

If the exact direction of the fracture-lines cannot be determined by palpation and manipulation, the use of

the fluoroscope or, better, the study of skiagraphs, will often permit the surgeon to determine how best to nail the fragments together. If sufficiently definite information cannot be obtained by palpation, manipulation, and the use of the Röntgen-rays, exploratory incision is the safest course in severe injuries of obscure character.

5. *Obscure or severe fractures may demand exploratory incision for replacement of fragments and prevention of ankylosis. Such incisions are not employed as often as they should be.*

Aseptic incision of joints, being in competent hands practically free from risk to life, is demanded in a certain number of elbow-fractures, because the anatomic integrity of the joint and its functional usefulness are jeopardized by the surgeon's ignorance of the lesion and his consequent inability to repair the structural damage. After incision, the fragments can be accurately adjusted; the torn periosteum replaced; muscles, fascia and nerves disentangled from undesirable positions between the bone-fragments, and sutured if lacerated; and fixation of the fragments consummated. It is probable also that cure will be hastened and pain lessened by the removal of bloodclots and the leakage of synovial fluid and inflammatory exudate, permitted by the incision; and that fat-embolism and non-union will be less likely to occur.

The well-informed modern surgeon, who must know the safety of aseptic operations, should not hesitate to adopt exploratory incision in appropriate cases. The patient with a bad fracture of the elbow has an intrinsic right to the benefit derivable from incision in competent aseptic hands.

6. *The best route for this exploratory investigation is through the groove between the biceps and the long supinator.*

My investigations in the laboratories of the Phila-

delphia Polyclinic have led me to adopt, for exploration of the condition of the lower end of the humerus, a curved incision on the outer portion of the anterior aspect of the elbow-joint, which turns up a flap exposing the biceps and the long supinator. The cut begins at a point about 8 cm. above the tip of the external

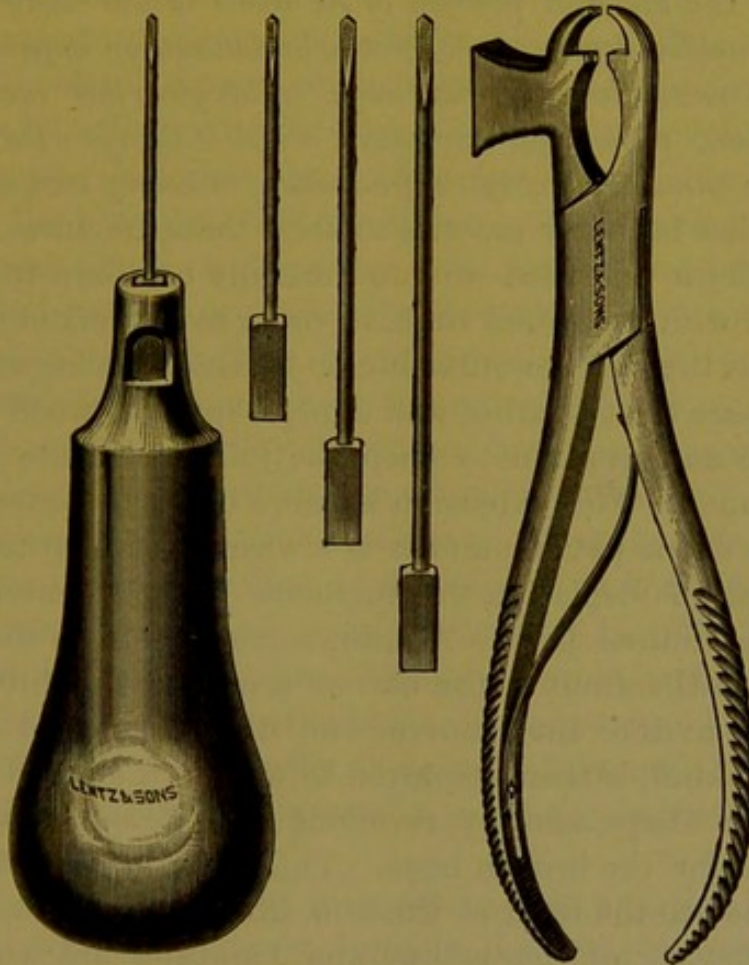


FIG. 6.

"Fracture-nails and Hammer-forceps."

condyle and ends about 6 cm. below the tip of the condyle. It is about 15 cm. long and convex toward the middle line of the arm, with the center of the curve corresponding with the point midway between the condyles. When this cellulo-cutaneous flap has been raised, the intermuscular groove between the biceps

and the long supinator is seen. Blunt dissection down this pathway discloses the front of the humerus and the anterior ligamentous covering of the joint. The musculospiral nerve will perhaps be seen, but it is easily preserved from injury. The entire width of the bone and joint is rendered accessible to touch and inspection.

7. *The extended position of the elbow is less likely than right-angled flexion of the joint to be followed by impairment of the normal humero-ulnar angle, which gives the "carrying function" to the upper extremity; and it is therefore the preferable posture in condyloid fractures of ordinary severity.*

It has been my practice to treat these fractures with the elbow extended and to carefully compare the injured with the sound limb, in order to preserve by my splints the humero-ulnar angle. I reduce the fragments, compare the two arms, and apply a splint of wood or of gauze and gypsum to keep the joint not quite fully extended. Full extension is more likely to prove irksome to the patient, and it is a wise precaution to run no risk of displacing the fragments by hyperextension of the injured joint. A thin, narrow board is usually laid on the front of the normal arm, and the direction of the axes of the humerus and ulna is marked on it. A penknife is then employed to whittle the board into proper shape, and, by reversing it, a proper splint is made for the broken bone. The splint is padded and applied to the front of the arm, little cotton is laid in the flexure of the elbow, and bandages are used to hold the splint in position. A gypsum-splint molded to the arm is more elegant, but is not always so conveniently obtained.

The extended elbow in these fractures has been advocated for various reasons. It has been said that it enables the surgeon to appreciate more readily any change in the deviation of axes than the right-angle position, which crowds up the soft tissues in

front of the joint and obscures the position of the fragments. The angular deformity, to be avoided, has been attributed to the displacing influence of the triiceps, which is relaxed by employing the extended posture. If the extended elbow is combined with supination of the radius the biceps is also considerably relaxed. The position advocated seems, therefore, to relax the important displacing muscles. Some writers allege that the displacement of the condyles and the destruction of the "carrying function" by right-angle splints is due to the fact that the radius lies at a higher level than the ulna, and that the splint and bandaging tend to bring them on the same level, thereby raising the internal condyle or depressing the external. I am inclined to believe, from experimental evidence on the cadaver, that this is to a certain extent true, though too much importance may heretofore have been accorded to it by us who advocate the extended elbow.

Strong clinical evidence of the worth of the extended posture is the assertion⁷ of Thompson, of Washington, who was able in two open fractures to keep the fragments in position when the arm was extended, but found that they were displaced if he attempted to keep them in position with the elbow at a right angle. Taylor, of San Francisco, reports⁸ a similar experience with a closed fracture.

It is unnecessary to intimate to this audience that Liston treated elbow-fractures in the straight position.

Thomas, of Liverpool, Jones, of Liverpool, Dulles,⁹ of Philadelphia, H. L. Smith,¹⁰ of Boston, and Bruce,¹¹ of Dingwall, Scotland, recommend *acute* flexion in the management of these injuries; but I have never

⁷ *Trans. American Surgical Assn.*, X, 1892, p. 58.

⁸ *Trans. American Surgical Assn.*, X, 1892, p. 65.

⁹ *Boston Med. and Surgl. Journ.*, August 30, 1894.

¹⁰ *Boston Med. and Surgl. Journ.*, October 25, 1894, and July 4, 1895.

¹¹ *British Med. Journ.*, 1896, II, p. 1201.

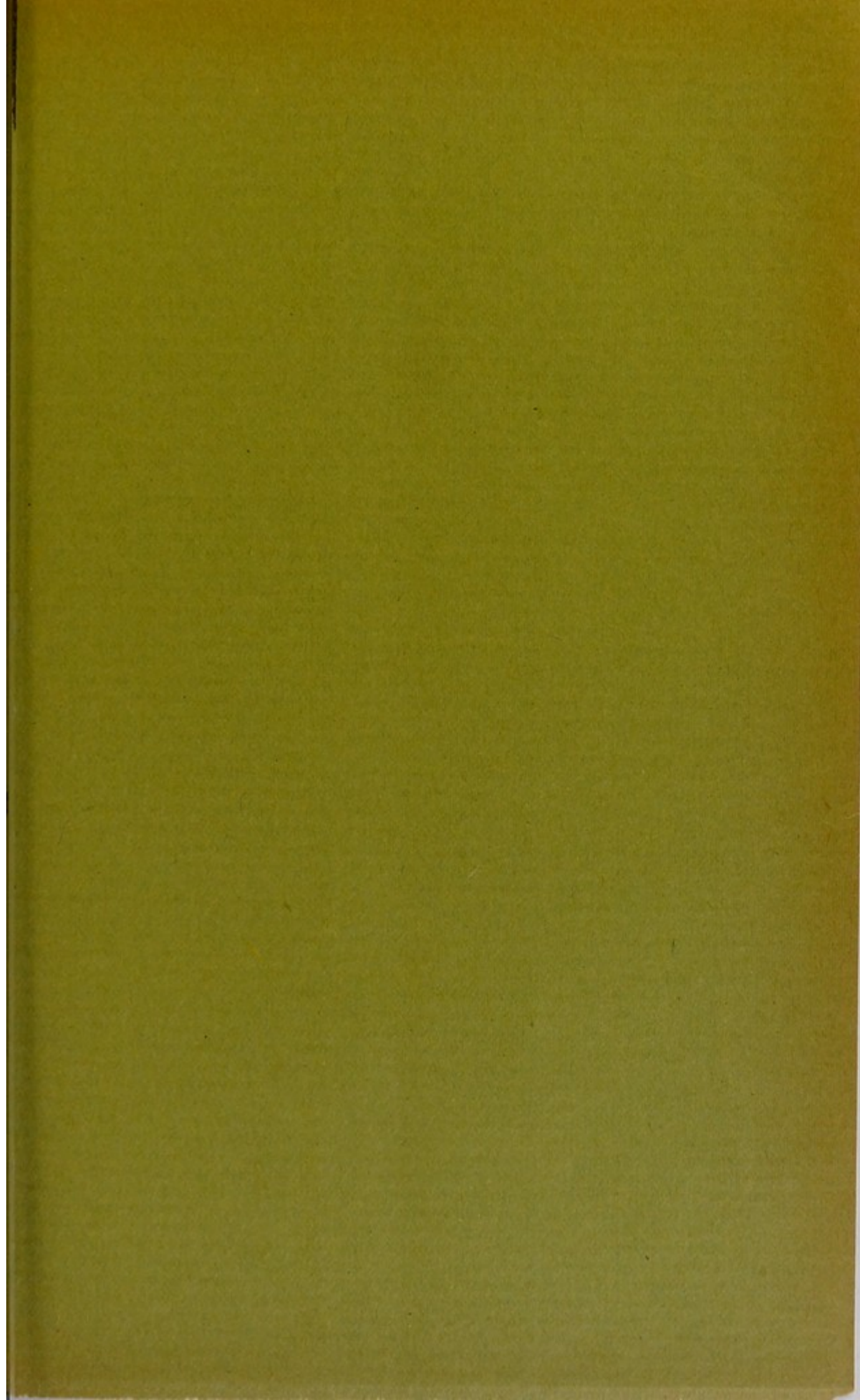
tried it, though some of my colleagues at the Philadelphia Polyclinic have had, I understand, satisfaction from its employ.

8. *Good results as to anatomic conformation and as to mobility can usually be obtained by the adoption of the measures suggested.*

This proposition is simply a corollary to the other statements of my paper and needs no elaboration.

9. *Osteotomy, with or without nailing, may be judicious treatment for fractures of the condyles united with deformity or followed by ankylosis.*

In July, 1878, I published in the *Edinburgh Medical Journal* an article advocating refracture for deformed union of fractures. In those days the investigations of Lister had not yet taught us all to make wounds almost with impunity; but since then the surgical world has recognized the value of osteotomy in correcting deformities, whether traumatic, trophic, or inflammatory. There is no valid reason why the same method should not be employed in elbow-fractures demanding relief for disability or deformity.



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