order that pulmonary embolism, resulting in infarction and hæmoptysis, may be averted. Acute and chronic pulmonary inflammations must be subjected to appropriate treatment, and earnest efforts made to establish a compensation for existing organic cardiac diseases.

The exciting causes of hæmoptysis most easily avoided are those producing active pulmonary congestion, such as violent physical efforts, mental excitement, great rarefaction of the atmosphere and the inhalation of irritating vapors and gases. The chief direct sequelæ of hæmoptysis are bronchitis, bronchopneumonia, anæmia, and asthenia. The first and second are to be treated in accordance with generally recognized methods. The anæmia and asthenia are to be combated with tonics, preparations of iron, nourishing food, moderate and regular out-of-door exercise in pleasant weather, and, if extreme, by alcoholics rationally administered. If no other cause for a given attack of hæmoptysis can be discovered, it should be regarded as a probable initial symptom of pulmonary tuberculosis, and appropriate prophylactic measures should be immediately inaugurated.

William H. Flint.

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HÆMOSTATICS.—Hæmostatic drugs are such as are employed to control hemorrhage. When the hemorrhage occurs upon an exposed surface or from some accessible cavity, ordinary surgical measures are usually resorted to; but if the bleeding is not amenable to surgical treatment or if it occurs in some deeply seated organ, it becomes necessary to make use of astringent and styptic drugs. These may be made to act directly upon the part by applying them to the bleeding point, or their hæmostatic effect may be obtained by internal administration.

Whenever bleeding occurs the efforts of nature are directed toward a spontaneous cure. There is at once a contraction of the injured vessel, the torn coats of the artery retract, and the escaping blood is coagulated by contact with the surrounding tissues and upon exposure to the air. Should the loss of blood be severe, there is a weakening of the heart's action and a lessening of the blood pressure which greatly aid nature's efforts. These changes afford us an indication for treatment, and it is upon these principles that we select our remedies and endeavor to overcome the trouble.

The local application of extremes of heat and cold is a very common and a very effective means of controlling hemorrhage. Ice almost immediately contracts the vessels and blanches the part, and the employment of very hot water produces in a similar manner a spasmodic contraction of the vessels, and exercises a more marked effect in coagulating the blood. The custom of applying cold to the thorax with the object of checking hemorrhage in the lungs, or to the abdomen when the intestines are the seat of the trouble, is of doubtful value, unless the bleeding vessels are close to the surface. Many hold that it may do more harm than good by driving the blood from the surface to the organs beneath. The application of heat to the spine, although less common, is probably a more rational mode of treatment, the heat being applied over the ganglia which control the nerve supply of the part. Both heat and cold are most effective when brought in direct contact with the bleeding surface. Lumps of ice may be swallowed in hæmatemesis, or inserted into the rectum or vagina if the intestinal canal or the uterus is the part affected. In the same way the application of hot water to the open wound, or a hot injection in uterine hemorrhage is always of service and much more desirable than a cold application if there is much depression.

The local actions of hæmostatics differ somewhat. Some cause a firm clotting of the blood and are termed *styptics,* while others produce their effect by acting more directly upon the vessels. Of the styptics, the best known are the salts of iron, especially the subsulphate and persulphate, alum, acetate of lead, and tannic acid, all of which, although they exercise a constringing effect upon the vessels, act almost entirely by causing firm, adherent coagulation, not only of the blood but also of the adjacent albuminous tissues. By the time when this mass becomes detached the bleeding points are obliterated and a healthy surface remains. The hæmostatics which act more directly upon the vessels are alcohol, oil of turpentine, a weak solution of acetate of lead, antipyrin, and suprarenal extract. Suprarenal extract, as well as its derivative adrenalin, is the most typical of this class, and is probably the most valuable local hæmostatic that we possess. It produces a most powerful contraction of the vessels, and this persists for a long time. A solution of adrenalin, 1 in 10,000, renders the conjunctiva or any of the mucous membranes almost devoid of blood. It has been much employed to secure bloodless operations upon the nose and throat, as well as to check hemorrhage from any mucous surface.

The effect of the internal administration of hæmostatics is not so definite, nor is it readily explained, but clinical experience has taught us that several drugs may be depended upon for their hæmostatic action. Ergot, hydrastis, oil of turpentine, and aromatic sulphuric acid have all proved of service. They act upon the muscular elements of the arterial coats, causing a marked diminution in the calibre of the vessels; their effect is particularly marked on unstriped muscular tissue.

Tannic acid and vegetable preparations the astringency of which is due to tannin, are much employed in this way and have been thought to be decidedly beneficial. Tannin, however, is never absorbed into the blood except as gallic acid, which does not coagulate albumen and possesses very slight astringent properties. Except in hemorrhages from the stomach and bowels, tannic acid probably exerts no true hæmostatic effect. In such cases the drug probably produces an astringent effect because it is brought into direct contact with the affected parts. The same argument applies to the use of the mineral astringents, as alum and acetate of lead, for they both actively coagulate albumen and are thought not to pass beyond the mucous membrane of the intestines. Lead, however, enters the circulation as an albuminate and has a decided action in causing muscular contractions. Its effect upon renal hemorrhage is marked, but upon other organs its value is not so certain. The action of alum is less certain; it is absorbed as an albuminate and exercises an astringent effect when excreted by the kidneys and skin Its beneficial action in hemorrhage from other organs is doubtful.

In addition to the help obtainable from astringent remedies, it is possible to derive considerable assistance, in our efforts to control hemorrhage, from the use of sedatives and revulsants, which secure rest and lessen congestive states. Formerly these ends were attained by such drugs as tartar emetic, aconite, lobelia, and tobacco, and from a resort to venesection. Excepting in cerebral hemorrhage these remedies are now never resorted to. Instead, we place the patient in the most favorable position to secure bodily ease and functional rest of the implicated organ. If the lungs are affected, talking is forbidden; if the bleeding is from the digestive organs, food is restricted and rectal feeding substituted. Opium is always of the greatest service. In all forms of hemorrhage there are much restlessness and mental anguish, which interfere with all our efforts to effect a cure. Opium overcomes this disturbance by putting the muscles at rest and by calming the mental irritability. It also favors functional rest, not only of the organ affected, but also of the heart and circulation. It should be given freely (opium, from one to three grains; or morphine, half a grain). The only contraindications to its employment are cerebral hemorrhage, or those conditions which are characterized by extreme prostration and by the fact that the respiratory function is markedly weakened. Active purgation must not be neglected unless the bleeding is from the stomach or intestines. Such remedies as calomel, compound jalap powder, elaterium, and croton oil produce free evacuations, lessen all congestive states of the abdominal and thoracic organs, and reduce the general blood pressure. *Beaumont Small.*

HAIR DYES, INJURIOUS EFFECTS OF.—Although it is unquestionably true that the injurious effects of hair dyes have been grossly exaggerated, physicians should bear in mind the widespread habit of dyeing the hair, when called upon to treat certain obscure nervous symptoms and atypical lesions of the skin. This habit is not new, nor is it one of the passing fads of the day. It has been handed down to us from the most remote antiquity, and its votaries are to be found not only among the peoples of the East, but also among those of the western hemisphere. Thus, for example, we find that even the primitive American Indian found it expedient to dye his hair. Therefore, in view of the prevalence of the custom and when we consider the very few cases that are thereby injured, we are justified in coming to the conclusion that the evil effects have been grossly exaggerated.

The animal, vegetable, and mineral kingdoms have all been drawn upon to furnish their quota of substances for dyeing the hair and beard, until finally modern chemistry has been called upon to perfect the art.

It would be beyond the scope of this article to enter into a full description of the several hair dyes and the substances that have been employed for this purpose; it will suffice us to make a short summary of the ones most commonly used, such as pyrogallic acid, walnut hulls, indigo, henna, curcuma, hydrogen peroxide, potassium bichromate, silver nitrate, salts of lead, copper and iron, and last, but not least, chloride of paraphenylendiamin.

The injurious effects of hair dyes may be divided into three classes: First, injury to the hair, second, injury to the general system, third, local injury other than to the hair

In the first class we would place hydrogen peroxide, which at the same time that it destroys the pigment extracts the fatty matter from the hair and thus destroys its vitality.

As an example of the second class the most common, most talked about is, of course, chronic saturnine intoxication with its attendant train of symptoms, wrist-drop, colics, etc.; this being due to the absorption of the salts of lead by the hairy scalp. At the present time we see little of this condition, but years ago it was relatively common.

In the third group we must place a number of trivial accidents, such as staining of the skin with the salts of such metals as iron, copper, manganese, silver, cadmium, etc.

The stains of iron, manganese, and cadmium may be removed by weak solutions of acids, while the brown stains of copper and the black stains of silver will be made to disappear by the application of cyanide of potassium and iodide of potassium.

Chromic acid or acid chromate of potassium will dye the hair yellow, but they are both caustic and poisonous.

The accidents brought about by pyrogallic acid and paraphenylendiamin chloride are more serious in character. Pyrogallic acid will sometimes produce, when used in sufficient strength anywhere about the face, a severe dermatitis with œdema, while if employed about the eyes it is apt to be followed by œdema of the eyelids, by conjunctivitis, and by extensive inflammation of the mucous lining of the nasal cavity.

Ever since the introduction of paraphenylendiamin chloride as a constituent of hair dyes many more instances of injuries due to hair dyes have been brought before the profession. The injuries that have sometimes followed the use of the drug include, among others, dermatitis of the hairy scalp, of the back of the neck, of the face, etc.—in fact, a dermatitis of that part of the skin that was brought in contact with the drug. In some cases the inflammation has extended to the neighboring parts, while Cathelmeau records a case in which the whole body was affected.

The character of the eruption varies from a slight erythema to a vesicular, papular, or pustular lesion; it may also be urticarial in character; œdema may be well marked, while pruritus may be intense. The eruption is sometimes accompanied by an elevation of temperature.

The *diagnosis* is sometimes attended with difficulty. Fournier gives as diagnostic points the suddenness of onset of symptoms, the rapidity of extension of the eruption, the enormous swelling of the eyelids. Sometimes the patients will aid us by connecting cause and effect. On the other hand, as in other conditions, too much reliance should not be placed on their statements, as they are apt to mislead us voluntarily or otherwise.

There is nothing special to offer in the way of *treatment;* these injuries should be treated exactly in the same manner as one would treat similar lesions in other conditions, provided that before the institution of any line of treatment the original cause be removed.

The *prognosis* is, as a rule, very good, although Brocq claims that in rare instances the condition proves rebellious to treatment. *N. J. Ponce de Léon.*

HAND.—Cresollius calls the hand "the minister of reason and wisdom." As the active servant of the brain, adjusted for the most delicate and varied uses, it has always been held in peculiar honor. The coat-of-arms of the surgeons' guild of the Middle Ages was a hand, with outspread fingers and an eye in their midst, typifying thus the noble art of chirurgie, which name was itself derived from χειρ, the hand, and ἐργον, work. Respect for this important member has even been carried so far that it has been supposed to contain a force within itself capable not only of intelligent action, but of transmission beyond the body. When we regard the high degree of muscular coördination which it possesses we readily see whence originates the first of these popular fancies, for the hand of the skilled musician, artist, or handicraftsman is a very different organ from that of the untrained and inexpert novice. The very word "handy" expresses this idea.

As to the second notion, it appears to be founded upon the extraordinary degree of tactile sensibility which the hand possesses. The laying on of hands has been a favorite method of healing from the very earliest historical period, and is still prevalent, not only where the royal touch is believed to be a sovereign remedy for "king's evil," but also among the so-called healing mediums.

The mesmeric passes were believed to be efficacious only when performed with the ends of the fingers, in order that the "force" might be drawn off into the patient's body. Von Reichenbach's patients saw flames of "od" force issuing from the ends of the fingers; many worthy people have no doubt that a nervous headache can be cured by some transfer of this force by means of passes over the brow of the sufferer; and we have lately had a revival of the old astrological theory of an "astral fluid" which is more transmissible from those with pointed fingers. Obscure nervous sensations felt in the fingers and along the nerve tracts are believed to be caused by this force or fluid. Owing probably to this superstitious reverence, we find that the physicians of the Middle Ages used the detached hand of a corpse for the scattering of tumors and the reduction of swellings.

The use of this strange remedy still survives. The author has recently found several authentic cases of such application. In one it was used for the cure of a white swelling, and in another for a protracted intermittent fever, a female homœopathic physician vouching for its efficacy. She explained this to the writer by stating that the "morbid processes going on in the dead hand attracted the disease and removed it" (!). Sometimes the virtue of the deceased is believed to have a marked influence. This was shown in the case of a well-known Catholic priest who died recently in Washington, and in that of a Carmelite nun in Baltimore. Many applications of the

dead hand were made in both cases for the cure of the sick and afflicted, showing that the old belief is still active.

Another superstition which had a prominent place in the black art of the Middle Ages was that of the "hand of glory." This was a dead right hand of a murderer prepared with appropriate conjurations, in which was placed a magic candle made of murderer's fat and the hair of the dead. This was believed to prevent sleepers from awakening and to open locks and bars. As late as 1831, such a hand was left by thieves in a house in Loughcrew, Ireland. Thieves in Mexico use for a similar purpose the left hand and arm of a woman dying in her first childbed, and in 1875 a Mobile negro carried around with him the hand of his murdered victim to insure himself against detection.

Sir Charles Bell, the author of the celebrated "Bridgewater Treatise on the Hand,"[1] says: "We ought to define the hand as belonging exclusively to man, corresponding in sensibility and motion with that intelligence which converts the being who is weakest in natural defence, to a ruler over animate and inanimate nature." However flattering to our pride this statement of the great physiologist may be, modern investigation has shown that it is not anatomically correct, as there is nothing in the structure of the human hand that distinguishes it, except in degree, from that of anthropoid apes. Even Huxley's statement, that the apes do not possess an extensor of the metacarpal bone of the thumb, is open to question. Comparative anatomy shows us in fact that a general typical form for the thoracic limb and hand pervades the entire vertebrate series. This is especially marked in the mammalia, and in many cases the student of human anatomy has no difficulty in determining at once the different bones of the forefect of an animal which he has never before seen. In one case within the author's experience, a professor of obstetrics who was not an anatomist, was obliged to examine a class in anatomy, and procured from the cabinet the skeleton of a bear's forepaw, which he passed around as belonging to the human skeleton. As the functions of the member vary, the different parts become reduced or increased either in size or in number, but a general plan pervades the whole, and the fin of a fish, the wing of a bird or a bat, the paw of an animal, are all constructed on a single type.

While the differences between the human hand and that of the higher apes are not essential, being only those of degree, yet the relative proportions of the different parts distinguish it markedly. The following table from Humphry shows the size of the hand and the foot relative to the stature taken as 100:

	Hand.	Foot.		Hand.	Foot.
Man.....	11.82	16.96	Chimpanzee ...	18.00	21.00
Gorilla	14.54	20.69	Orang	20.83	25.00

This superior length is due mainly to the metacarpal bones and phalanges.

With regard to the primitive origin of limbs two distinct views have been advanced by anatomists. According to the first the proximal part of the limb, which we are accustomed to call the shoulder or pelvic girdle (scapula and clavicle for the arm, innominate bone for the leg), arises from visceral arches of the vertebræ, and upon these radial bars of cartilage are set for the support of the fins. The pelvic girdle is thought to have become shifted backward in a marked degree. A complete homology, therefore, is believed to exist between the thoracic and the pelvic limbs.

The opposing view, which has recently been rapidly gaining ground, is that the shoulder and pelvic girdles are formed from coalesced vertebral elements. It is held that the most primitive form of limb is simply a lateral skin fold extending along the whole body, and that into this certain cartilaginous processes, or rays (actinophores of Ryder, pterygophores of Parker), extend. Each of these may bear several others extending radially through the fin. When necessary for more special forms of locomotion, the actinophores become united into solid bars constituting the shoulder and pelvic girdles, and the other skeletal elements are distally situated rays. Fig. 2439 shows various forms of fins found in primitive fishes; and it will be seen that there is a certain general resemblance to a hand with a large number of digits. According to this view there is no absolute homology between the thoracic and pelvic limbs, but only a homodynamy. Between fishes with fins and amphibia with feet there is a gap which has not yet been filled up by the discovery of intermediate forms, but it appears probable that the limb in its reduced state is the result of adaptation to walking instead of swimming.

In swimming it is necessary only to propel the body forward, in walking it must be also supported and raised; hence the necessity of the strong proximal bones and the bending at the shoulder, elbow, and wrist, and at the hip, knee, and ankle.

Fig. 2439, IV., shows how closely the plan of the hand and arm of an amphibian corresponds with that of man. From this point up through mammals there are many modifications, produced by the peculiar functions which the limbs are called upon to perform. When of use for prehension, digging, etc., the five-fingered type remains, and it is in fact the most persistent of all; but occasionally the occurrence of extra digits in the human species reminds us of a far-off ancestry, in whom the rays were more numerous. When the anterior limbs are used more for locomotion they become variously modified by stress and impact, and lose unnecessary digits. The reduction always takes place laterally. First the thumb becomes rudimentary or disappears, then the little finger, next the

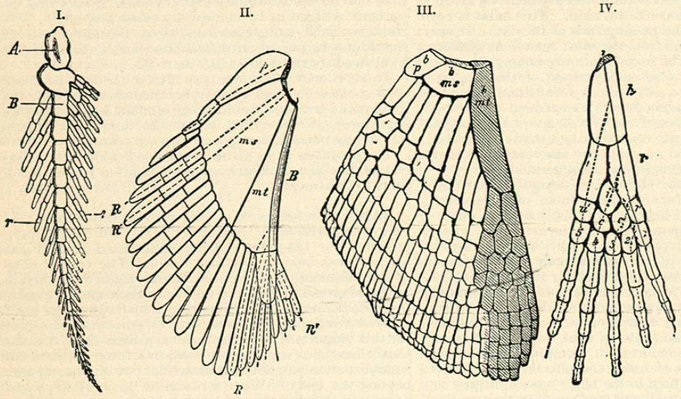

Fig. 2439.—Skeletons of the Thoracic Limb of Lower Vertebrates, showing the Gradual Development of the Hand.

second finger, then the fourth, and so on. The discussion of the various causes for this is of extreme interest, but would exceed the proper limits of this article. The principal typical forms are shown in Fig. 2440.

Embryological evidence as to the development of the hand agrees, as far as it can at present be understood, with the facts observed in the animal series.

The first rudiment appears as a thickening and crescentic protuberance (see Fig. 2441, *A*), which grows laterally from the body wall. Further outgrowth may be arrested at this point, and in that case we have a child born with a hand springing directly from the shoulder, a species of monstrosity reminding one of the flipper of a seal, and hence called phocomelus. Normally, however, other segments are developed between the first bud and the body wall (Fig. 2441, *B*), and in these the bones of the arm develop. The formation of the fingers is first indicated by notches along the edge of the distal bud from which converging grooves run, indicating the future interdigital spaces (Fig. 2441, *C*). The first groove that appears is that between the thumb and the forefinger. The terminal phalanges soon become free, but the remaining portions of the fingers are united until the third month. If development is arrested here, we have the fingers remaining with a web between them, as in the amphibian paddle and in some quadrupeds. The thumbs become free first.

The varied structures of connective tissue, cartilage, bone, muscles, nerves, and vessels all develop gradually within this rudimentary bud, as they do in other parts of the body, by a differentiation of mesoblastic cells.

Some interesting problems are connected with the time and order of ossification of the various parts. The typical plan of the hand is shown in Fig. 2439, IV. In the wrist there are originally nine bones, which are arranged in two rows; those of the first are named systematically, the intermedium, between ulna and radius, ulnare, radiale, and correspond to the scaphoid, semilunar, and cuneiform bones of man. There is then a centrale (sometimes two, as shown in the figure) found in many apes and rodents, represented in the second month of fœtal life by a small independent cartilage; and then, in a second row, carpales I., II., III., IV., and V., each bearing a metacarpal bone. The first three of these correspond to the trapezium, trapezoid, and os magnum, the fourth and fifth uniting to form the unciform. The pisiform bone is generally held not to be an essential carpal element, but a sesamoid developed in the tendon of the extensor carpi ulnaris. A radial sesamoid occurs in some apes, and is occasionally found in man.

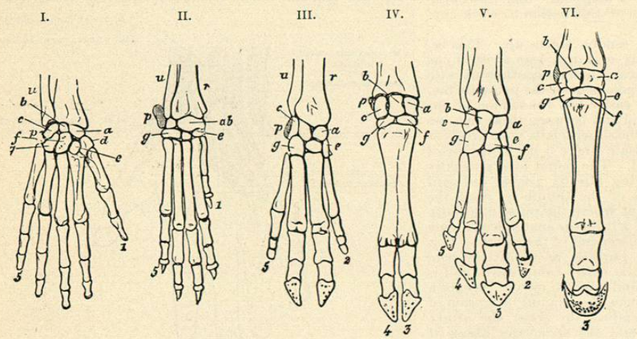

Fig. 2440.—Skeleton of Hand or Forefoot of Six Mammals. I., Man; II., dog; III., pig; IV., ox; V., tapir; VI., horse. *r*, Radius; *u*, ulna; *a*, scaphoid; *b*, semilunar; *c*, cuneiform; *d*, trapezium; *e*, trapezoid; *f*, os magnum; *g*, unciform; *p*, pisiform; 1, thumb; 2, index finger; 3, middle finger; 4, ring finger; 5, little finger. (Gegenbaur.)

At birth all the carpal bones are cartilaginous. Ossification begins in the os magnum (first year), then follow the unciform, cuneiform, semilunar, scaphoid, trapezoid, and trapezium in about that order, and at intervals of from nine months to a year, so that the carpus proper is complete during the eighth year. The pisiform is somewhat later, not ossifying until from the tenth to the twelfth year.

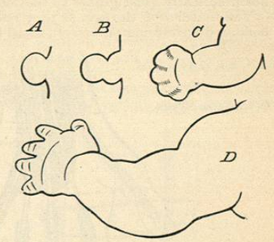

Fig. 2441.—Outlines of the Anterior Extremities of Human Embryos at Different Ages. (Allen Thompson, after His.) *A*, At four weeks; *B*, at five weeks; *C*, at seven week; *D*, at nine or ten weeks.

The metacarpals follow the rule of long bones and ossify much earlier, commencing in the shaft at about the ninth week of fœtal life, an epiphysis remaining cartilaginous. In the metacarpal bone of the thumb this epiphysis is at the proximal end, but in the others it is distal. The epiphysis begins to ossify about the third year. The phalanges ossify in a similar manner, but the epiphyses in them are always at the proximal end. The agreement in ossification between the first metacarpal and the phalanges has given rise to much speculation. It has been supposed to indicate that the missing bone of the thumb is not a phalanx, but a true metacarpal. Sappey[2] believes the metacarpal epiphysis to be the metacarpal proper, the remaining part being a phalanx, which would make the thumb agree with the other digits as to the number of segments, as is the case with some other mammals, the sloth, for example. The metacarpal bone proper has, he supposes, atrophied so as to allow the thumb to be set farther back and obtain more perfect opposability. It appears doubtful whether we ought to accept this interpretation, as a proximal epiphysis occasionally appears in the second metacarpal, and some animals have both proximal and distal. It is suggested that too much weight should not be given by osteologists to epiphysial ossifications, as it appears probable that their presence or absence depends very much upon the activities of the animal in producing strains upon the skeletal elements.

The hand is regarded as divided topographically into three regions: the wrist, middle hand, and fingers—corresponding to the skeletal divisions of carpus, metacarpus, and phalanges.

Region of the Wrist.—Externally this region is not very precisely defined. Its upper limits are generally regarded as marked in front by the upper transverse crease which runs across the forearm, always quite well marked even in extreme extension. Its lower limits are marked by another furrow, which curves around the base of the thumb. Behind, the marks of limitation are by no means as clear. Upon strongly extending the hand

(dorsal flexion) there appear three or more furrows which correspond in a general way to the joints of the wrist, viz., the radio-carpal, medio-carpal, and carpo-metacarpal. Although described as such by Malgaigne, they are not practically good guides to the joints in question.

The muscles of the arm as they reach the wrist all become reduced to comparatively small tendons, which pass

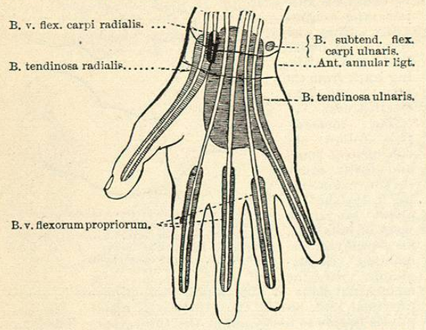

FIG. 2442.—Synovial Sheaths of the Palmar Surface of the Hand.

down over this region to be inserted below, the flexors lying on the anterior surface, and the extensors on the posterior and external. The wrist is, therefore, the narrowest part of the limb, and this affords an increased facility of motion to the hand as a whole. The bony parts are so arranged as to form an arch with the concavity forward, filled with the descending flexor tendons, and the great vessels and nerves. Under the skin of the anterior surface, which is smooth and without hairs, can easily be felt the prominent points of this arch, viz., on the radial side the tubercle of the scaphoid, on the ulnar the pisiform. These vary in prominence in different individuals. It is not uncommon for uninstructed persons to suppose that they have "a bone out," and unscrupulous quacks take advantage of this notion to work supposed cures.

Upon flexing the hand a tendon starts up. This belongs to the palmaris longus, and in a lean wrist it can be plainly seen to spread out and become continuous with the palmar fascia. On the radial side of the palmaris tendon, and close to it, can be easily felt the tendon of the flexor carpi radialis. Behind and between these two lies the median nerve. When the superficialis volæ artery is large, it may be seen to pulsate where it lies alongside of the tubercle of the scaphoid. The radial artery usually does not appear here, having already passed outward under the extensor tendons of the thumb to reach the back of the hand. The point where the pulse is usually felt is not, strictly speaking, within the anatomical region of the wrist, but upon the lower end of the radius. It is admirably adapted for the purpose, as the artery here lies upon a bony bed, may be easily compressed, and is about to make a sudden and abrupt curve. Hence a careful palpation shows at once the amount of tension of the arterial wall. By extending the wrist, the artery may be slightly stretched and the structures above it rendered tense, so that it may be still more easily felt. Occasionally the superficialis volæ is given off higher than usual, and makes a secondary pulsation, the "*pulsus duplex*" of old authors (not the pulsus dicrotus). In this case it is easy to control it by pressing it against the scaphoid. On the ulnar side, the flexor carpi ulnaris tendon shows prominently in flexion of the wrist, as it passes down to its insertion in the pisiform bone, and externally to this the pulsation of the ulnar artery may be felt. The tendons of the flexors of the fingers lie deeper.

The skin upon the front of the wrist is firmly bound to the deeper structures by a very thin layer of subcutaneous tissue, and it is therefore difficult to make a flap from it in amputating the forearm. Flexion has produced a number of transverse markings. These are the *rasceta* of the chiromants, a word derived from the Arabic, signifying wrist. There are usually three of these, and they are not only prominent in all states of the hand, but are found in fœtal life. An attempt has therefore been made to give them significance as characteristic signs, but when we reflect that the band of the fœtus is also movable and actively used, and that its condition is one of pronounced flexion of all the joints, it is not surprising, in view of the peculiar relations of the skin and subdermal tissue, that these as well as the lines of the palms should be formed.

Across the front of the wrist passes a thick band of fascia, called the anterior annular ligament. This being attached to the bony prominences on either side, confines the tendons in the deep carpal furrow or canal. The continual friction of the tendons along this furrow has caused extensive synovial sacs or sheaths to be formed. Occasionally but a single one occurs, enclosing all the tendons. The usual arrangement is, however, for two sheaths (Fig. 2442), one (*bursa tendinosa ulnaris*) surrounding the tendons of both superficial and deep flexors, the other (*bursa tendinosa radialis*) surrounding the tendon of the flexor longus pollicis. The ulnar sheath is almost always continuous with the sheath of the little finger, and amputation of that digit is therefore more apt to be followed by extensive suppuration than that of the index, middle, or ring fingers. These extensive synovial sacs are very troublesome when inflamed, as they may lead to extensive suppuration of the forearm, and, indeed, death has been known to follow. An amputation of the hand is much less serious.

Upon the dorsal surface of the wrist the skin is much more movable, somewhat hairy, and without prominent furrows. Under it may be seen two prominent, bony eminences—first, the round head of the ulna, second, the more obscure, pointed styloid process of the radius. From this latter, running toward the thumb, the tendon of the extensor of the metacarpal bone of the thumb appears on extension, and a short distance from it the extensor of the first phalanx. The triangular space between these

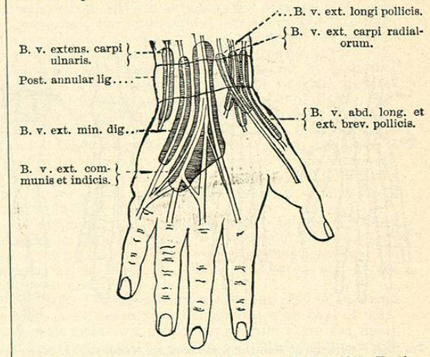

FIG. 2443.—Synovial Sheaths of the Dorsal Surface of the Hand.

has been called *la tabatière anatomique*, or anatomist's snuff-box, because it was formerly the custom, when snuff-taking was fashionable, to carry snuff to the nose in this little hollow (Hyrtl). By pressing deeply on this space, the beating of the radial artery may be felt as it passes under the tendons to reach the first metacarpal interspace, where it passes into the palm. It here rests on the scaphoid and trapezium. Over the back of the

wrist and hand the tendons which come down from above, and are at first closely pressed together, begin to spread out to go to their respective insertions. These tendons are, from within outward, those of the extensor carpi ulnaris, extensor minimi digiti, extensor communis digitorum, extensor indicis, and the extensors of the thumb. These tendons are also confined by an annular ligament, and are furnished with synovial sheaths, as shown in Fig. 2443. The affection popularly known as weeping sinew (ganglion) is rather common in connection with these sheaths.

The small bones of the skeleton of the wrist are undoubtedly of considerable value in breaking and dispersing the shocks transmitted from the lower hand. The general plan of its construction has been already alluded to. We may consider the radius as bearing, first, the scaphoid (radiale), which in turn bears the trapezium and trapezoid (carpales I. and II.), the supporters of the first and second metacarpals; second, the semilunar (intermedium), which bears the os magnum (carpale III.) and the third metacarpal. The ulna does not directly join with the wrist, its carpal bone, the cuneiform (ulnare), being separated from it by the triangular fibro-cartilage. This bears the unciform (carpales IV. and V. united) and the fourth and fifth metacarpals. The joints and ligaments of the wrist will be treated in a separate article.

REGION OF THE MIDDLE HAND.—The muscles which belong to the hand proper are arranged in two groups, one upon the radial side, making an elevation called the thenar eminence; another on the ulnar side, called by correspondence the hypothenar eminence. The upper part, where these two join, is called the ball of the hand, or by French anatomists *le talon de la main*. The central portion between the eminences is the hollow of the hand, and it can be contracted and deepened by the action of the muscles on either side. Because of this, it was called by the old anatomists *poculum Diogenis*, or Diogenes' cup, in allusion to the story that the cynic philosopher, on seeing a shepherd drink from his hand, vowed to henceforth use this, as the simplest possible utensil, instead of the rude wooden cup which he had heretofore deemed the acme of simplicity. Around this hollow are set the so-called "mounts" of chiromancy, governed, as is asserted, by the seven planets. The thenar eminence is styled the mount of Venus, and we may see a survival of the old notion in the fact that among the vulgar a titillation of this surface is believed to excite amatory passion.* It is possible that there may be an anatomical basis for this belief. An inspection of Fig. 2451 will show that the region in question lies in the boundary between the distribution of the ulnar and the median nerves, and is somewhat less fully supplied than are other parts of the hand. It is therefore, like other regions with the same character of nerve distribution, susceptible to that obscure form of nervous excitement called "tickling," which is known to cause a variety of reflex acts. We are as yet hardly sufficiently versed in the laws of transmission of impulses to decide absolutely that this may not have a reflex effect connected with the genital apparatus, especially if aided by an association of ideas.

The lower part of the hypothenar eminence is called by palmisters the mount of the Moon, its upper the mount of Mars. At the root of the four fingers are the other mounts, which anatomical peculiarities are caused by the insertion into the roots of the fingers of the strong palmar fascia, by slips between which the tissues bulge. The mount of Jupiter belongs to the index, Saturn to the mediums, the Sun to the ring finger, and Mercury to the little finger. That this absurd farrago is not entirely obsolete the author has had ample evidence, as several intelligent people have assured him that they believe that these eminences have power to attract the seven different qualities of "astral fluid," and the doctrine has been fully set forth in more than one serious treatise within the last ten years.[3,4,5,6,7,8] Indeed, it would seem as if the advances of science within the present century, instead of extinguishing ignorant pretension, had caused pseudo-sciences to spring up by the score. Dazzled and bewildered by the evidences seen on every hand of the power of science, those untrained in the exact methods of scientific research are unable to distinguish between the true and the false, and a vast field is left open for charlatans and visionaries. The old astrologists believed not only that the hand was governed by the influence of the stars, but that certain signs were fixed

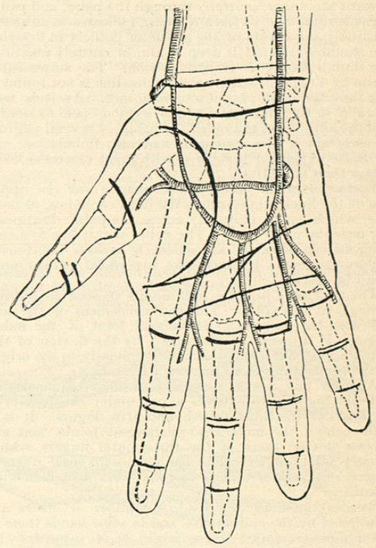

FIG. 2444.—Surface Markings on the Palm of the Hand. The thick black lines represent the chief creases on the skin. (Altered from Treves.)

upon it before birth, and became a basis from which to interpret the individual's character and constitution. Since this character and constitution have their limitations, signs for these also were found in the hand; and they further assumed that future events, such as sickness, death, and other matters of fortune or misfortune, could be foretold. There were many who went much farther than this into all the excesses of charlatanry.

The hand, being the servant of the mind, is modified and changed according to the use to which it is put; hence, say the palmisters, this organ is the appropriate index of character, and the lines of the hand, caused by the nervous influences actuating different muscles, and the tension and stress exerted on the skin, must be, if truly interpreted, a most significant guide. A little reflection will show that the modern disciples of palmistry have fallen into the same error as have the physiognomists and phrenologists, in that they expect to obtain exact and detailed particulars by examining physical characters which are highly generalized, being the result of a great number of separate physiological processes and acts.

Certain general notions as to bodily constitution, use, and adaptability can undoubtedly be made out upon the inspection of the hand; but there appears to be no warrant for any exact details. The principal lines are shown upon Fig. 2444.

* Iago says of Desdemona: "Didst thou not see her paddle with the palm of his hand? Lechery by this hand, an index and obscure prologue to the history of lust and foul thoughts."

It will be seen that they form, rudely, the letter *M*. The one running around the ball of the thumb and marking off the thenar eminence was known to the old chiromants as the linea vitalis, or line of life. Measurements along this, made by describing arcs of circles from the several mounts, were believed to represent different periods of life, and any break in the line at the points where these crossed was said to indicate sickness or death at that period. This, gravely set forth in all recent works on palmistry, also appears in books of the sixteenth century, and probably farther back.[9] This fold, with another which occasionally occurs running from the wrist toward the finger, centrally through the palm, and called the saturnine line, or linea fortunæ, indicates to an anatomist only the action of the adductor pollicis in drawing the thumb over, and is deep or almost entirely absent as the thumb has great or little flexion. The statement is made by Langer,[10] that the saturnine line is not found in any but those of pure Caucasian race. As it is well marked in the chimpanzee, this seemed open to doubt, and the author has examined the hands of several negroes to ascertain if the statement had any foundation. In all those examined it showed with great clearness, even better than in whites.

From the radial border of the hand, near the upper end of the linea vitalis, arises the linea cephalica, or head line, which passes obliquely across the palm, disappearing near the ulnar edge. The value of this line to a surgeon is considerable, as, where it crosses the fourth metacarpal bone, it marks the superficial palmar arch (see Fig. 2444).

The arch may in some individuals be seen to pulsate strongly at this point. The commencement of the line indicates the metacarpo-phalangeal joint of the index finger. It appears to be caused by the flexion of the four fingers, and corresponds rather closely to the origin of the lumbricales from the flexor tendons.

Another line, not so extensive, is the linea mensalis, or heart line, which extends across under the mounts at the bases of the third, fourth, and fifth fingers. It is a little behind the metacarpo-phalangeal joints, and expresses flexion there of the three outer fingers, which usually act together. The name mensalis was given it because the names of the mounts were also names of months.

Besides the lines described, a number of others are mentioned by the chiromants, and in some hands there is a complete network. These might be of value for the purpose of proving personal identity in medico-legal cases. The occupation of the individual may occasion marks, callosities, and discolorations of the skin, alterations of the nails and hairs, formation of special bursæ, and even changes in the articulations, muscles, and bones, which are of importance in determining identity. The limits of this article will not permit of a full treatment of this subject, which has been very carefully examined by Vernois.[11] The shape of the hand may be permanently altered by the use of tools. The epidermis of the horny hand of a laborer may be so thick as to prevent the eruption of an abscess. The subcutaneous connective tissue of the palm is composed of short and thickly set fibrous bands, which firmly unite the skin with the deep fascia, forming partition walls of little chambers which contain fat. When the tissue is cut through, these little adipose masses, released from their confinement, extend beyond the edges of the wound. This arrangement secures a considerable degree of elasticity and protection. Abscesses do not usually point under thicker parts of the subcutaneous tissue, but seek the ball of the thumb and the hypothenar eminence.

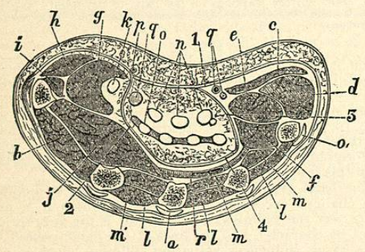

FIG. 2445.—Horizontal Section of the Hand through the Middle of the Thenar and Hypothenar Eminences. (Tillaux.) *a*, Metacarpal bone; *b*, first dorsal interosseus; *c*, palmaris brevis; *d*, abductor min. digiti; *e*, flexor brevis min. dig.; *f*, opponens min. dig.; *g*, flexor brevis poll.; *h*, abductor poll.; *i*, opponens poll.; *j*, adductor poll.; *k*, flexor long. poll.; *l*, dorsal interossei; *m*, palmar interossei; *n*, flexor sublimis; *o*, flexor profundus; *p*, superfic. volæ; *q*, median nerve, and (on inner side) ulnar artery and nerve; *r*, deep palmar arch; 1, palmar fascia; 2, outer septum; 3, inner septum; 4, deep fascia of palm.

The deep fascia is a strong and firm sheet, triangular in shape, the palmaris longus, its tensor, being inserted at the point of the triangle. Indeed, so continuously are the two united, that we may properly consider the fascia to be an expansion of the tendon. It occurs, however, when the muscle is wanting. Opposite the fingers it splits into four processes, which are inserted by these slips at the bases of the fingers and into the sheath of the flexor tendons and the first finger-joint. Acting through these slips, the palmaris acts therefore as a flexor of the fingers. A chronic shortening of this sheet is known as Dupuytren's contraction, and is always accompanied by a permanent bending of fingers. The little finger and ring finger are most affected; the thumb never, as it receives only a very insignificant slip of the palmar fascia.

A band of fascial fibres stretches across the roots of the fingers, and is known as the superficial transverse ligament. A thin fascia also separates the interosseous muscles from the rest of the palm. The metacarpal bones of all the fingers except the thumb are bound together at their lower ends by a strong strip called the transverse metacarpal ligament, and processes extend between this and the palmar fascia, making thus distinct chambers through which pass the flexor tendons as they go down to the fingers. It is through this passage that suppuration extends from the fingers into the palm.

Another series of orifices at the sides of the fingers permits the collateral vessels and nerves and the tendons of the lumbricales to reach the fingers.

The structures beneath the palmar fascia are contained in three compartments, which are separated by intermuscular septa; one (see Fig. 2445), external, separates the muscles of the thenar eminence and becomes continuous below with the sheath of the adductor pollicis, passing with it to be inserted into the third metacarpal; the other, internal, is attached to the anterior border of the fifth metacarpal, separating off the muscles of the hypothenar eminence. The middle compartment is the most important, as it contains, besides the flexor tendons and their accessory muscles, the vessels and nerves of the palm. The following table (on page 485) gives the principal facts regarding the muscles of the palm, as stated by the best authorities.

It should be noted that between the two heads of the flexor brevis pollicis the tendon of the long flexor of the thumb passes, lying in the groove of the trapezium. The deep head of this muscle (supplied by the ulnar nerve), as usually described, should rather be called a portion of the adductor pollicis, with which it is somewhat closely allied. The palmaris brevis probably, by its contraction, assists to protect the ulnar artery and nerve, which pass directly under it. When the fist is firmly clenched, this muscle assists in tightening the palmar aponeurosis, and its situation is marked by a little hollow on the ulnar side of the hand. It is not usually capable of independent action, but the author has found some persons who had the power to move it at will, thus wrinkling the skin. It appears to be a muscle derived from the panniculus carnosus, like the small muscles of the face.

	Origin.	Insertion.	Innervation.	Action.
THENAR MUSCLES.				
Abductor pollicis.....	Trapezium and annular ligament.	Base first phalanx of thumb.	Median	Abducts and rotates thumb and extends second phalanx.
Opponens pollicis	Trapezium and annular ligament.	Metacarpale I. along whole length.	Median	Brings first metacarpal forward and rotates it inward.
Flexor brevis pollicis ...	Trapezoid, os magnum, and metacarpales II. and III.	Base first palanx of thumb, with sesamoids.	Outer head median. Inner head ulnar.	Flexes and rotates first phalanx of thumb.
Adductor pollicis.....	Shaft of metacarpale III.	Base first phalanx of thumb.	Ulnar	Adducts thumb.
HYPOTHENAR MUSCLES				
Abductor minimi digiti.	Pisiform and tendon flexor carpi ulnaris	Base first phalanx digit V., with slip to extensor tendon.	Ulnar	Draws little finger away from others.
Opponens minimi digiti.	Annular ligament and unciform.	Ulnar border metacarpale V.	Ulnar	Draws little finger forward, narrows hand, and deepens hollow.
Flexor brevis minimi digiti.	Annular ligament and unciform.	Base first phalanx digit V.	Ulnar.....	Keeps phalanx firmly down in grasping.
Palmaris brevis	Palmar fascia and annular ligament.	Skin of inner border of palm.	Ulnar	Draws up integument on inner side.
MEDIAN MUSCLES.				
Lumbricales	Radial sides of tendon of flexor profundus digitorum.	Radial sides of tendons of extensor communis digitorum and first phalanges.	First two by median, last two by ulnar.	Extensors of last two phalanges, flexors of first phalanges when these are semiflexed by the dorsal interossei. The first and second are abductors and rotators, the third and fourth adductors and rotators.
Palmar interossei	Metacarpales II., IV., and V.	Bases of first plalanges digit. II., IV., and V.	Ulnar	Extensors of last two phalanges, adductors and rotators, flexors of first phalanges.
Dorsal interossei.....	Adjacent sides of metacarpals, more particularly upon those of the finger where insertion occurs.	Base of first phalanges digit. II., III., and IV., and to extensor tendon.	Ulnar	Flexors and abductors of first phalanges, and in slight degree rotators. The third extends last two phalanges.

The lumbricales are so called because of their round, worm-like appearance. The old anatomists, because of their use in flexing and extending the fingers, called them fiducinales, or fiddler's muscles.

Duchenne[12] noticed that in persons who were suffering from lead paralysis, and had therefore no control over the extensor muscles supplied from the musculo-spiral nerve, there was still some power of extension in the second and third phalanges. The statement made in the table as to the action of the lumbricales is that of Adam,[13] founded upon observations made on the cadaver, and with electrical excitation with special instruments.

Fig. 2446 shows the manner of insertion of the lumbricales, as well as that of the interossei and the flexor tendons.

Besides the muscles mentioned in the table, the tendons shown in Fig. 2446 lie in the hollow of the hand. As they approach the fingers, the tendons of the superficial flexor lie immediately upon those of the deep, and in fact embrace them in a groove upon their under surface, this groove deepening until it at last becomes a slit through which the tendons of the deep flexor pass. It is therefore impossible to cut the tendons of the superficial flexor without at the same time cutting those of the deep flexor.

The back of the hand is convex, and shows plainly the metacarpal bones. When laid upon a flat surface, it is comparatively flat, but when the flexor tendons act they pull the bones together in such a way as to increase the convexity. The adaptability of this for the purpose of firmly seizing objects may be seen by reference to Fig. 2449. When the fingers are extended and spread apart, the extensor tendons shown in Fig. 2447 are well displayed.

Shallow furrows appear between the tendons, and at the lower part of the dorsum the heads of the metacarpal bones become prominent. At the base of the fingers the skin becomes thinned out into an interdigital web semilunar in shape. The web between the thumb and the index finger is thicker and more marked than elsewhere, because it contains in front the adductor of the thumb where it becomes free from the first dorsal interosseous muscle, which covers it in the upper part of the interspace. As the skin and fascia on the dorsal surface of the web are thinner than on the palmar, abscesses of the palm which reach the base of the fingers usually discharge behind.

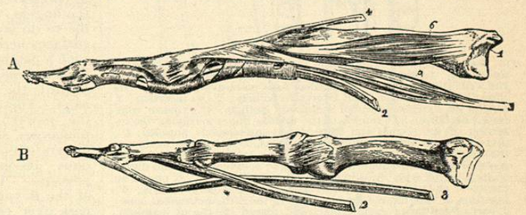

FIG. 2446.—Bones of Two Fingers, with the Insertions of the Tendons. (R. Quain.) In *A*, the tendons of the flexor muscles are bound to the bones by the fibrous sheath. In *B*, the sheath has been removed, as well as the vincula accessoria; 1, metacarpal bone; 2, tendon of the flexor sublimis: tendon of the flexor profundus; *, perforation of the sublimis by the profundus tendon; 4, tendon of the extensor communis digitorum; 5, lumbricalis muscle; 6, one of the interosseous muscles.

The skin of the dorsum is in many respects the opposite of that of the palm, being thin, easily movable, hairy, especially toward the ulnar side, and but slightly sensitive. Œdema is much more quickly shown here, the subcutaneous tissue being loose and numerous veins course through it. Some idea can be obtained of the tonicity of the vascular walls by noting their visibility through the skin. They vary much, however, in different individuals.

The deep fascia forms the sheaths of the tendons as they pass down. These tendons are arranged in two sets, which may be said to represent a superficial and a deep extensor similar to the arrangement of the flexors. To the superficial extensor belong the tendons of the extensor communis and the extensor minimi digiti, which pass down under the annular ligament almost vertically, diverging to their respective insertions after reaching the dorsum. The tendons of the communis, which go to the last three fingers, are united by oblique bands. This restricts the motion of the ring finger to a considerable degree, and it cannot be fully extended when the third or fifth digit is held firmly flexed. Subcutaneous section of these bands is sometimes resorted to for the purpose of giving pianists more independent movement of the