

ZANERIAN PENMANSHIP ANATOMY, PHYSIOLOGY, PSYCHOLOGY, ANALYSIS, AND HISTORY.

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A PICTORIAL EPITOMIZED HISTORY OF THE EVOLUTION OF WRITING FROM THE FIFTEENTH CENTURY TO THE PRESENT

The invention of the printing press, the spread of learning, and the development of commerce all combined to demand something swifter than the *Italic* and other print-like hands then in vogue. Such writing was "plain as print" but slow and labored in execution.

Style of writing used about the time the printing press was invented, 1450.

About the time Columbus discovered America, the Scribes discovered that by connecting the letters as shown in the following round hand, speed could be gained and effort lessened. Such writing was easier in execution than its predecessor, the *Italic*, and nearly as legible.

Style of writing evolved during fifteen hundred.

The spread of knowledge and commerce following the discovery and colonization of America, during the eighteenth century, demanded speedier writing, and the following light-line, connective hand sprang into existence. It was rapid, but, when carelessly written, somewhat illegible.

Style of writing employed during the eighteenth century.

LB 1540
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The New World and the new United States of America began to move more swiftly than any other, and, to keep pace with the events, the Angular hand responded to the new demand. It proved too illegible if written hurriedly and therefore did not come into universal usage.

Style of writing used first half of nineteenth century.

The progress of events by 1850 were pregnant with freedom, not only freedom for the black man, but for the white man's handwriting, as it was still somewhat labored and slow. The Semi-angular or Spencerian style was created to serve the double standard of beauty and business, which it unquestionably did as well as one servant can serve two masters.

Style of writing evolved about the year 1850.

The last decade of the nineteenth century saw the Spencerian merge gradually into a slightly smaller, more slanting and running, as well as somewhat swifter hand. Its loops were a trifle long and its angular turns somewhat illegible, but it was a step in advance of its predecessors.

Style of writing taught during the nineties.

The teaching of writing to children necessitated something simple and plain. The vertical met that demand, but failed to satisfy or meet the demands of business. It was suited to childhood rather than to commerce, and thereby failed in general usage at the hands of adults.

Style taught in public schools from 1894 to 1904.

Today the world demands writing that is plain, rapid, and easy. It must be easy to learn, easy to write, and easy to read. To be all of these, it must be simple and semi-round as well as semi-slanting. It must also be rapid and capable of being written with the arm movement instead of the fingers. Such is the following:

*Talent determines the nature
of one's success but weaknesses de-
termine its extent and power.*

As will be seen by a glance at the foregoing historic styles, whenever the world demanded faster writing the forms were changed to admit of freedom and speed. They did not add more speed to the old hands, but modified the style so as to allow speed to be applied without destroying the form. Just as in sailing the seas. For a while the sails sufficed, but the time came when more sails became burdensome and then they were abandoned and a new ship was invented. So it was on land. The stage coach and relay of horses did for a time, but eventually new coaches and new forces replaced the old. It is the old, old story of "necessity being the mother of invention."

A glance at the various styles and dates demonstrates that there has been progress in the art of writing more and more rapidly. Not more plainly but more speedily. This progress will doubtless continue. Change is the law of growth in the world of art, and writing is no exception to the rule.

Today the world demands plain, rapid writing. The hand combining plainness and ease of execution in the highest degree is the one to adopt and teach. Such is the last one illustrated as nearly as we can now portray it.

TECHNICAL AND DESCRIPTIVE ANALYSIS.

Letters have like and unlike qualities. Like qualities make them easy and rapid in execution, and unlike qualities make them legible and easy to read.

Analysis emphasizes these likes and unlikes, and acquaints us with the construction of letters, and therefore with their form and execution. No analysis means superficial knowledge of form, while too much analysis interferes with practice and robs the lesson of interest and enthusiasm.

Principles are forms common to a number of letters; the thirteen principles constitute the main portion of all of the small and capital letters. Study these principles critically, and learn them by number for convenience in studying, analyzing, and teaching the letters.

The greater number of principles a system contains, the easier is the analysis of the letters, as there are fewer modifications.

Principle One is a straight line, one space high, made downward, on the main slant of about 60 degrees. Used in all small letters but two.

Principle Two is a right curve, one space high and one space wide, made upward on the connective slant of about 30 degrees. Used in 23 small letters.

Principle Three is a left curve, one space high and one space wide, made upward on the connective slant of about 30 degrees. Used in 13 small letters.

Principle Four is a lower turn composed of principles one and two joined, being one space high and one space wide. Used in 20 small letters.

Principle Five is an upper turn composed of principles three and one joined, being one space high and one space wide. Used in 7 small letters.

Principle Six is a double turn composed of principles three, one, and two joined, being one space high and two spaces wide. Used in 5 small letters.

Principle Seven is a loop composed of principles two and one joined, being three spaces high and one space wide, crossing one space high, the loop part being one-half space wide. Used in 5 small or extended letters.

Principle Eight is principle four inverted, composed of principles one and three joined, three spaces long, extending two spaces below the base line. Used in 4 small or extended letters.

Principle Nine is an oval or ellipse, composed of principles three and two modified, three spaces high and two spaces wide, the left side being made first and downward. Used in 5 capitals.

Principle Ten is a modified reverse oval with a loop beginning with principle two modified. Used in 2 capitals.

Principle Eleven is principle ten modified by converting the down stroke into a straight line. Used in 5 capitals.

Principle Twelve is principle eleven modified by converting the down stroke into a reverse compound curve. Used in 4 capitals.

Principle Thirteen is a compound curve composed of principles three and two modified, finished with a dot one-half space high. Used in 7 capitals.

The letter **i** contains one angle, one turn, one dot, and three strokes. It is also composed of principles 2 and 4.

The letter **u** contains two angles, two turns and five strokes, being sharp at the top and rounding at the base. It is composed of principles 2, 4, and 4.

The letter **n** contains one angle, three turns, and five strokes. It is composed of principles 5 and 6. It is also the same as **u** in height and width.

The letter **m** contains two angles, four turns, and seven strokes, and is like the **n** except that it contains one more principle. It is composed of principles 5, 5, and 6.

The letter **x** contains two turns, two angles, and four strokes. It is composed of principles 5 and 4 by retracing a portion of the first part with the second.

The letter **v** contains two turns and for a finish a short retrace with a connecting stroke composed of principle 2. The letter is composed of principle 6 and finish.

The letter **w** contains two angles, two turns, and a finish as in **v**. It is composed of principles 2, 4 and 4.

The letter **e** contains a loop, and is composed of principles 2 and 4 joined by a turn.

The letter **c** is composed of principle 4 with a dot and turn at the top.

The letter **o** is an ellipse. It is composed of principles 3 and 2, and a finish as in **w**. The principles are modified by being shortened, more curving, and less slanting.

The letter **a** contains an oval, one angle, one turn, and four strokes. It is composed of principles 3, 2 and 4. Principle 3 is modified by being made downward. It is an **i** without the dot and with principle 3 added.

The letter **r** contains one acute and one obtuse angle, and one turn. It is composed of principles 2 and 4. Both are modified slightly. It resembles **i** with a shoulder or hump in the back.

The letter **s** is composed of principles 2 and 2, the last being made downward and more curving.

The letter **t** contains an angle, a turn, and a retrace; also a letter **i**. It is composed of principles 2, 1, and 4, and a horizontal straight line.

The letter **d** contains one angle and one turn, and an **i**, a and uncrossed **t**. It is composed of principles 3, 2, 1, and 4.

The letter **p** contains an inverted **d** with two angles. It is composed of principles 2, 1, 3, and 2. Principles 2 and 1 are modified by being lengthened.

The letter **l** contains a loop and turn, and an **i**. It is composed of principles 7 and 2.

The letter **b** begins the same as **l** and finishes the same as **w**. It is composed of principles 7 and 2, and finishes as **v**.

The letter **h** contains a loop, one angle, and two turns. It begins as **l** and ends as **n**. It is composed of principles 7 and 6.

The letter **k** contains a loop, an open oval, and one angle, and one turn. It begins and ends the same as **h**, and is composed of principles 7, 3, 2, and 4. Principles 2 and 3 are modified.

The letter **j** begins the same as **i**, and contains an angle, loop and dot. It is composed of principles 2 and 8.

The letter **y** begins as **n** finishes, and ends as **j**. It is composed of principles 6 and 8, and contains two turns, one angle, and a loop.

The letter **z** begins like **n** and ends like **y**, and contains one turn, one angle, and a loop. It is composed of principles 5 and 8, the latter being modified at the beginning.

The letter **g** begins as **a** and ends as **j**. It contains an oval, angle, and loop. It is composed of principles 3, 2, and 8.

The letter **q** contains a complete **a** and **i**, and a loop. It is composed of principles 3 and 2, 1 and 2 modified, and 2.

The letter **f** contains an **l** and **i**, and begins like the former and ends like **q**. It is composed of principles 7, 1 and 2 modified, and 2.

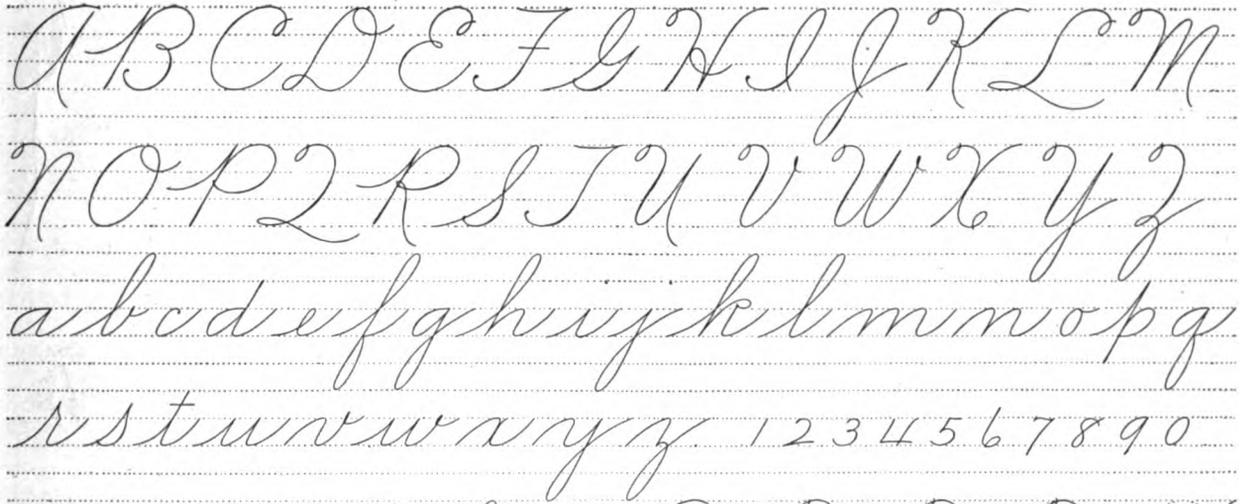
The letter **O** is an ellipse and is composed of principle 9 with a lateral curve ending upward.

The letter **A** is much like an enlarged small **a**, and is composed of principles 9 and 1 modified in direction, proportion, and length.

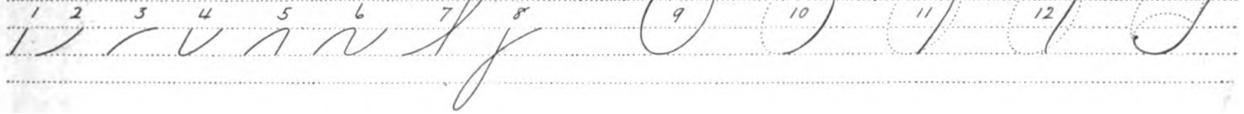
The letter **C** is composed of principle 9 modified, and resembles the small **c**, but is more rounding.

The letter **E** begins and ends as **C**, and is composed of principle 9 with a loop in the center.

The letter **D** begins with principle 13 and ends as the **O**. It is composed of principles 13 and 9 modified.



The Thirteen Principles Comprising the Letters.



The letter P resembles the small p, and is composed of principles 2, 1 and 10 modified; the 1 in length, and the 10 in shape, size and direction.

The letter B resembles P and the inverted E. It is composed of principles 2, 1, 10, and 10 modified, and contains one angle, one retrace, two open ovals, and one loop.

The letter R contains a P and a finish similar to A. It is composed of principles 2, 1, 10, and compound curve, and contains one each of the following: Retrace, oval, loop and turn.

The letter K is composed of principles 11, 13, and compound curve, the 13 being modified. The letter ends the same as R.

The letter H begins the same as K and ends the same as O. It is composed of principles 11, 3, 1, and loop finish.

The letter N begins as H and ends as A. It is composed of principles 11 and 5, the latter being modified.

The letter M begins and ends the same as N, and looks like a tall small m. It is composed of principles 11, and 5 and 5 modified.

The letter V begins as N and ends as small v. It is composed of principle 12 and principle 2 modified.

The letter W begins and ends as V, and is composed of principle 12 and principles 2 and 4 modified by being made longer. It also resembles the small w.

The letter U begins as V and ends as A. It is composed of principle 12, and principle 1 modified.

The letter Y begins as U and ends the same as small y. It is composed of principle 12 and principles 2 and 8 modified.

The letter J is composed of principles 3 and 8 modified. It finishes the same as small j.

The letter I begins like J and ends like S. It is composed of principles 3 and 13 modified.

The letter X begins as H and ends as H, principle reversed. It is composed of principle 10 and 10 reversed.

The letter Z begins as X and ends as the small z. It is composed of principle 10, and principle 8 modified.

The letter Q begins as Z and ends with principles 3 and 2. Note the difference in the loops of Z and Q.

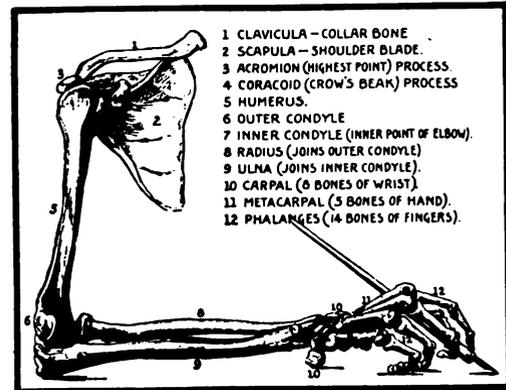
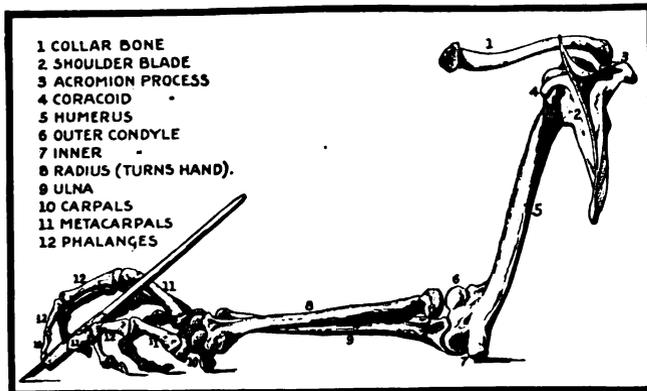
The letter L begins as C and ends as Q. It is composed of principles 13, 3, and 2 modified.

The letter S begins as I and ends as s. It is composed of principles 7 and 2, or 7 and 13.

The letter G begins as S and ends with principle 13 modified. It is composed of principles 7, 2, and 13 modified.

The letter T is composed of principle 1 made horizontally and principle 13.

The letter F is the same as T with a cross similar to that of the small t.



PENMANSHIP PHYSIOLOGY.

The human body, particularly the hand and arm, is a machine by which writing is done. To develop, care for, and train this machine, one needs to understand it, else injury may result.

The parts most directly related to writing are the fingers, hand, fore and upper-arm, and shoulder. These parts are composed of bones, muscles, ligaments, tendons, blood vessels, nerves, tissue, etc., etc.

The nerves stimulate activity as well as convey information. The blood vessels convey food to the muscles, bones, nerves, and tissue. The bones serve as levers for action, and as a framework. The muscles are the agents of motion, acting upon the levers from the impulse from the nerves.

The hand contains twenty-seven bones as follows: 8 carpals (in the wrist), 5 meta carpals (in the palm), and 14 phalanges (in the fingers). The forearm contains two bones: the ulna which joins the under point of elbow and the little finger side of the hand, and the radius which joins the thumb side of the hand and the upper part of elbow. The upper arm contains one bone called the humerus. The shoulder contains three bones: the head of the humerus, the scapula or shoulder blade, and the clavicle or collar bone.

The muscles which move the fingers and open and close

the hand are situated in the forearm, the larger portion being in front of the elbow. The muscles which move the forearm and cause it to act as a hinge at the elbow are situated in the upper arm between the elbow and shoulder. The muscles which move the upper and consequently the whole arm, are situated back, on top, and in front of the shoulder.

Thus it is that the muscles which move the forearm are situated on the upper-arm and somewhat removed from the member in action or being acted upon. These muscles act much as the string and pulley as illustrated on page fourteen. Large, powerful muscles are therefore used to create many, small, rapid, continuous motions as used in writing.

These muscles are taught to act quite quickly and rapidly by correct and persistent training. The exercises, principles, letters, letter-exercises, words, etc., usually given are used as penmanship gymnastic exercises to train the muscles to do the mind's bidding. It is only by such training that correct learning is possible. And it is only through intelligent practice that improvement is sure to come. Intelligent practice implies knowledge of the machine which does the writing, to keep it in order, and to train it, and of the forms to be written, to know how best to construct and execute them.

*The essentials of good writing
are neatness, plainness, uniformity,
and ease in execution.*

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PENMANSHIP PSYCHOLOGY.

Mind manifests itself through the brain, spinal cord, nerves, and muscles. Brain seems to be the dynamo in which mind generates power or manifests itself. The spinal cord is the main channel through which the mind acts. Nerves transmit energy and intelligence. Muscles act by means of stimulus from the nerves.

Mental functions are described as feeling, knowing and willing. We first feel, see, hear, smell, or taste. We next become conscious of these feelings or perceptions and know. We then desire to do something, and the act of doing is called will. As concerns writing, the process is as follows: Through the eye the mind perceives form; the mind becomes conscious of form and desires to produce it; the will says, "all right," and directs the muscles to perform that which the eye observed and the mind perceived.

We have also three actions of the mind known as voluntary, involuntary, and reflex actions. Voluntary acts are conscious and under the direct control of the intellect and will. Involuntary acts are those which preserve life, such as breathing, digestion, circulation, etc., and are not only unconscious but largely independent of the will. Reflex acts are those which become habitual, such as talking, walking, writing, etc. At first they are conscious, but through repetition and practice they become automatic.

Nerves are of two kinds; in-carrying or sensory nerves, and out-carrying or motor nerves. The former carry messages to the brain from the senses, and the latter carry messages from the brain to the muscles. The hand is therefore in direct communication with the mind by these nerves which act as telephone or telegraph lines. This connection is so close, real, and intelligent, that the hand is now very generally considered as projected brain. The hand is also recognized as the ready servant of the mind, ever ready to

do its bidding. So successful does this service or performance become through conscious thought and consequent repetition, that the hand learns to do many wonderful and skillful acts almost unconsciously. Walking, talking and writing are three of many of these semi- or unconscious acts.

At first they are all thoughtful and difficult, but by repeated effort they become quite easy and thoughtless in performance. We become skillful, graceful, good walkers in proportion to our careful, skillful practice in walking. We become good talkers if we give thought to substance and utterance. We become good penmen in proportion to our skillful practice of good penmanship in writing.

The hand unconsciously endeavors to perform the dictates of the mind. If the latter dictates good, clear, tangible, accurate, specific forms, the hand will produce them almost faithfully. The reason we have so much poor penmanship in the world is that people think very indefinitely about the forms they are endeavoring to execute.

Think good forms and the nerves will convey the message to the muscles and they in turn will execute them on paper. This is psychology simplified but none the less scientific and trustworthy. It is not a theory, but a fact or condition, and you will therefore make no mistake in storing up perfect percepts of form. To do this, you need to study form critically, noting the proportion of the letter, its general shape, location, number, and character of its lines, loops, angles, etc.

Know good form, think good form, will good form, and you will soon write good form. This manual is arranged to facilitate getting the necessary knowledge of form and the necessary skill to execute it. Follow the thought and action and good writing will follow as surely as night follows day.

THE PHYSIOLOGY OF THE ARM

OR THE

STUDY OF THE MACHINERY OF WRITING

NOTE.—This chapter is intended for professional penmen, and for those who wish to prepare as such. The work is technical and tedious, but imbedded therein are facts which teachers who aspire to or profess to be professionals should know.

THE BONES.

Composition—Animal and mineral matter. The former predominates in youth; the latter in old age.
Function—Support to the body as a framework, and to serve as levers to produce and increase motion.

The Shoulder.

Clavicle—Collar bone—Shape of italic s, joins sternum and acromion (highest point) process of the scapula.

Scapula—Shoulder blade—Flat, like trowel or spade. Glenoid cavity, socket for humerus, acromion and coracoid (crow's beak) processes.
Function—To move shoulder, and attach muscles thereto.

Upper Arm.

Humerus—Caput humeri—head. External and internal condyle; former joins with radius; latter with ulna.
Function—To move arm in all directions.

Forearm.

Radius—Joins external condyle; rotates against ulna; it pronates or turns palm down, and it supinates or turns back of hand down. Articulates with scaphoid and semi-lunar bones of the wrist—back of thumb.

Ulna—Joins internal condyle; articulates like hinge; rotates against radius at wrist.
Functions—To move elbow like hinge; to turn or twist; the former to eat, the latter to fan.

THE HAND.

Wrist.

Carpal—Eight in number; two rows of four each; upper, scaphoid, semi-lunar, cuneiform, and pisiform; lower, trapezium (major), trapezium (minor), magnum, unciform.
Function—To operate the wrist in all directions.

Palm.

Metacarpal—Five in number (one thumb, four fingers).
Function—To move the hand; to partially close it, and to open it.

Fingers.

Phalanges—Fourteen in number. First phalanges, five in number; second phalanges, five in number; last phalanges, four in number.
Function—Open and close the hand.

THE MUSCLES.

Shoulder.

The muscles are first named. Their head or origin is then described, and their outer extremity, end, or insertion is then located.

Pectoralis Major—Broad, flat muscle situated immediately beneath skin of breast.

Origin—Clavicle, sternum, and ribs.

Insertion—Anterior lip of the bicipital groove of the humerus, about two inches below the head.

Function—Draws arm forward across the breast, and rotates it slightly inward.

Latissimus Dorsi—Broad, triangular muscle of the back, covering lower part of shoulder blade.

Origin—Spinous processes, lower ribs, etc.

Insertion—Bottom bicipital groove of humerus, about two inches from head.

Function—Draws arm backward and rotates it slightly inward.

The Pectoralis major and Latissimus dorsi are the largest muscles used in writing. They move the forearm in and out the sleeve when the arm rests at the elbow. They are the seat of the arm or so-called "muscular" movement, as well as of the whole-arm movement.

Deltoid—The shoulder-cap muscle.

Origin—Spinous process of scapula, acromion, and outer third of clavicle.

Insertion—Deltoid impression, just above the middle of the outer shaft of humerus.

Function—Raises the arm from the side to a horizontal position. This is the seat of whole-arm movement. This muscle suspends the elbow while the pectoralis major and latissimus dorsi muscles propel the arm in writing. Resting the arm on the table relaxes the deltoid muscle.

Upper Arm.

Biceps Brachii—Two-headed muscle in front of humerus.

Origin—By its inner or short head, to the apex of the coracoid process; by its outer or longer head to the upper part of glenoid cavity over head of humerus, descending along bicipital groove. The two unite and form fleshy part.

Insertion—Bicipital tuberosity of the radius; also winds about between ulna and radius.

Function—Flexes forearm and turns or rolls it outward.



Triceps Brachii—Three-headed muscle situated back of humerus between shoulder and elbow.

Origin—By its middle or long head, below glenoid cavity; by its outer head to the outer edge of humerus; and by its inner head to inner edge of humerus.

Insertion—Olecranon process of ulna at elbow; crazy bone (stops extending forearm).

Function—Extends forearm.

Brachialis Anticus—A broad, flat muscle beneath and on either side of biceps muscle.

Origin—Lower half inner humerus and adjacent muscular tissue.

Insertion—Coronoid process of ulna which stops bending of forearm.

Function—Flexes forearm in connection with biceps.

Anconeus—Between outer condyle and olecranon.

Origin—External condyle of humerus.

Insertion—Outer side olecranon and triangular surface of ulna.

Function—Assist in extending forearm. These four muscles cause the forearm to act like a hinge at the elbow—like the movement of a hinge; hence hinge or forearm movement as applied to writing. It is used in conjunction with the movement of the upper arm, and shoulder muscles, as well as in conjunction with the finger movement. It is the center of action of the whole arm from fingers to and including shoulder.

Elbow.

Pronator Teres—Inner side of elbow.

Origin—Inner condyle of humerus and inner side coronoid process of ulna.

Insertion—Middle of outer side of radius.

Function—Flexes forearm by turning radius on ulna, and assists in flexing elbow.

Anconeus—Aforementioned.

The pronator teres and biceps cause the forearm to roll. The former turns forearm so wrist is flat.

Supinator Longus—Inner and upper edge forearm and elbow.

Origin—External condyle and ligament.

Insertion—Base styloid process radius at wrist.

Function—Flexes forearm and supinator of hand and forearm.

Forearm and Hand Flexors.

Flexor Carpi Radialis—Middle of inner side of forearm.

Origin—Inner condyle of humerus.

Insertion—Metacarpal bone of forefinger.

Function—Flexes hand in wrist and assists pronation of hand.

Flexor Carpi Ulnaris—Under side of forearm.

Origin—Inner condyle, inner side olecranon, and upper two-thirds outer side ulna.

Insertion—Pisiform bone; base of little finger.

Function—Flexes wrist and pulls hand inward.

Palmaris Longus—Center wrist and forearm.

Origin—Inner condyle humerus.

Insertion—Palmar fascia; middle of wrist.

Function—Flexes entire hand as a whole.

Flexor Pollicis Longus—Upper inner side of forearm, back of thumb.

Origin—Upper two-thirds of radius and adjacent ligament.

Insertion—Base last phalanx of thumb.

Function—Flexes entire thumb.

Forearm and Hand Extensors.

Extensor Carpi Radialis Longus—Outer side elbow.

Origin—Outer condyle, humerus and ligament.

Insertion—Base second metacarpal bone.

Function—Extends hand and adducts it on thumb side.

Extensor Carpi Radialis Brevis—Upper edge forearm.

Origin—Outer condyle and fascia of elbow.

Insertion—Base third metacarpal bone.

Function—Extends hand.

Extensor Carpi Ulnaris—Outer side forearm.

Origin—External condyle humerus and fascia.

Insertion—Base fifth metacarpal bone.

Function—Extends hand and adducts it on little finger side.

Adductor Pollicis Longus—Draws thumb from finger.

Extensor Pollicis Brevis—Extends first phalanx.

Extensor Pollicis Longus—Extends last phalanx.

Origin—Middle ulna and radius.

Insertion—Metacarpal, first and last phalanx of thumb.

Hand and Finger Flexors.

Lumbricales—Four muscles in palm of hand.

Origin—Radial side tendons of extensor digitorum communis.

Insertion—First phalanges.

Function—Flexes first phalanges all fingers.

Flexor Pollicis Brevis—Ball of thumb.

Origin—Trapezium and trapezoid bones, and annular ligament.

Insertion—Base first phalanx thumb.

Function—Flexes the thumb.

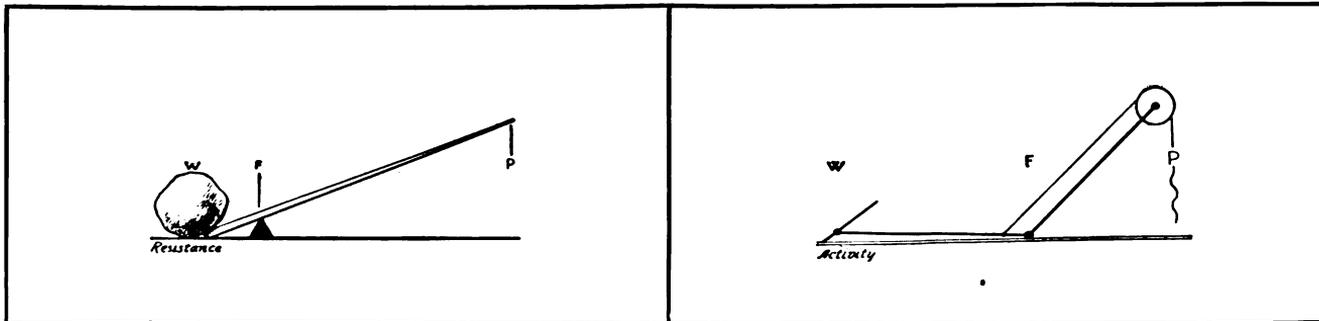
Extensors.

Extensor Digitorum Communis—Back of forearm.

Origin—External condyle humerus, etc.

Insertion—Back and base second and third phalanges of the four fingers.

Function—Extends all phalanges of fingers.



APPLIED PHYSIOLOGY.

A knowledge of bones and muscles is of value to the penman and teacher, inasmuch as it enables them to weigh, measure, and determine effort in learning and in doing.

The Attachment of muscles to bones is of such character as to multiply motion many times, thereby reducing muscular activity to the minimum.

The principle of animal mechanics is thus disclosed and compared with pure mechanics. The lever seems to be the basic principle of this activity, and comparison with its three divisions, the power, the fulcrum and the weight, seem appropriate here.

The Power is represented by the attachment of the muscle at its head or origin by means of tendons to bones, ligaments, or other muscles, and by its contracting qualities.

The Fulcrum is represented by the joints, because they serve as the center of activity. The muscle being inserted into the bone near the fulcrum, as is customary, the resultant motion produced at the extremity of the lever is much greater than at the fulcrum.

The Weight is represented by the hand in writing and by the pen which it holds and wields. The weight in this class of levers is much lighter than the power, but motion is much greater in volume.

The Object in animal mechanics is similar to the crane in principle of leverage — to multiply motion rather than to multiply power, as in the common lever. Strength in the form of large, strong muscles is utilized to produce a vast number of small, rapid motions.

Skill is the result of this saving of effort on the one hand and multiplication of motion on the other hand. The longer the lever, the more uncontrollable, and the larger the muscle, the more unmanageable, as concerns the execution of small forms.

Arm Movement in writing is therefore more difficult to control than finger movement, because the levers are longer and the muscles larger. Finger movement is more tiring than arm movement, because the levers are shorter and the muscles smaller.

The Functions of the arm muscles and levers in writing are to create sufficient quantity of motion to make it easy to propel the pen, and the hand and fingers to secure quality and control to make it easy to manage.

Motion in writing, and in similar arts, is multiplied on a conservative average of about eight times. That is to say, if the muscle producing a given motion moves one inch, the extremity of the lever or members acted upon would move eight inches. Or, to reverse the problem (for it is a poor rule that will not work both ways), if a letter were made one inch high, the muscular contraction or expansion would be but about one-eighth as great.

The ratio between muscular contraction on the inside and resulting outward motion varies with the members employed and art performed. Thus the levers of the fingers being comparatively short, they must act relatively more than the levers of the arm. As much more as they are shorter. Or, to reverse the proposition again, the levers of the arm being longer than those of the fingers, and farther removed from the pen, will, in producing a given form, move or act as much less than the fingers as they are longer than the fingers.

Nature thus economizes effort by using strength to secure activity. By a comparatively small muscular contraction, a large outward movement is produced. It is thereby an exchange of strength for volume. When we actually travel over eight miles of space with our feet, we travel but one mile in muscular contraction.

Effort, however, is of a two-fold nature — it is put forth to create motion and it is put forth to control motion. Some arts require more effort to create, while other arts require more effort to control.

Large arts, such as walking, chopping, sweeping, sewing, pounding, etc., require more creative than controlling effort. This is due to the fact that much strength as well as much motion is demanded, both of a quantitative character; the maximum of strength and activity.

Small arts, such as writing, watch-making, engraving, embroidery, etc., require more controlling than creative effort. This is due to the fact that quality of motion is demanded rather than quantity. The effort is expended in managing, in limiting, and in reducing activity.

The Art of Writing being one of our smallest and swiftest arts, is consequently one of the most difficult to acquire and perform. To secure speed, the arm rather than the fingers must be employed, and to secure legibility, either the fingers must assist, or the muscles of the arm be trained to act minutely and orderly enough to produce good writing as well as rapid writing.

The latter method, if reduced to a working basis, reduces effort to the minimum. Few, however, seem capable of thus writing, as the skill is of such a high order because of the long levers and the small forms, that the training is too taxing and extended to admit of the necessary time and energy on the part of the average citizen who does not aspire to become a professional penman. The former method, the co-operation of the fingers with the arm to secure form, seems the one most in accord with nature, and consequently the one most commonly employed.

Finger Movement is comparatively easy to acquire because the levers are relatively short and the power close to the weight—the contraction near the pen. This refers to slow writing rather than to rapid writing, as the latter is difficult to acquire, no matter whether the fingers or the arm are employed. Finger-movement writing may be said to be tiring; arm-movement writing, difficult.

Arm Movement is relatively difficult to acquire because the levers are comparatively long and the power far removed from the weight—the contraction of muscle (the source of motion) somewhat distant from the pen. The management of the pen thereby becomes greater

than the movement or propulsion of the same. The reason becomes apparent when you endeavor to write on the blackboard with the crayon attached to the end of a yard-stick, or when you attempt to write with pen or pencil by holding it four or five inches from the point.

Combined Movement or co-operation seems most rational, logical, and natural, inasmuch as the larger members may serve in the larger forms and the smaller members in the smaller forms. Then, too, the fingers can assist the arm in those forms it fails to perform advantageously, while the arm in return can assist the fingers in those letters they fail to produce easily or quickly enough.

The Fingers are so constructed as to contract more easily and powerfully than they extend. Their chief function is to grip and not to open and close—to hold the implement while the arm performs the labor. This also explains why finger movement is more tiring than arm movement.

The Elbow is the center of activity for nearly all performances of the hand and arm. It being midway between the hand (the smallest) and the shoulder (the largest), it is therefore a happy medium or golden mean between the two extremes, acting, as it does at all times, in conjunction with one or the other, and usually with both. The fingers act forward and backward, outward and inward on a line with the forearm. The movement emanating from the shoulder acts in the same direction as the fingers, driving the forearm in and out the sleeve. The elbow acts, not in the same direction, but in opposition to the two former. It therefore co-operates with both, and without which neither the finger nor the upper arm could write at all freely or well. A stiff elbow would be a serious barrier to good writing.

The Logical Conclusion is that arm movement is necessary for rapid writing, as well as for graceful, professional writing. The function of the fingers is to hold rather than to propel the pen—to assist in minor detail rather than to create motion.

