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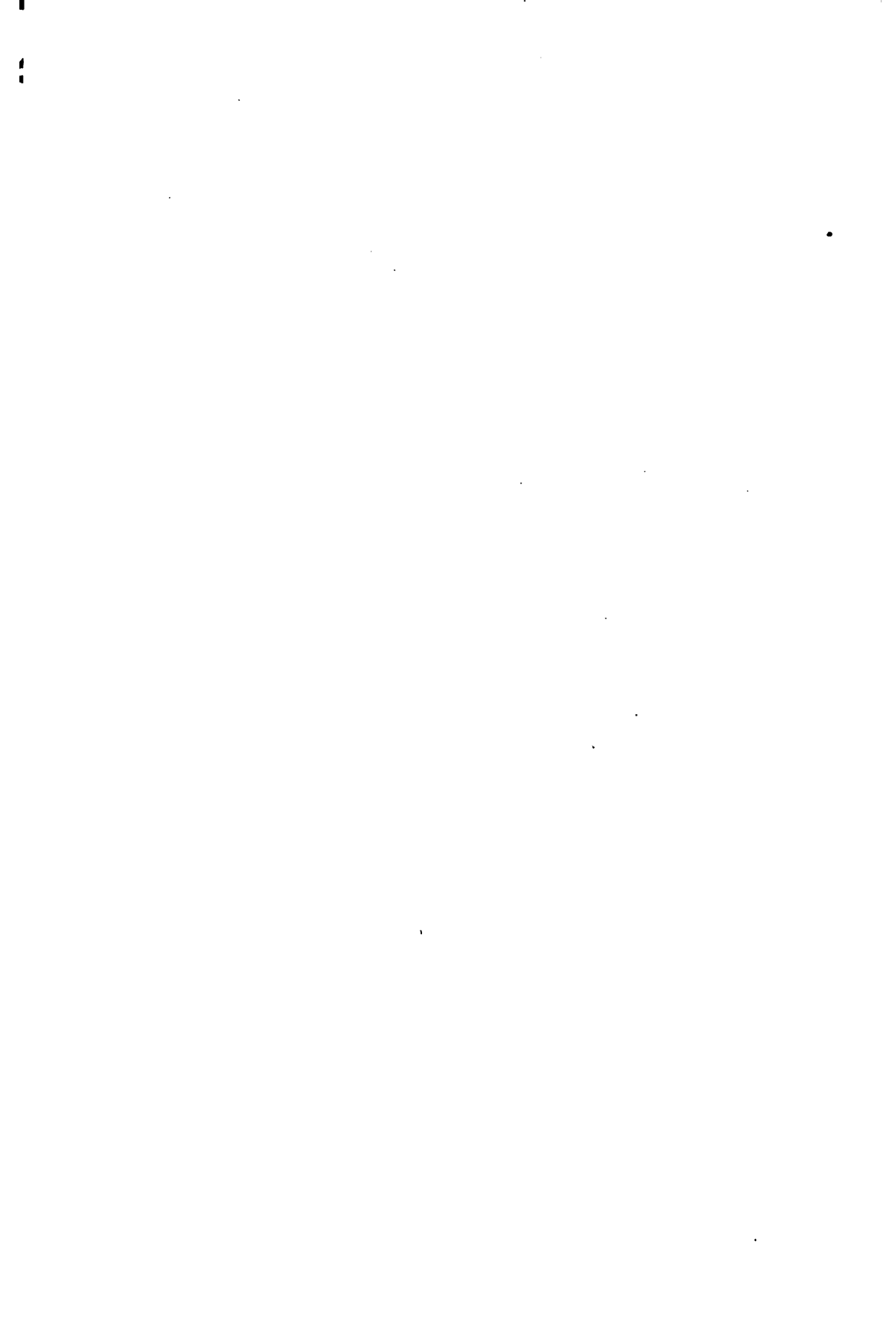
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Spinal Concussion and the
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in the Treatment of Disease

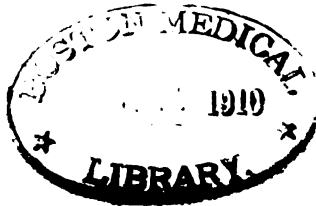
By

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Illustrated

The Philopolis Press
Suite 406, Lincoln Building, San Francisco, California
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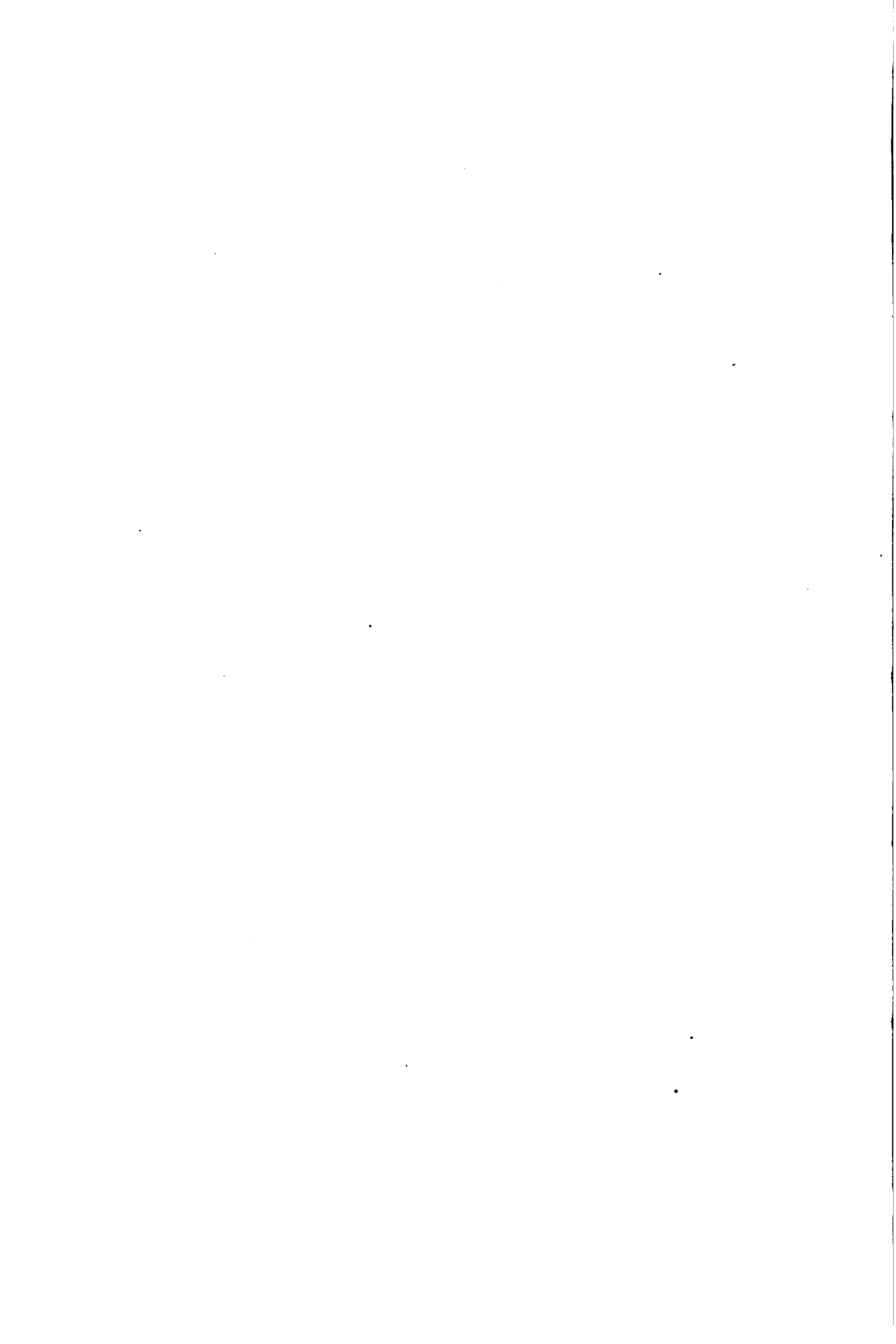
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ALBERT ABRAMS

1910

TO HIS FRIEND
DR. PIERRE MARIE,
PROFESSOR IN THE FACULTY OF MEDICINE, PARIS,
IN RECOGNITION OF HIS DISTINGUISHED SERVICES IN THE
ADVANCEMENT OF MEDICINE, THIS
BOOK IS DEDICATED BY
THE AUTHOR.



Preface

THE subject of spinal therapeutics has received less attention from the medical profession than it deserves. Even the laity know that cold applied to the back of the neck may arrest hemorrhage from the nose, and that heat applied to the small of the back may hasten menstruation. The profound and far-reaching physiologic truths which underlie these simple phenomena have either been ignored or only given inconsiderate attention.

Others, less scientific but more astute, have determined empirically that manipulation of the spine does sometimes cure conditions that have failed of cure in the hands of experienced physicians. So it has come to pass that schools of practice exploiting spinal manipulation as a cure-all have arisen. Neither the fury of tongue nor the truculence of pen can gainsay the confidence which these systems of practice have inspired in the community.

The author was led to a deeper study of spinal therapeutics in investigating various visceral reflexes which bear his name. As the years passed on, he ascertained that a number of pathologic conditions could be more easily and certainly controlled by spondylotherapeutic means, than by the conventional measures.

Some physicians may consider the remedial methods discussed in this book to be unduly and unworthily simple, on the principle that what is obvious can hardly compete with what is obscure in the treatment of disease. The most mystifying phenomena rest upon the least complex causes; and the simpler a thing is, the harder it is to understand.

Anybody, however, who investigates the study of spinal therapeutics in earnest, will discover that the simplicity is only apparent. The successful practice of spondylotherapy requires knowledge, observation and experience of the highest kind, and is comparable to the best effort in any other department of scientific medicine. Indeed, one of the author's truest motives has been to lift this whole subject of spinal therapy out of the low state in which it blunders onward, hitting or missing as the case may be, and rescuing it from the lowly esteem which physicians as a class have thus felt for it. He has endeavored to put it in a place befitting its scientific importance, and to emphasize its great practical helpfulness in disease.

P r e f a c e

Any method of cure that is more or less new is inclined to be viewed critically by the formalist and traditionalist, and so it should be. The writer knows better than any one else can the incompleteness and imperfections of his work. It is really a pioneer effort and he only asks that it be judged as such. Indeed, the author hopes to receive many suggestions and if need be, corrections, and to profit by them.

One word concerning the cases cited in illustration of the methods which the author has described in various parts of the book. These may seem more or less incredible, the outcome of enthusiasm, bias, of some defect of the power of scientific observation, or of judgment. Yet the cases cited are not the most remarkable that the author has encountered in his practice. Some of these cases have been deliberately suppressed with a feeling that many readers are hardly prepared to appreciate or to credit the results which may be achieved by an earnest study and practice of spondylotherapy. To eschew a remedy because we cannot gauge its material properties may be an act worthy of the scientist, but the aim of the physician is to cure disease. In the presence of a sick man, two questions are to be answered: "What is the matter with him, and what will do him good?" Neither the pragmatist who accepts nothing but what is demonstrated morphologically, nor the representative of an exclusive system of practice, with his introspective reasoning, can aid therapeutics. The former forgets that the crucial test for the action of remedial measures is in their clinical application and that many of our most potent drugs have been inherited from the therapeutic acumen of our medical ancestors. "The diseases of which we know the least pathology are the diseases which we treat successfully." Cure, as conceived by the introspectionist, cannot merit the imprimatur of the scientist, and for this reason, the author has endeavored to justify his conclusions by demonstrable evidence.

ALBERT ABRAMS.

246 POWELL STREET,
SAN FRANCISCO, CAL.,
JANUARY, 1910.

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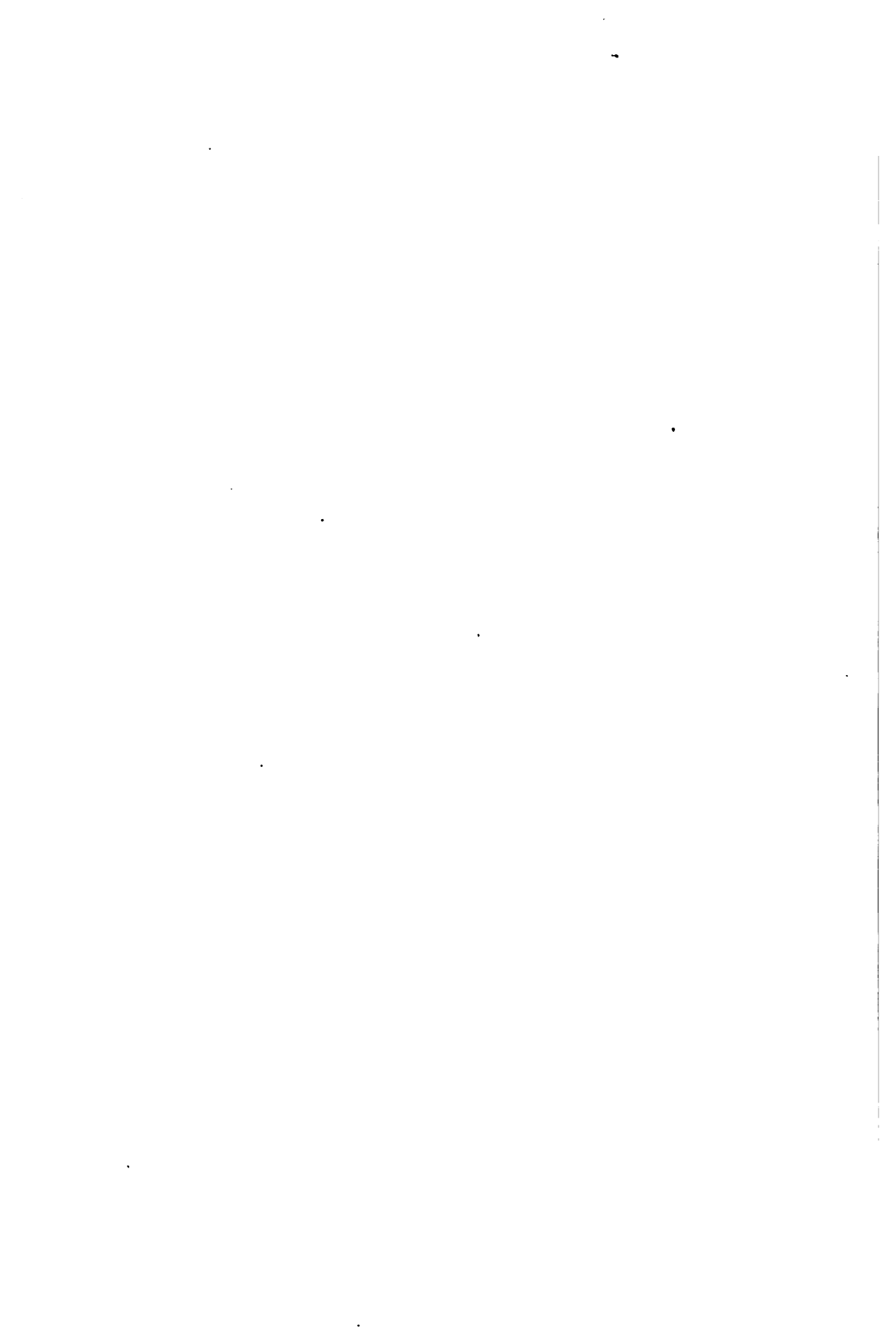
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SPONDYLO THERAPY

CHAPTER I.

HISTORICAL.

PRIMITIVE ERA OF SPONDYLOTHERAPEUTICS—THE GRIFFIN BROTHERS
—SWEDISH GYMNASTS —OSTEOPATHY—CHIROPRACTIC—DANA—
QUINCKE—HEAD—THE VERTEBRAL REFLEXES.

IN the primitive era of hydrotherapy, the application to the spinal region of the hot-water bag and ice-bag was a conventional procedure dictated by empiricism with little physiologic knowledge concerning the action of water on the spinal centers. Even at the present day, our therapeutic armament embraces various physical methods which are indiscriminately employed with neither rhyme nor reason. Thus therapeutics is discredited and any good results achieved from treatment are attributed to suggestion. We dare not wholly ignore the physical methods of treatment even though there is no physiologic reason to justify their employment, although it should be the constant effort of the physician to rationalize his methods. We are not justified in discrediting clinical observations because they have not been confirmed in the laboratories. Gowers observes, "The diseases of which we know the least pathology are the diseases which we treat successfully."

We should be prepared to welcome new truths, even though, as Goethe observed, they threaten to overturn beliefs which we have entertained for years and have handed down to others.

One must not forget, however, the unconscious tendency of specialists to exaggerate the importance of some special method of treatment.

S p o n d y l o t h e r a p y

In the presence of abdominal pain, the surgeon who uses his head as well as his knife thinks of appendicitis, but when he uses his knife to the exclusion of his head, he thinks of nothing else. There is the gynecologist whose conception of disease is limited to the uterus and adnexa, and there is the oculist with mental astigmatism, who reflects his subjectivity in the examination of his patients.

We all know the tendency to patronize special organs, diseases or remedies, and the poet Crabbe, in verse, thus immortalizes this tendency:

“One to the gout contracts all human pain,
He views it raging in the frantic brain;
Finds it in fevers, all his efforts mar,
And sees it lurking in the cold catarrh.
Bilious by some, by others nervous seen,
Rage the fantastic demons of the spleen;
And every symptom of the strange disease,
With every system of the sage agrees.”

THE GRIFFIN BROTHERS.

In 1834 William and Daniel Griffin, physicians, respectively, of Edinburgh and London, published a work in which 148 cases were analyzed showing the relation of certain symptoms to definite spinal regions. These symptoms were associated with spinal tenderness in fixed regions. They concluded that the tenderness in question was either primary in the spinal cord or secondary to visceral or other diseases. The Griffin Brothers queried as follows: “We should like to learn why pressure on a particular vertebra increases, or excites, the disease about which we are consulted, why it at one time excites headache or croup or sickness of the stomach.” “Why, in some instances, any of these complaints may be called up at will by touching a corresponding point

T h e G r i f f i n B r o t h e r s

of the spinal chain?" The following table by the Griffin Brothers¹ demonstrates the tender areas of the spine:

CASES.	PROMINENT SYMPTOMS.
Twenty-eight cases of cervical tenderness, 8 men; 8 married, 12 unmarried.	Headache, nausea or vomiting, face-ache, fits of insensibility, affections of the upper extremities. In 2 cases only, pain of stomach; In 5, nausea and vomiting.
Forty-six cases of cervical and dorsal tenderness, 7, 15 married, 24 unmarried.	In addition to the foregoing symptoms, pain of stomach and sides, pyrosis, palpitation, oppression. In 34 cases, pain of stomach. In 10 cases, nausea or vomiting.
Twenty-three cases of dorsal tenderness, 4, 0 - - 6 married, 16 unmarried.	Pain in stomach and sides, cough, oppression, fits of syncope, hiccough, eructations. In one case only, nausea and vomiting. In almost all, pain of stomach.
Fifteen cases of dorsal and lumbar; 1 man; 11 married, 3 unmarried.	Pain in abdomen, loins, hips, lower extremities, dysury, ischury in addition to the symptoms attendant on tenderness of the dorsal. In 1 case only, nausea.
Thirteen cases of lumbar tenderness.	Pains in lower part of abdomen, dysury, ischury, pains in testes or lower extremities, or disposition to paralysis. In 1 case only, spasms of stomach and retching.
Twenty-three cases, all of the spine, 4, 0 --4 married, 15 unmarried.	Combines the symptoms of all the foregoing cases.
Five cases; no tenderness of the spine.	Cases resembling the foregoing.

S p o n d y l o t h e r a p y

At this period (1834) Swedish gymnasts, notably Ling, observed among cardiopaths, tenderness over the 4th or 5th dorsal nerves when this region was subjected to friction. The Swedish school recognizes definite areas of spinal tenderness identified with the various organs. Thus, in affections of the stomach, tenderness is observed in the region of the 6th, 7th and 8th dorsal nerves on the left side, and manipulation of the region in question often evokes eructations of gas.

In 1841 Marshall Hall published his memorable work which established the importance of the spinal reflex.

OSTEOPATHY.

In 1874 osteopathy was founded. It was based on the theory that health signifies a natural flow of blood and that the bones may be employed as levers to relieve pressure on nerves, veins and arteries. The pressure is assumed to be caused by dislocated bones, and, when the osteopath refers to a "lesion," he intimates malposition of a bone.

The theory of the osteopath may be at variance with our accepted views of etiology, yet the latter, by his manipulations, unconsciously evokes reflexes which are cogent factors in favorably influencing disease.

The osteopath indignantly resents any comparison of his system to massage. The following statement occurs in a representative work on this system by G. D. Hulett²: "Masseurs are aware of the fact and the possible significance of tender points in the tissues along the spine over the area from which the nerves are given off to the organs which are in a diseased condition; evidently, however, they have considered these tender points as always secondary to the diseased viscus." "The essential distinction between osteopathy and all other systems of healing," continues the same

C h i r o p r a c t i c

writer, "based on manipulation, clusters around the etiology of disease." In other words, in disease of an organ, the masseur acts directly upon the organ; but the osteopath taking into consideration what he regards as a fact "The ability of nature to functionate properly, treats the central force."

According to the foregoing, the osteopath regards disease from a central and not from a peripheral standpoint.

CHIROPRACTIC.

This system was founded in 1885. The theory sustaining this system presumes that, in consequence of displaced vertebræ, the intervertebral foramina are occluded through which the spinal nerves pass (Fig. 1).

In this way the nerves are pinched and chiropractors assume that such pinching is responsible for 95 per cent of all diseases. Chiropractic concerns itself with an "adjustment" of the subluxations, thus removing pressure on the nerves.

What the chiropractor calls "nerve-tracing," consists of following a sensitive nerve from its vertebral exit to and from the affected organs. The chiropractor differentiates his method from osteopathy by the following asseverations:

1. The hands are used in a different manner and the movements are dissimilar;
2. The etiology of disease is unlike that accepted by osteopathy;
3. Chiropractors "adjust" for more diseases than osteopaths and the results are immediate.

It is known that pain may be felt at a point distant from the actual site of a lesion. Such pains are know as **TRANSFERRED PAINS**. Thus the pains sometimes felt in the

S p o n d y l o t h e r a p y

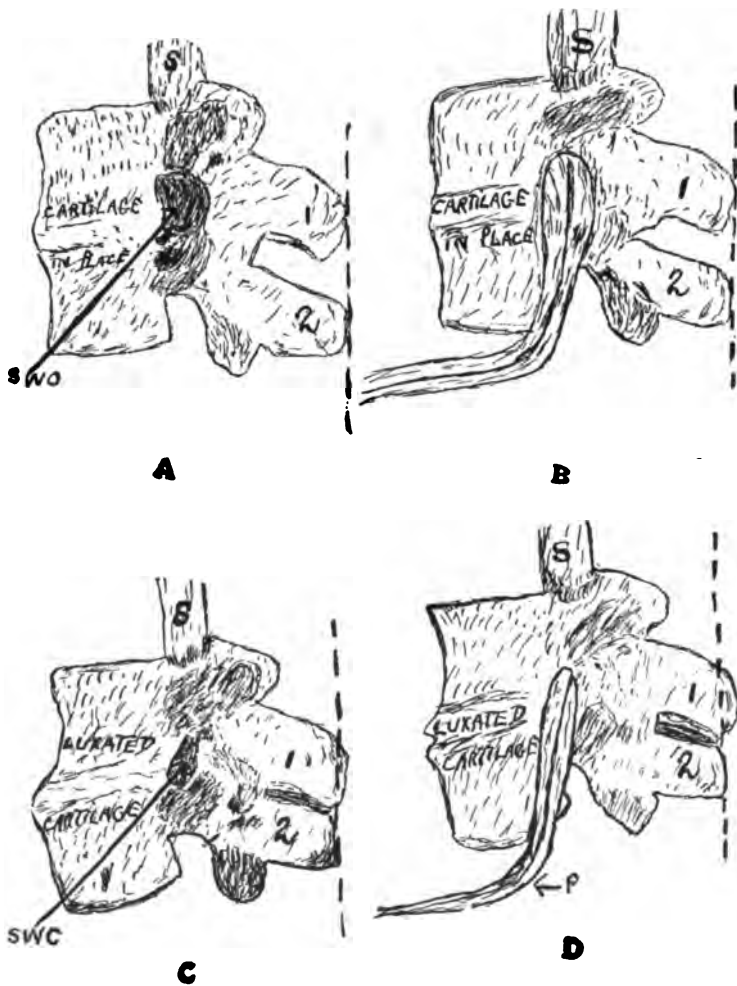


FIG. 1.—Illustrating the chiropractor's conception of disease. A, the vertebrae are in the normal position with the spinal window open (SWO); B, showing that with an open spinal window the nerve is not compressed. The dotted lines show the correct alignment of the spinous processes; C, the spinal window is closed (SWC) owing to displaced vertebrae and in consequence the nerve at its exit is pinched (D). (After Palmer.)

The Vertebral Reflexes

mammary gland in uterine disease and in the knee in hip-joint disease are transferred or referred pains.

The well-known illustrations of Dana (page 56) represent the location of transferred pains.

In 1890 Quincke studied the sites of SYMPATHETIC SENSATIONS (page 57).

Still later, in 1893, Henry Head, of London, demonstrated that in visceral disease, pain and disturbed sensation may be referred to definite cutaneous areas (*vide* page 58).

THE VERTEBRAL REFLEXES.

In medical literature the author has referred repeatedly to certain VISCERAL REFLEXES elicited by cutaneous irritation, viz., the *lung reflexes* of dilatation³ and contraction⁴, the *heart reflex*⁵, *liver reflex*⁶, *stomach and intestinal reflexes*⁷, and the *aortic reflexes*⁸.

The reflexes in question are endowed with more than mere physiologic interest. They yield unequivocal demonstration of the fact that the sensory peripheral nerve terminations receive impressions which are conducted, communicated or reflected by aid of the nervous system.

Such impressions react on the viscera and the manifestations of the reaction may be utilized in a diagnostic and therapeutic direction.

The evidence heretofore adduced in explanation of the results achieved by electric, hydriatic, mechanic and balneary treatment of disease was naught else than a mere array of words conceived only in conjecture.

The cutaneous visceral reflexes referred to, suggest the rationale of the different peripheral methods of treatment.

Visceral reflexes may be evoked not only by cutaneous irritation but likewise by concussion and the application of

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the sinusoidal current to the spinous processes of the vertebræ.

Reflexes elicited from the spinous processes have been specified by the author as VERTEBRAL REFLEXES.⁹

The manipulation of definite vertebræ corresponds with the elicitation of specific reflexes, but, if the spinous processes are promiscuously manipulated, counter-reflexes are evoked which nullify the reflexes sought. As we proceed with our subject, we will determine that vertebral manipulation is influential for weal or woe in the treatment of disease and it will be the endeavor of the author, to endow spondylotherapeutics with some scientific accuracy and thus substitute order for chaos.

To excite the vertebral reflexes for therapeutic purposes, concussion by means of an apparatus (page 176) or the sinusoidal current (page 151) is employed. For diagnostic purposes, either the sinusoidal current or simple concussion after the manner to be described is used. When the current is employed, the moistened, indifferent pad (usually large) is placed over the sacral region, whereas an interrupting electrode (Fig. 46), which permits one to close and open the circuit, is placed over definite spinal processes.

For simple concussion the author employs a piece of soft rubber or linoleum about 6 inches long, $1\frac{1}{2}$ inches wide, and about a $\frac{1}{4}$ of an inch in thickness as a pleximeter for receiving the stroke and a plexor with a large piece of thick rubber for delivering the blow (Fig. 2).

The plexor used by the author is similar to that employed by French clinicians for obtaining the knee-jerk and is known as the plexor of Déjérine.

In the absence of the latter, a mallet or even an ordinary tack-hammer will suffice.

One may also strike the spinous processes with the

The Vertebral Reflexes



FIG. 2.—Plexor and pleximeter employed for eliciting the vertebral reflexes.

knuckles or better still, the fingers may be used as a pleximeter and the clenched fist as a plexor. In the latter instance, the palmar surfaces of the fingers are applied to the spinous processes to be concussed, and, with the clenched fist, the dorsal surfaces of the fingers are struck a series of short and vigorous blows (Fig. 3).

The use of a pleximeter and plexor is decidedly more effective than the latter method which is only employed in an emergency. Here the strip of linoleum or rubber is applied to the spinous process or processes to be concussed, and, with the hammer, a series of sharp and vigorous blows are allowed to fall upon the pleximeter.

S p o n d y l o t h e r a p y



FIG. 3.—Showing the method of concussing the spinous processes with the hands for eliciting the vertebral reflexes.

Naturally, the blows jar the patient somewhat, but beyond this no inconvenience is suffered.

The vertebral reflexes, when the stimulant is concussion, are probably due to transmitted mechanic stimulation of the roots of the spinal nerves, insomuch as many physiologists contend that the spinal cord does not react to direct stimuli. In some instances concussion is more effective than the sinusoidal current in eliciting certain vertebral reflexes, whereas, in other instances, the current supersedes concussion. The relative value of these methods, however, will be studied in detail in succeeding chapters. There is yet another method for eliciting the vertebral reflexes by means of

The Vertebral Reflexes

pressure at the vertebral exits of definite spinal nerves (page 169).

Reference to Fig. 4 shows the spinal muscular reflexes thus far elicited by the author, whereas, Fig. 5 represents the visceromotor reflexes of spinal origin. The latter, with the exception of the aortic reflexes, probably act on the musculature of the organs independently of the vaso-motor system.

Unstriated or involuntary muscular fibers are present in practically all the organs of the body. Even the liver is not exempt. Here the muscular fibers contained in the fibrous coat of the organ enter the organ at the transverse fissure.

The viscera, even in health, vary in size, and this alternate enlargement and diminution in bulk is due in part to variations in the supply of blood and in part to the contractility of the visceral musculature.

If I am permitted to digress for a moment to give expression to my prejudiced conception of many morbid manifestations, I witness muscular tissue in a state of incoordination, uncontrolled by will and subordinated to the vagaries of undisciplined reflex centers, the muscular orgy presents the tableau of muscles gone mad. Practically everywhere throughout the organism where muscle is found, fibers coexist which dilate or contract. When neither function predominates there are no morbid manifestations; in other words, a normal function is a question of muscular equilibrium. The moment one set of fibers gains the ascendancy over its antagonist the symptomatic picture is made up of spasm or paralysis (*vide Asthma*, page 303).

SPINAL MUSCULAR REFLEXES.

These reflexes are best elicited by means of a powerful sinusoidal current after the manner already described (page 11). Concussion by means of the plexor and pleximeter

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will also excite some of them. It will be observed that the reflexes in question are bilateral, in contradistinction to the conventional cutaneo-peripheral reflexes, which are unilateral.

For the convenience of their clinical elicitation they have been studied with relation to definite vertebral spinous processes.

It must be observed, however, that the areas in question may vary in different patients, but, as here cited, the areas are approximately correct. Like all reflexes, the degree of stimulation necessary for their excitation varies with the individual, but, as a rule, powerful currents are necessary. Practically every muscle, or group of muscles, may be brought to contraction, but, insomuch as this work is designed for a utilitarian rather than an academic purpose, only a few muscular reflexes thus far elicited by the author will be cited.

1. STERNO-CLEIDO-MASTOID REFLEX.—This is best observed when the head is flexed and when the interrupting electrode is fixed over the spinous process of the 7th cervical vertebra. Concussion of the latter will also evoke the reflex. This bilateral reflex is most pronounced at the sterno-clavicular attachment of the muscles.

2. BICEPS, TRICEPS, AND WRIST-JERK.—Elicited by concussion of the spinous processes of the 5th and 6th cervical vertebræ or by application of the current to the same processes. Here the processes are concussed in succession or the electrode used is large enough to embrace both spinous processes. The upper extremities must be placed in a state of flexion, with muscles absolutely relaxed and the elbows resting in either hand of an assistant. The elbows may also rest on a table in the flexed position and relaxed.

3. PALMAR REFLEX.—This consists of a contraction of two or more fingers when the interrupting electrode is applied over the spinous process of the 6th cervical vertebra.

The Vertebral Reflexes

4. PECTORAL REFLEX.—The patient lies on his side with arms elevated to bring the pectoral muscles into slight prominence, after which the dorsal spinous processes (3d to the 6th) are either concussed or sinusoidalized.

5. SCAPULAR REFLEX.—Concussion or sinusoidalization of the 5th cervical spinous process.

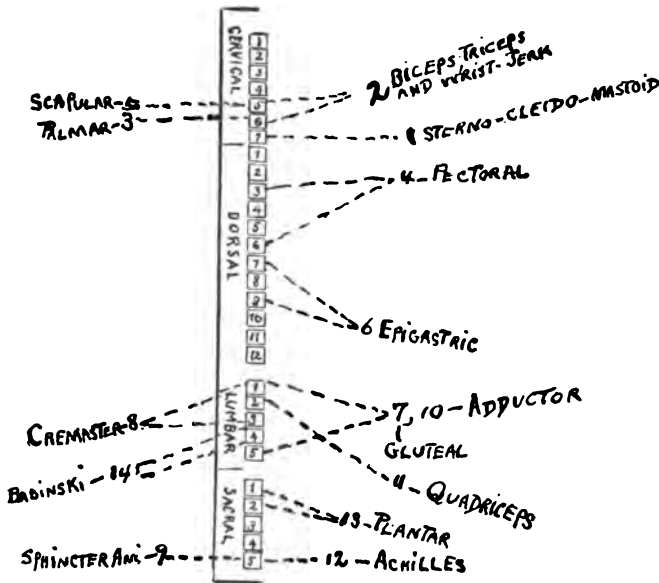


FIG. 4.—The spinal muscular reflexes.

6. EPIGASTRIC REFLEX.—Concussion or sinusoidalization of the dorsal spinous processes (7th to the 9th).

7. GLUTEAL REFLEX.—When the patient is on his side sinusoidalization or concussion of any of the lumbar vertebræ. The reflex is accentuated as the last lumbar vertebra is attained.

8. CREMASTERIC REFLEX.—When the 1st, 2nd and 3d lumbar vertebræ are concussed or sinusoidalized.

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9. SPHINCTER ANI REFLEX.—Sinusoidalization with a small electrode at a point corresponding to the sacro-coccygeal articulation.

10. ADDUCTOR REFLEX.—Adduction of both lower extremities when the spinous processes of all the lumbar vertebrae are sinusoidalized or concussed. The patient sits on a chair with both lower extremities extended and relaxed.

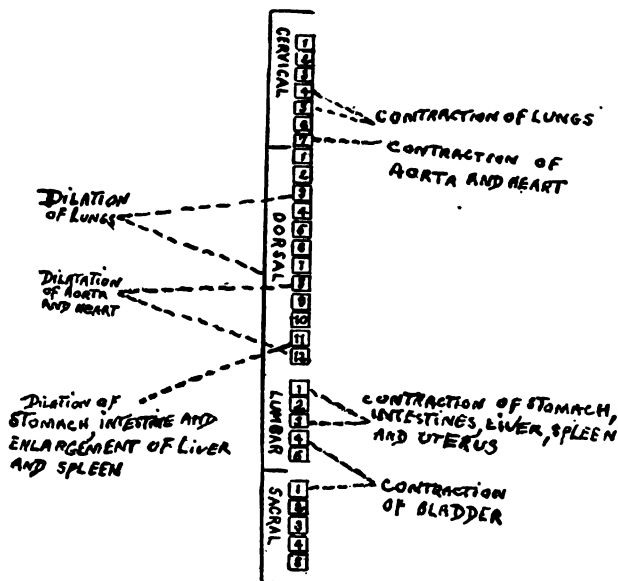


FIG. 5.—Viscero-motor reflexes of spinal origin.

11. QUADRICEPS REFLEX.—With the patient seated and legs extended, concussion or sinusoidalization of the spinous process of the 2nd lumbar vertebra will produce a decided contraction of the quadriceps femoris. It may be noted that it is a contraction of this muscle which is responsible for the patellar reflex (*knee-jerk*). When one leg is crossed upon the other (the conventional position for eliciting the knee-jerk), a knee-jerk can be obtained in the norm. In

The Vertebral Reflexes

several tabetics in whom the knee-jerk was absent (by tapping the patellar tendon) it was very much exaggerated in either one or the other leg when one leg was crossed upon the other during sinusoidalization (with the interrupting electrode) of the spinous process of the 2nd lumbar vertebra.

The foregoing phenomenon is discussed on page 28.

12. **ACHILLES REFLEX.**—The patient rests on his knees on a chair, with feet projecting over the edge of the latter. In the conventional way, striking the Achilles tendon results in flexion of the foot.

With the patient in the same position the interrupting electrode is fixed over the sacrococcygeal articulation, whereas the large pad is applied in the lumbar region. Here, likewise, the current evokes flexion of the foot.

13. **PLANTAR REFLEX.**—Evoked by sinusoidalization of the 1st and 2nd sacral segments.

14. **BABINSKI REFLEX.**—If, in the norm, we irritate the inner side of the sole of the foot from the heel to the toes by stroking with a moderately sharp object, all the toes undergo plantar flexion; but, if the great toe (and perhaps the other toes) undergoes dorsal flexion (Fig. 6), the Babinski reflex or phenomenon is present. As a rule the latter phenomenon indicates a lesion of the pyramidal tract.

The observations of the author show that the Babinski reflex may be elicited in the norm by applying the interrupting electrode (large electrode over the sacrum) over the spinous process of either the 3d or 4th lumbar vertebra.

Schneider's explanation of the Babinski reflex is as follows; Plantar flexion of the toes (the normal reflex) depends upon a cortical component of the reflex, whereas dorsal flexion of the toes (Babinski reflex) depends on the spinal component. If then, there is a lesion of the pyramidal tract, the reflex for the plantar flexion is interrupted, whereas

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the spinal component for dorsal flexion is retained. In several cases with lesions of the pyramidal tract observed by the author, and in all of whom the Babinski reflex was present by irritating the sole of the foot, the same reflex could not be elicited as in the norm by sinusoidalization of the spinal column. In these cases, however, the plantar reflex was elicited by sinusoidalization in lieu of the Babinski reflex,

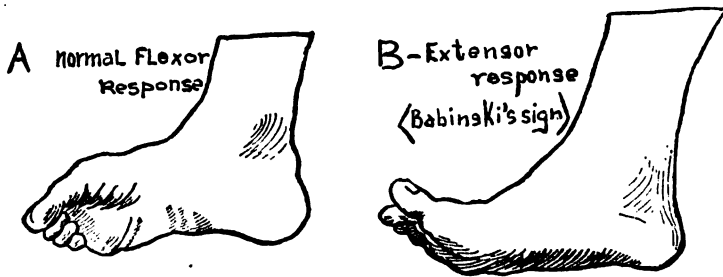


FIG. 6.—The Babinski toe-reflex (Hutchison and Rainy).

which occurs in the normal subject. The latter observation would seem to show in part the correctness of Schneider's explanation of the Babinski reflex. The occurrence of the plantar reflex in these cases suggests that it is likewise a spinal and not a cortical reflex and that its occurrence in lieu of the Babinski by sinusoidalization is equally diagnostic of a lesion of the pyramidal tract.

The physician will observe that the spinal muscular reflexes (provided the current remains in action for several seconds) consist of clonic rather than tonic contractions, and, furthermore, that the spinal reflexes may be elicited even though the ordinary cutaneo-peripheral reflexes are absent.

Anatomic, Topographic and Physiologic Data

CHAPTER II.

ANATOMIC, TOPOGRAPHIC AND PHYSIOLOGIC DATA.

STRUCTURE OF THE SPINAL CORD—ROOTS AND DISTRIBUTION OF THE SPINAL NERVES—LOCATION OF THE SPINAL NERVES—ANATOMIC LANDMARKS—SYMPATHETIC SYSTEM—PHYSIOLOGY OF THE SPINAL CORD—LOCALIZATION OF THE FUNCTIONS IN DIFFERENT SEGMENTS OF THE SPINAL CORD.

A transverse section of the spinal cord (Fig. 7) shows it to consist of central gray matter containing nerve-cells and

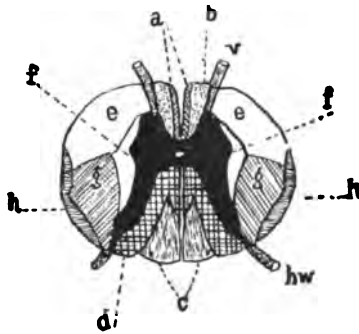


FIG. 7.—Illustrating the conducting paths in the spinal cord at the level of the third dorsal nerve. The black part represents the gray matter; V, anterior, and HW, posterior root; A, direct, and G, crossed pyramidal tracts; B, anterior column ground bundle; C, Goll's column; D, postero-external column; E and F, mixed lateral paths; H, direct cerebellar tracts (Landois).

surrounding white matter made up of nerve-fibers. The gray matter is divided into the anterior and posterior horns. The SPINAL NERVES take their origin from the spinal cord and on either side make their exit through the intervertebral foramina. There are 31 pairs of spinal nerves:

Cervical nerves	8 pairs
Dorsal	“	12 “
Lumbar	“	5 “
Sacral	“	5 “
Coccygeal	“	1 pair

S p o n d y l o t h e r a p y

ROOTS OF THE SPINAL NERVES.

The anterior or ventral roots arise from the motor cells in the anterior horn of the gray matter and are *motor* in function. The posterior or dorsal roots arise from the nerve-cells of the spinal ganglia from which they can be traced into the cord and are *sensory* in function.

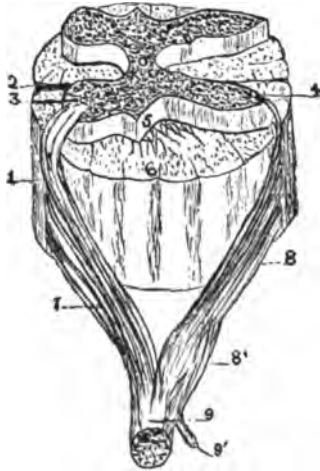


FIG. 8.—A spinal nerve with its anterior and posterior roots (Testut). 1, a portion of the spinal cord viewed from the left side; 2, anterior median fissure; 3, anterior horn; 4, posterior horn; 6, formatio reticularis; 7, anterior root; 8, posterior root with 8', its ganglion; 9, spinal nerve; 9', its posterior division.

On the posterior root of each of the spinal nerves, a ganglion is found which is located in the intervertebral foramen external to the point where the nerve perforates the dura mater (Figs. 8 and 38).

DISTRIBUTION OF THE SPINAL NERVES.

Just beyond the ganglion, the roots of the spinal nerves unite to form a trunk which constitutes the *spinal nerve*.

After the latter passes out of the intervertebral foramen, it divides into a posterior division for the supply of the pos-

Anatomic Landmarks

terior part of the body and an anterior division which supplies the anterior part of the body. In each division there are fibers from the roots of both nerves.

Each spinal nerve receives a branch from the sympathetic (Fig. 9).

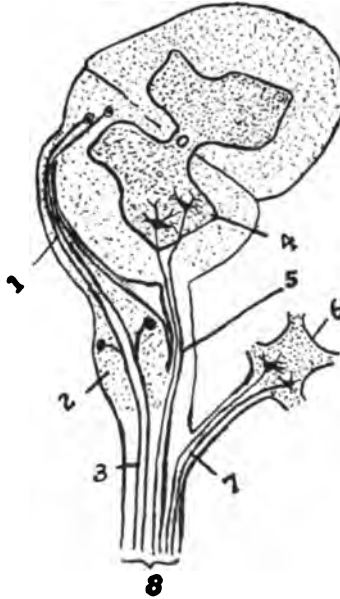


FIG. 9.—Diagram after Böhm and Davidoff to show the composition of a peripheral nerve-trunk. 1, axon of ganglion-cell; 2, spinal ganglion; 3, dendrite of ganglion-cell; 4, anterior horn of gray matter of spinal cord; 5, axon of motor nerve-cell; 6, sympathetic ganglion; 7, axon of sympathetic neuron; 8, nerve-trunk.

The roots of the majority of spinal nerves pass obliquely downwards and outwards to their points of exit from the intervertebral foramina, hence the level of their emergence from the cord does not correspond to that of their exit from the intervertebral foramina (Fig. 10).

ANATOMIC LANDMARKS.

There is usually a furrow or medium groove in the back, at the bottom of which lie the spinous processes. In

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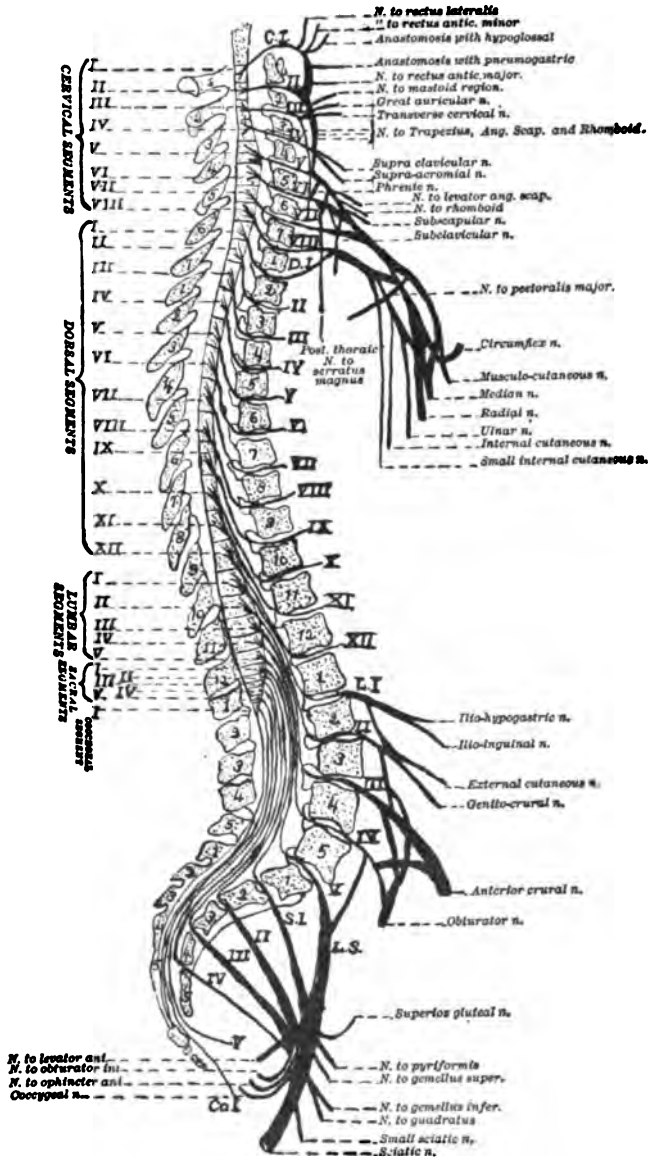


FIG. 10.—The relations of the segments of the spinal cord and their nerve-roots to the bodies and spines of the vertebræ (Déjérine et Thomas, modified by Starr).

Anatomic Landmarks

emaciated individuals the spinous line replaces the groove. The spinal furrow is less evident in the cervical than in the lumbar region; in the former situation it is between the trapezii and between the larger erector spinæ muscles in the dorsal and lumbar regions.

Palpation and definition of the vertebral spinous processes are facilitated by directing the patient to lean far forward or the processes may be rubbed with the hand, thus evoking a spot of hyperemic redness over the tip of each spinous process.

The 5th lumbar spine (marked by a depression) is used for measuring the external conjugate diameter of the pelvis. The latter diameter from the depression to the upper border of the symphysis pubis measures $20\frac{1}{4}$ cm. or $8\frac{1}{2}$ inches. The two posterior superior spinous processes of the ilium are on a line with the 3d sacral spine below which lie the sacro-iliac joints.

PETIT'S TRIANGLE is a triangular space corresponding to the central point of the crest of the ilium (Fig. oo).

This triangle is the occasional site of a lumbar hernia and is also a convenient region for relieving congestion of the kidney by local bleeding.

Deep pressure made in the neck in the direction of the carotid artery and opposite the cricoid cartilage detects a tubercle belonging to the transverse process of the 6th cervical vertebra and is known as CHASSAIGNAC'S TUBERCLE. Against the latter the carotid artery may be compressed by the finger.

The VERTEBRAL ARTERY may be compressed in the suboccipital region, the thumb and finger of one hand being placed in the hollows behind the mastoid process, while counterpressure is made by the other hand on the forehead. As the arteries lie under the complexus muscle, the pressure

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must be rather firm. If such pressure inhibits pulsating noises or vertiginous feelings, the inference is that, these are caused by congestion in regions supplied by branches of the

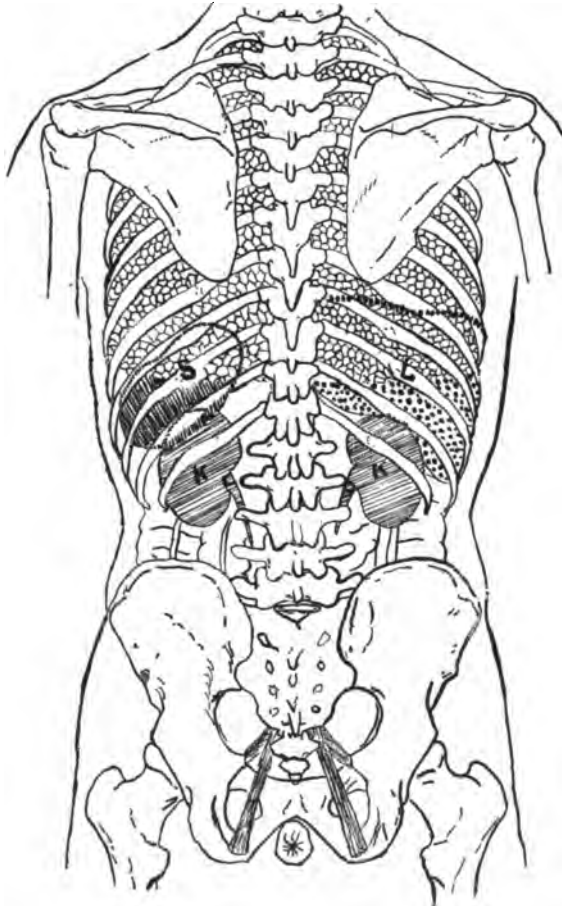


FIG. 11.—Diagram of the posterior aspect of the thorax and abdomen and showing the relation of the viscera to the surface. Liver (L); spleen (S); kidneys and ureters (KU).

basilar artery (internal ear). If noises in the ear are diminished by compression of the carotid artery, they are probably caused by congestion in the middle or external ear, and are often synchronous with the pulse.

L a n d m a r k s

LANDMARKS.

SPINES OF THE VERTEBRAE.	RELATION.
Atlas.	On a line with the hard palate. The transverse process is just below and in front of the tip of the mastoid process.
Axis.	Felt beneath the occiput and is on a level with the free edge of the upper teeth.
4th cervical vertebra.	Opposite the hyoid bone.
6th cervical vertebra.	On a line with the cricoid cartilage. Esophagus commences.
7th cervical vertebra (<i>Vertebra prominens</i>)	Easily recognized, owing to its prominence and serves as a guide for counting the processes downwards. Location of the inferior cervical ganglion.
2d dorsal spine.	Corresponds to the head of the 3d rib. The scapula covers the ribs from the 2nd to the 7th, inclusive. The apex of the lower lobe of the lung is at the level of the 3d rib behind.
3d dorsal spine.	Corresponds to the inner edge of the spine of the scapula. Termination of the arch of the aorta on the left side.
4th dorsal vertebra.	Opposite the junction of the 1st and 2nd section of the sternum. Thoracic aorta commences to the left. Trachea bifurcates midway between the 3d and 4th dorsal spines, the roots of the lungs thus lying a little below and external.
7th dorsal spine.	Corresponds to the inferior angle of the scapula when the patient is sitting with the arms hanging at the side.
10th dorsal vertebra.	Corresponds to the tip of the ensiform cartilage. Lower edge of lung posteriorly. Cardiac orifice of the stomach.
12th dorsal spine.	Corresponds to the head of the last rib. Aortic orifice in diaphragm.
4th lumbar spine.	Highest point of the crest of the ilium. The umbilicus is near the same plane. Division of the aorta. Below the tip of this spine, point of election for <i>lumbar puncture</i> . The disk of this vertebra corresponds to the ileo-cecal valve.

S p o n d y l o t h e r a p y

LOCALIZATION OF THE SPINAL NERVES.

In the adult, as a rule, the spinal cord extends from the lower surface of the foramen magnum to the lower edge of the 1st lumbar vertebra, and only exceptionally as far as the 2nd lumbar vertebra.

The position of the cord shows slight alterations in position in the movements of the body. Thus it rises during spinal flexion. The root-origin of the spinal nerves may be determined as follows (Consult Fig. 10):

- | | |
|--|---|
| For the upper 4 CERVICAL NERVES subtract 1 from the number of the nerve. | Thus the root-origin of the 3d cervical is opposite the 2nd cervical spine. |
| For the 4 lower cervical nerves and upper 6 DORSAL NERVES, subtract 2 from the number of each nerve. | Thus the root-origin of the 8th cervical nerve corresponds to the 6th cervical spine. |
| For the lower 6 dorsal nerves subtract 3 from the number of the nerve. | Thus the root-origin of the 9th dorsal is opposite the 6th dorsal spine. |

The LUMBAR NERVES take their origin contiguous to the 10th and 11th dorsal spines and the SACRAL NERVES between the 11th dorsal and 1st lumbar spines.

THE SYMPATHETIC SYSTEM.

This portion of the nervous system is concerned in the distribution of impulses to the glandular structures, cardiac muscle and the non-striated muscular tissue of the body. While this system is not supposed to be independent in action of the cerebro-spinal system, Langley employs the term *autonomic* to indicate that the efferent fibers of the sympathetic are endowed with a certain independence of the central nervous system. The autonomic fibers are removed from the control of the will and preside over unconscious

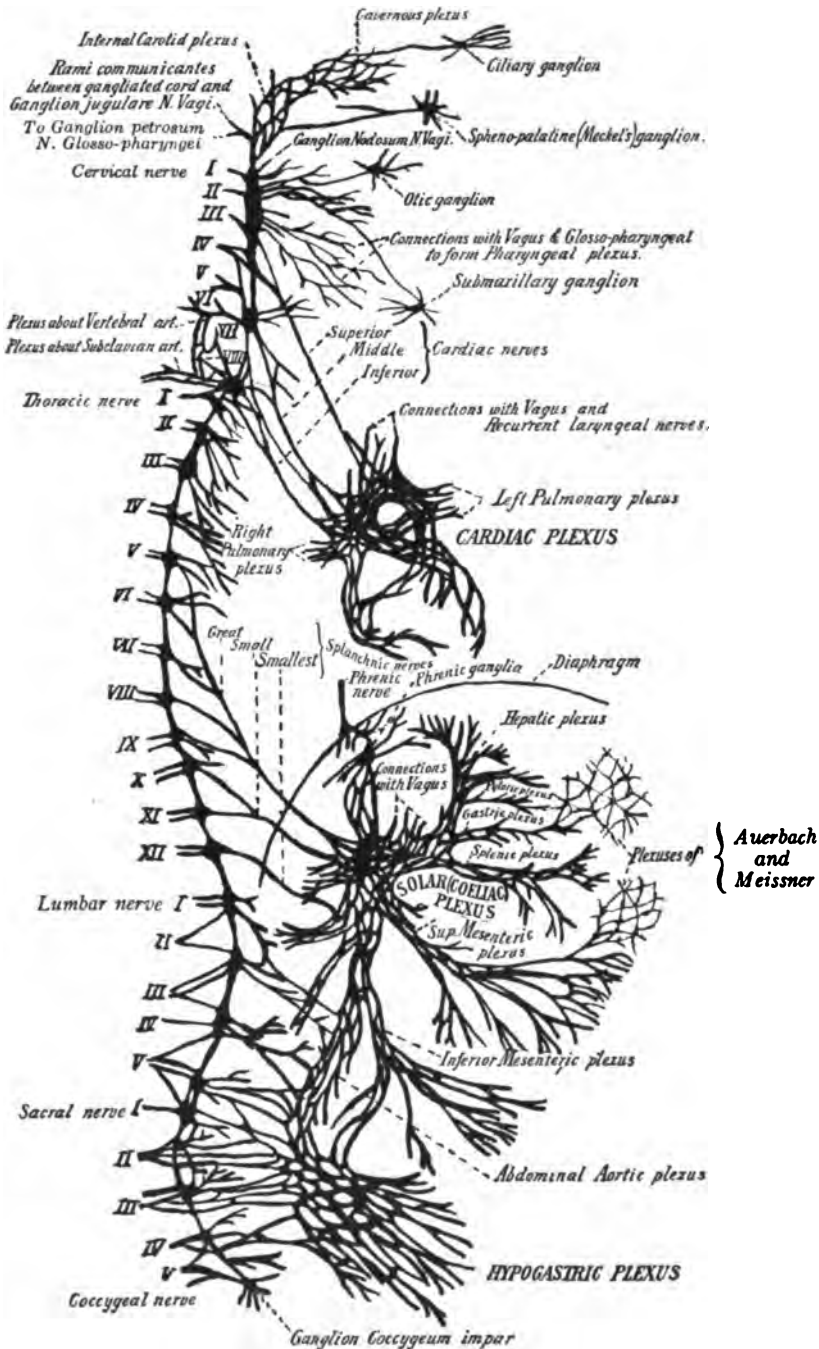


FIG. 12.—Illustrating the principal communications between the sympathetic and cerebro-spinal nervous system (Flower, modified by Morris).

S p o n d y l o t h e r a p y

reflexes like intestinal peristalsis, contraction and dilation of the arteries and the secretory activity of the digestive glands. The sympathetic system communicates with the cerebro-spinal system, by means of efferent and afferent nerves. Fig. 12 shows the principal communications between the two systems.

The sympathetic nerves are now regarded as carrying chiefly motor fibers, and their cell-origin is most probably the lateral horns on the same side of the spinal cord.

THE PHYSIOLOGY OF THE SPINAL CORD.

The spinal cord has a dual function; it acts as an independent central organ and as a conductor of nervous impulses.

Reference will be made primarily to the spinal cord as a **REFLEX CENTER**.

A reflex refers to involuntary production of activity in a part brought about by conduction of a stimulus along an afferent (sensory) nerve to the motor cells in the cord or medulla. This stimulus is converted into an impulse by the motor cells, which impulse is then conducted to a part by means of an efferent (motor) nerve.

The mechanism of the reflex known as the knee-jerk is illustrated in Fig. 13. To elicit this reflex, it is necessary to have an intact **REFLEX ARC**, otherwise the reflex is abolished. The reflex arc is made up as follows:

1. A healthy tendon which, when struck with a hammer, constitutes the peripheral stimulus which is then conducted by—

- 2, an afferent (sensory) nerve along the posterior roots to the anterior horn of the spinal cord where, by means of the motor cells, it is converted into an impulse which is then conducted by means of

T h e K n e e - J e r k

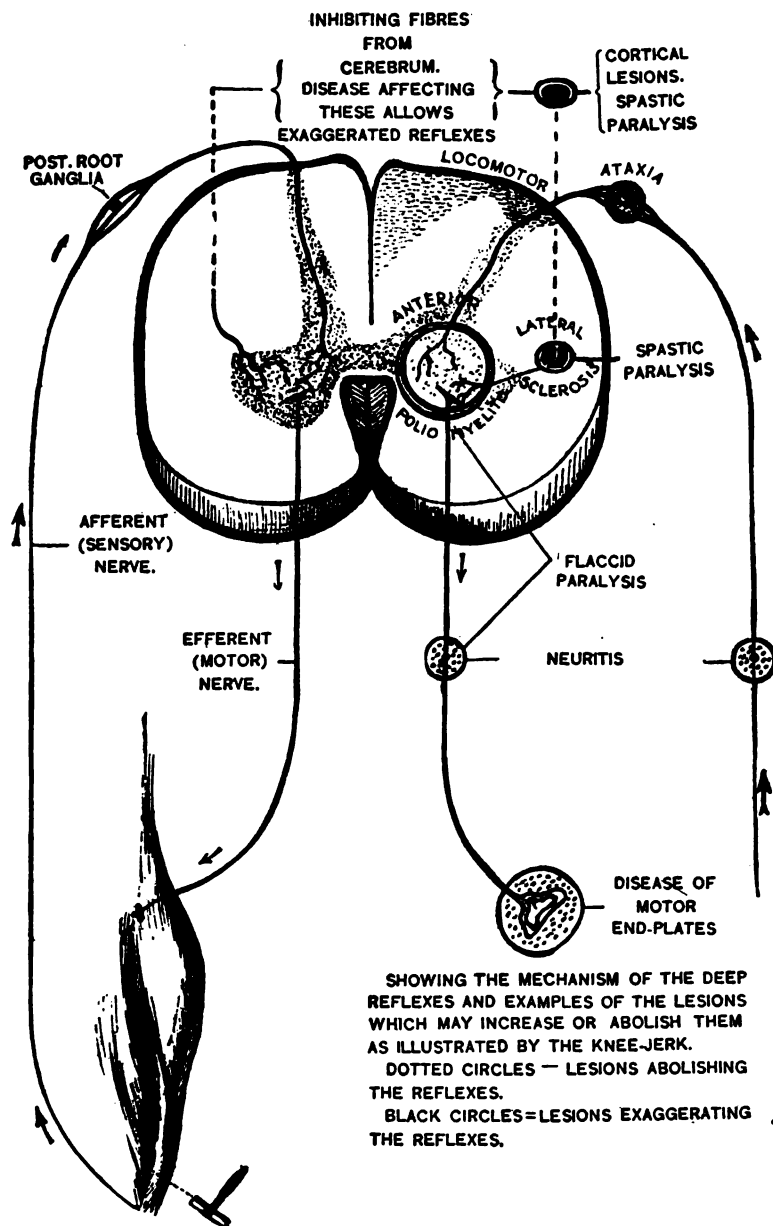


FIG. 13.—Showing the mechanism of the knee-jerk; also the two chief types (spastic and flaccid) of paralysis (Butler).

S p o n d y l o t h e r a p y

3, an efferent (motor) nerve to a healthy muscle.

The text-books usually describe the following reflexes :

1. Superficial or cutaneous elicited by irritation of the skin or a mucous membrane resulting in contraction of the muscles contiguous to the site of irritation ;
2. Deep or tendon reflexes elicited by striking a tendon, muscle or periosteum near the tendon ;
3. Organic or visceral reflexes which result in special acts like urination and defecation.

The reader is referred to page 7, where consideration was given to the vertebral reflexes. The latter are essentially central and are elicited by concussion or sinusoidalization of the spinous processes of definite vertebræ and by pressure at the vertebral exits of the spinal nerves.

A single paradigm may be cited to show the importance of the central vertebral reflexes in diagnosis. In LOCOMOTOR ATAXIA the posterior root-fibers in the posterior columns in the lumbar region are involved, in consequence of which the knee-jerk* is diminished or usually abolished.

The knee-jerk would be similarly influenced in lesions involving the anterior horns of the gray matter by cutting off the motor path. In other words, to elicit the knee-jerk the reflex arc in the lumbar cord must be intact. Reference to Fig. 14 shows that the center for the knee-jerk is located in segment III, of the medulla lumbalis and reference to Fig. 4, shows that the quadriceps reflex (central vertebral reflex) corresponds practically to the same site.

*The knee-jerk reflex arc is made up of nerve-fibers which pass to and from the crureus (one of the four muscles constituting the quadriceps extensor) by the anterior crural nerve and to and from the hamstrings by the sciatic nerve. The nerves to the crureus arise from the spinal nerve-roots corresponding to the 3rd and 4th lumbar; the hamstring supply is from the 5th lumbar and 1st and 2nd sacral roots. It will be noted that concussion will not elicit the knee-jerk. Here it is necessary to sinusoidalize simultaneously the 2nd lumbar vertebra and the sacral region.

T h e K n e e - J e r k

Now, in locomotor ataxia, the knee-jerk is abolished, owing to involvement of a part of the reflex arc (the afferent or sensory path), and when the knee-jerk is elicited in the usual way, it may be difficult to say whether any other part of the arc in question is implicated. If one can provoke the central quadriceps reflex, one can at least conclude that the descending paths (efferent or motor) are intact. For a like reason a *peripheral neuritis* may be difficult to differentiate from locomotor ataxia owing to involvement of the peripheral sensory nerves.

In a number of patients with locomotor ataxia examined by the author, a quadriceps reflex was usually present, and in a number of instances an exaggerated knee-jerk was obtainable on either one or the other leg. Usually it was absent in the more atactic leg or in advanced stages of the disease.

Here one was constrained to conclude that when the knee-jerk was obtainable, the posterior root-fibers were not entirely destroyed. It was also found that the Achilles reflex could be elicited (corresponding to segment V of the *medulla lumbalis*, Fig. 14) in a number of cases of locomotor ataxia by sinusoidalization over the sacrococcygeal articulation.

The elicitation of the vertebral reflexes directs reference to a mooted point in physiology, viz., whether the tendon reflexes are or are not true reflexes. According to the prevailing opinion, they are not true reflexes but are due to direct stimulation of the muscle itself. The author questions the correctness of the latter observation inasmuch as a veritable Achilles reflex and knee-jerk can be elicited in the norm by vertebral stimulation.*

*The author is convinced that this subject embraces a field of research of vast importance to the neurologist. Man is available for experimentation for, in the study of the vertebral reflexes, they can be evoked with an accuracy almost equal to their elicitation by vivisection.

S p o n d y l o t h e r a p y

In eliciting the knee-jerk the large electrode must be placed over the lower sacral region and the interrupting electrode over the spinous process of the 2nd lumbar vertebra and one leg crossed upon the other leg. A strong current is necessary. With some sinusoidal machines the knee-jerk cannot be evoked, but with Kellogg's apparatus (Fig. 44) it can practically always be excited.

LOCALIZATION OF FUNCTION IN THE DIFFERENT SEGMENTS OF THE SPINAL CORD.

A SPINAL SEGMENT refers to the part of the cord contained between two sets of roots. Each segment must be regarded as a unit endowed with motor, sensory, vasomotor, trophic and reflex functions with regard to the peripheral distribution of the roots of the nerves which emerge from and enter it. A segment is called after the nerve-roots which take their origin from it and not with reference to its relation to the vertebræ.

A diagrammatic representation of the spinal cord is shown in Fig. 14. The cord is divided into its four regions. Within each region the spinal segments are indicated by numbers. On the right-hand side of the diagram, muscles or groups of muscles are indicated, and the lines proceeding from them pass to the segments of the cord in which the cell-bodies of origin are located.

On the left side of this diagram the sensory regions are indicated and the lines show their relation to the different segments of the cord itself.

To determine the condition of the cord at different levels the following table¹¹ is serviceable. It shows the different segments controlling the skeletal muscles, the reflex centers and the chief location of the segmental skin-field.

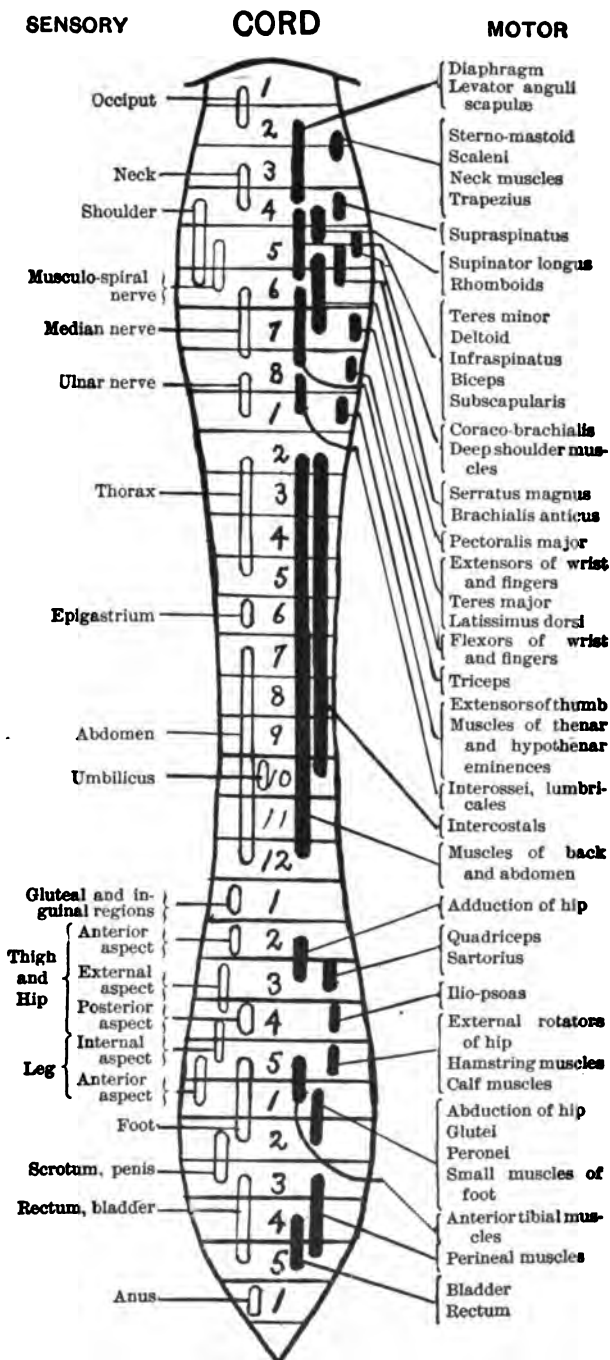


FIG. 14.—Diagrammatic representation of the spinal cord showing the spinal segments for motion and sensibility. Jakob, Starr, Sachs, Dana, Mills and Butler.

S p o n d y l o t h e r a p y

LOCALIZATION OF THE FUNCTIONS IN THE SEGMENTS OF THE SPINAL CORD.

SEGMENT	STRIPED MUSCLES	REFLEX	SKIN-FIELDS
I, II, and III C.....	Splenius capitis Hyoid muscles Sterno-mastoid Trapezius Diaphragm (C III-V) Levator scapulæ (C III-V)	Hypochondrium (?) Sudden inspiration produced by sudden pressure beneath the lower border of ribs (diaphragmatic).	Back of head to vertex. Neck (upper part).
IV C.....	Trapezius Diaphragm Levator scapulæ Scaleni (C IV-DI) Teres minor Supraspinatus Rhomboid	Dilation of the pupil produced by irritation of neck. Reflex through the sympathetic (C IV-DI).	Neck (lower part to second rib). Upper shoulder.
V C.....	Diaphragm Teres minor Supra and infra spinatus (C V-VI) Rhomboid Subscapularis Deltoid Biceps Brachialis anticus Supinator longus (C V-VII) Supinator brevis (C V-VII) Pectoralis (clavicular part) Serratus magnus	Scapular (CV-DI). Irritation of skin over the scapula produces contraction of the scapular muscles. Supinator longus and biceps. Tapping their tendons produces flexion of forearm.	Outer side of shoulder and upper arm over deltoid region.
VI C.....	Teres minor and major Infraspinatus Deltoid Biceps Brachialis anticus Supinator longus Supinator brevis Pectoralis (clavicular part) Serratus magnus (C V-VIII) Coraco-brachialis Pronator teres Triceps (outer and long heads) Extensors of wrist (C VI-VIII)	Triceps. Tapping elbow tendon produces extension of forearm. Posterior wrist. Tapping tendons causes extension of hand (C VI-VII).	Outer side of forearm, front and back. Outer half of hand (?).

Segmental Localization

LOCALIZATION OF THE FUNCTIONS IN THE SEGMENTS OF THE SPINAL CORD—CONTINUED.

SEGMENT	STRIPED MUSCLES	REFLEX	SKIN-FIELDS
VII C	Teres major Subscapularis Deltoid (posterior part) Pectoralis major (costal part) Pectoralis minor Serratus magnus Pronators of wrist Triceps Extensors of wrist and fingers Flexors of wrist Latissimus dorsi (C VI-VIII)	Scapulo-humeral. Tapping the inner lower edge of scapula causes adduction of the arm. Anterior wrist. Tapping anterior tendons causes flexion of wrist (C VII-VIII).	Inner side and back of arm and forearm. Radial half of the hand.
VIII C	Pectoralis major (costal part) Pronator quadratus Flexors of wrist and fingers) Latissimus Radial lumbricales and interossei	Palmar. Stroking palm causes closure of fingers.	Forearm and hand, inner half.
I D	Lumbricales and interossei Thenar and hypothenar eminences (C VII-DI)	Upper arm, inner half.
II to XII D . .	Muscles of back and abdomen Erectores spinæ (D I-L V) Intercostals (D I-D XII) Rectus abdominis (D V-D XII) External oblique (D V-XII) Internal oblique (D VII-L I) Transversalis (D VII-LI).	Epigastric. Ticking mammary region causes retraction of epigastrium (D IV-VII). Abdominal. Stroking side of abdomen causes retraction of belly (D IX-XII).	Skin of chest and abdomen in oblique dorso-ventral zones. The nipple lies between the zone of D IV and D V. The umbilicus lies in the field of D X.
I L	Lower part of external and internal oblique and transversalis Quadratus lumborum (L I-II) Cremaster Psoas major and minor(?)	Cremasteric. Stroking inner thigh causes retraction of scrotum (L I-II).	Skin over lowest abdominal zone and groin.

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LOCALIZATION OF THE FUNCTIONS IN THE SEGMENTS OF THE SPINAL CORD—CONTINUED.

SEGMENT	STRIPED MUSCLES	REFLEX	SKIN-FIELDS
II L.....	Psoas major and minor Iliacus Pectineus Sartorius (lower part) Flexors of knee (Remak) Adductor longus and brevis	Front of thigh.
III L.....	Sartorius (lower part) Adductors of thigh Quadriceps femoris (L II-L IV) Inner rotators of thigh Abductors of thigh	Patellar tendon. Tapping tendon causes extension of leg. "Knee-jerk"	Front and inner side of thigh.
IV L.....	Flexors of knee (Ferrier) Quadriceps femoris Adductors of thigh Abductors of thigh Extensors of ankle (tibialis anticus) Glutei (medius and minor)	Gluteal. Stroking buttock causes dimpling in fold of buttock (L IV-V).	Mainly inner side of thigh and leg to ankle.
V L.....	Flexors of knee (hamstring muscles) (L IV-S II) Outward rotators of thigh Glutei Flexors of ankle (gastrocnemius and soleus) (L IV-S II) Extensors of toes (L IV-S I) Peronæi	Back of leg and part of foot.
I to II S.....	Flexors of ankle (L V-S II) Long flexor of toes (L V-S II) Peronæi Intrinsic muscles of foot	Foot reflex. Extension of Achilles tendon causes flexion of ankle (S I-II). Ankle-clonus. Plantar. Tickling sole foot causes flexion of toes or extension of great toe and flexion of others.	Back of thigh, leg, and foot; outer side.
III to V S. . . .	Perineal muscles. Levator and sphincter ani (S I-III)	Vesical and anal reflexes.	Skin over sacrum and buttock. Anus. Perinæum. Genitals.

Segmental Skin-Fields

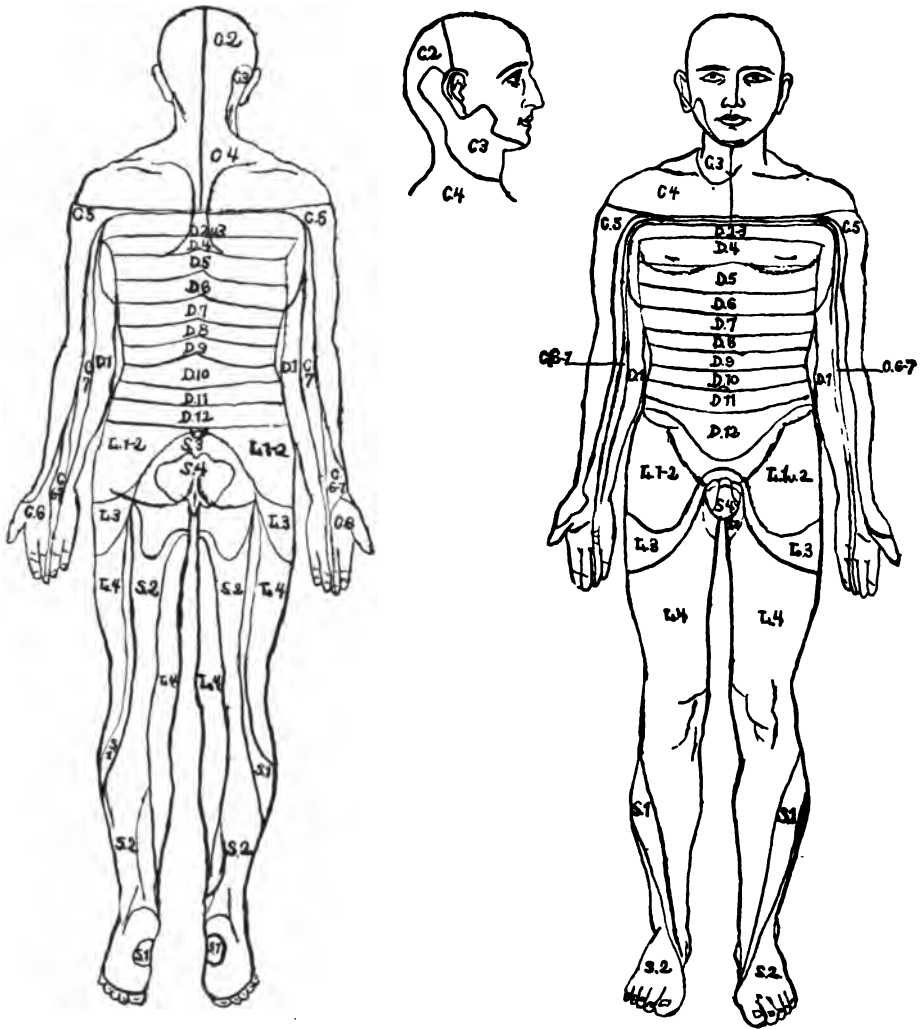


FIG. 15.—Showing the areas on both surfaces of the body which are related to the different segments of the spinal cord. When a segment of the cord is destroyed, the surface of the body is anesthetic in the area corresponding to that segment. C, cervical; D, dorsal or thoracic; L, lumbar; S, sacral.

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Fig. 15 shows the segmental skin-fields which assist in determining the segmental level of spinal cord and of dorsal root-lesions.

VISCERO-MOTOR CENTERS.

It will be noted that the following physiologic location of the visceromotor cells does not correspond with the clinical localization of the visceromotor reflexes (Fig. 5). However, the former are cited for the sake of completeness. It will also be observed that the clinical evidence tallies with physiologic observation, viz., that there is usually a double visceromotor mechanism consisting of excitation and inhibition.

TABLE OF THE VISCERO-MOTOR CENTERS.

STRUCTURE.	LOCATION OF VISCERO-MOTOR CELLS.
Pupil (constriction of).	Nucleus of the 3rd cranial nerve.
Pupil (dilatation of).	Between the 6th cervical and 2nd dorsal segments.
Bronchi and bronchioles (constriction of).	Nucleus of the 10th cranial nerve.
Heart (acceleration of).	6th cervical to the 2nd dorsal segments of the cord.
Heart (inhibition of).	Nuclei of the 10th and 11th cranial nerves.
Alimentary canal (accelerating peristaltic movements).	Nucleus of the 10th cranial nerve.
Alimentary canal (inhibition of peristaltic movements).	4th dorsal to the 2nd lumbar segments.
Uterus (inhibition of muscular coat and contraction of the cervix and vagina).	2nd, 3d and 4th lumbar segments.
Dilatation of cervix uteri and vagina.	2nd, 3d and 4th sacral segments.
Bladder (contraction of the sphincter).	2nd, 3d and 4th lumbar segments.
Bladder (relaxation of the sphincter).	2nd, 3d and 4th sacral segments.

Relation of Spines to Segments

By referring to Fig. 10 the physician will be able to determine the relation of the segments of the spinal cord to the spines of the vertebræ. It may be recalled that a segment is called after the pair of nerves which arise from it and not from its vertebral relation. The following table shows the approximate relation of the spines of the vertebræ to the segments of the spinal cord.

APPROXIMATE RELATION OF THE VERTEBRAL SPINES TO THE SPINAL SEGMENTS.

CERVICAL SEGMENTS.	VERTEBRAL SPINES.
I	
II	} 1st <i>cervical</i> spinous process.
III	} 2nd cervical spinous process.
IV	} 3d cervical spinous process.
V	} 4th cervical spinous process.
VI	} 5th cervical spinous process.
VII	
VIII	
DORSAL SEGMENTS.	
I	} 6th cervical spinous process.
II	} 7th cervical spinous process.
III	} 1st <i>dorsal</i> spinous process.
IV	} 2nd dorsal spinous process.
V	} 3d dorsal spinous process.
VI	} 4th dorsal spinous process.
VII	} 5th dorsal spinous process.
VIII	} 6th dorsal spinous process.
IX	} 7th dorsal spinous process.
X	} 8th dorsal spinous process.
XI	
XII	
LUMBAR SEGMENTS.	
I	} 9th dorsal spinous process.
II	} 10th dorsal spinous process.
III	} 11th dorsal spinous process.
IV	
V	
SACRAL SEGMENTS.	
I, II and III	} 12th dorsal spinous process.
IV and V	
COCCYGEAL SEGMENT.	
I	} 1st <i>lumbar</i> spinous process.

The *vaso-motor apparatus* is discussed on page 272.

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CHAPTER III.

SYMPTOMATOLOGY.

EXAMINATION OF THE BACK—THE NORMAL SPINE—DISEASES OF THE SPINE—SPONDYLOGRAPHY—EXAMINATION OF THE MUSCLES OF THE BACK—STIFF BACK—MUSCULAR HYPOTONIA—PAIN AND TENDERNESS OF THE SPINE—SYMPATHETIC SENSATIONS—DERMATOMES OF HEAD—VERTEBRAL PAIN—VERTEBRAL TENDERNESS—VERTEBRAL PERCUSSION—VIBROSUPPRESSION.

The VERTEBRAL COLUMN subserves the following objects:

1. It is the central pillar of the body and supports the weight of the head;
2. It connects the upper and lower segments of the trunk and gives attachments to the ribs.
3. It diminishes the effects of shocks conveyed from various parts of the body chiefly by means of its curves and the elastic intervertebral discs which act the part of buffers.*
4. It is endowed with considerable mobility and furnishes a solid tube for the spinal cord.

The MUSCLES of the back and trunk are the only agents in supporting the spine erect. When the muscles in question are exhausted, relief is involuntarily secured by means of rotation and lateral flexion, thus eventuating in the condition known as scoliosis.

THE NORMAL SPINE.

The normal spine must be studied with relation to its CONTOUR and FLEXIBILITY. Any deviation of the spinous

*If the height of an individual is taken in the morning and again at night a decrease in the total height of the body of from 1 to 2 cm. during the day will be noted. This fact may be attributed to compression of the intervertebral discs by the weight of the body in the erect posture.

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processes from the median plane of the body may be determined by marking each spinous process with a pencil while the patient stands erect. In the norm the marks represent a straight line. The median line of the body is obtained by holding a plumb-line behind the patient so that the lower end of the line dips into the groove between the buttocks. In the norm each marked spinous process will lie under the plumb-line.

A record may be made by placing crinoline gauze or tracing paper on the back through which the spinal marks may be seen and thus transferring the marks to the gauze or paper.

The contour of the spine may be determined by means of a strip of lead or pure tin thick enough so that it can be molded on the spine and still preserve its shape when removed. The prominent spinous processes should be indicated upon it. The curves of the spine thus obtained may be transferred to paper for further study.

Certain curves are constant, viz.:

1. Forward in the upper;
2. Backward in the middle, and
3. Again forward in the lower region.

These curves are fixed in the adult but may be almost annihilated in early childhood by traction in the horizontal position.

In the erect posture a normal individual will show the following curves (Fig. 16):

1. Cervical, the convexity of which is forward. It begins at the 1st cervical and ends at the 2nd dorsal vertebra;
2. Thoracic or dorsal, the convexity of which is backward. It begins at the 3d dorsal and ends at the

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- 12th dorsal vertebra; its most prominent point behind corresponds to the spine of the 7th dorsal.
3. Lumbar, which is convex anteriorly, commences at the middle of the last dorsal vertebra and ends at the sacro-vertebral angle. This curve is more marked in the female than in the male.
 4. Pelvic, which is concave anteriorly, commences at the sacro-vertebral articulation and ends at the point of the coccyx.

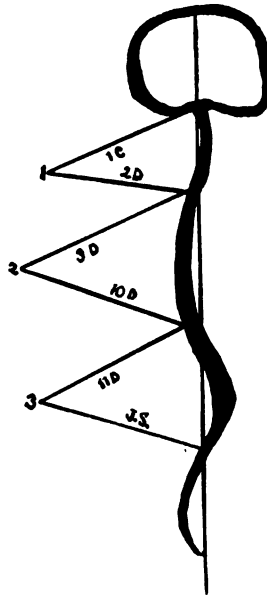


FIG. 16.—Normal vertebral curves and divisions of the spine (Whitman).

The average length of the spinal column in the male is about 2 feet and 4 inches and the female spine is about 2 feet in length. The length of the individual parts is as follows:

1. Cervical.....	5 inches
2. Dorsal.....	11 "
3. Lumbar.....	7 "
4. Sacrum and coccyx.....	5 "

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In the adult many causes, notably occupations, cause variations of the normal contour of the spine, but in children such variations may be regarded as abnormal.

The normal contour results from balancing of the body in the erect posture, and if there is any variation in one part compensation induces a change in another part, eventuating often in a complete reversal of the normal spinal curves.

Even in the norm there is a slight lateral convex curve to the right, extending from the 5th dorsal to about the 3d lumbar vertebra, which has been attributed to the following causes :

1. Aortic pressure on the vertebral bodies;
2. Excessive use of the right side of the body;
3. Right-handedness.

The FLEXIBILITY of the human spine is largely dependent on movements between the spine and the pelvis and the head.

It is evident that exercises destined for the spine only must presume pelvic fixation, for otherwise, as Lovett¹² puts it, "Part of the muscular force is used in displacing the pelvis to the opposite side to balance the body and the movement becomes a general and not a spinal one."

The MOVEMENTS of the spine are :

1. Flexion;
2. Extension;
3. Lateral flexion;
4. Rotation.

In FLEXION, or forward-bending, if extreme and perfect, the spinous processes will describe the arc of a circle and the distance by measurement from the 7th cervical vertebra to the sacrum is greater than a like measurement secured in the erect or prone posture.

In EXTENSION, or backward-bending, the movement is chiefly limited to the lumbar and the last two dorsal verte-

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bræ. In hyperextension, if measurement is made of the distance from the 7th cervical vertebra to the sacrum (over the spinous processes), it is decreased when compared with a like measurement in the erect posture.

LATERAL FLEXION may be tested by side-bending in the erect posture. In the norm the movement is located at and below the lumbar dorsal junction.

ROTATION is most pronounced in the erect posture in the

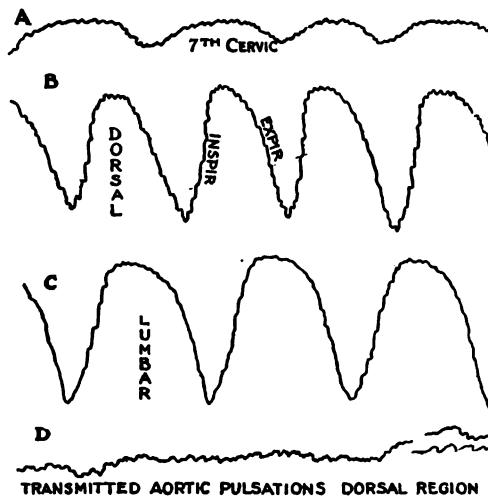


FIG. 17.—Spondylograms reduced one-half. A, taken at the level of the 7th cervical spine; B, taken in the dorsal region; C, taken in the lumbar region; D, transmitted aortic pulsations taken in the dorsal region during the time the patient suspends respiration.

cervical and dorsal regions; the maximum is attained at the top of the cervical column extending below to the lower dorsal region where it is no longer evident.

SPONDYLOGRAPHY.

It is generally contended that the spinal column enjoys a considerable range of motion as a whole, but that the motion between any two individual pieces is extremely

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limited. It is known that during deep respiration a straightening of the vertebral column occurs involuntarily. The author has reason to believe that the vertebræ enjoy a greater degree of motion than is usually accepted and to prove this

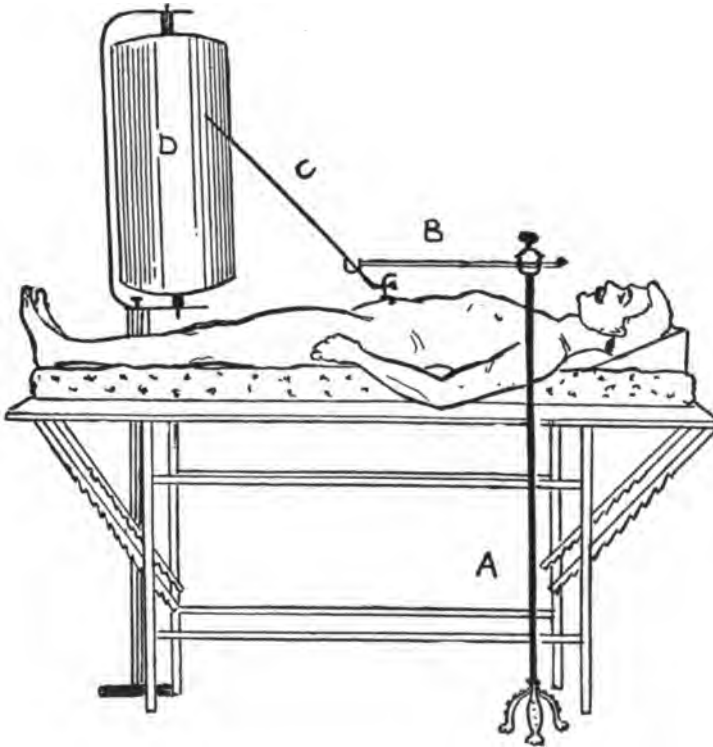


FIG. 18.—Apparatus for taking a spondylogram. The position of the patient is adapted for taking tracings of the abdominal aorta. To take a spondylogram the patient must be in the prone position. A, stand with an adjustable rod; B, C, lever; D, tambour for recording. To the short end of lever (C), a string is passed through an opening and the end of the string is fixed by adhesive plaster to a spinous process.

contention the accompanying spondylograms are submitted (Fig. 17).

They were obtained with the patients in the prone posture during quiet breathing. The serrations noted in

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the tracings are probably transmitted aortic pulsations. The apparatus (Fig. 18) employed for eliciting the spondylograms was originally constructed by the author for taking tracings of the abdominal aorta.³²

Spondylography will aid in the early diagnosis of respiratory vertebral immobility and by furnishing a permanent record, the course of a vertebral disease may be accurately controlled. Here we are in the possession of a method which may be as important to the orthopedist as is the sphygmograph to the clinician.

DISEASES OF THE SPINE.

SPINAL EXAMINATION FOR DEFORMITY.

With the patient in the erect position (heels together and arms hanging) note if the curves are normal or if there is any abrupt projection of one or more spines.

Any ROTATION of the vertebræ may be determined by comparing the prominence of the angles of the ribs, the transverse processes of the lumbar vertebræ, the height and prominence of the scapulæ and the prominence of the iliac crests on the two sides. Estimation of rotation or twist is best determined by Adam's position: The patient bends forwards (with unflexed knees) until the trunk is horizontal with the hands hanging down. With the head on a level with the spine the physician notes whether either side of the trunk is more prominent upward. The presence of an upward prominence indicates rotation or twist. Next, the anterior aspect of the body is inspected and the following noted with reference to the two sides of the body; deformities of the chest and the level of both anterior iliac spines. Again, inspecting the back, the patient is instructed to bend forward (with knees straight) and note should be made if he bends freely and straight forwards. If the movement, however, is

Examination for Deformity

restricted and oblique and if the angles of the ribs are uncovered by the scapulæ and project more on one side, one is dealing with signs of ROTATION OF THE SPINE. The presence and degree of this rotation determine the diagnosis of *Scoliosis* and not, as Gould¹³ emphasizes, the lateral deviation of the tips of the spinous processes. Next, the patient assumes the prone posture on a flat couch. In the latter position the following may be noted:

CURVES.

Natural curves lost and replaced by a general convexity of the spine backwards altered by movement and disappearing in the recumbent posture.

The general convexity of the spine backwards is permanent and uninfluenced by movement or the recumbent position and the movements of the spine are diminished.

There is an abrupt curve of the spine backwards or several spinous processes are projected posteriorly.

Diminution of the natural curve in the dorsal region with straight dorsal spine sunk in between the scapulæ and rotation of the spine.

Lateral deviation of the spines without rotation and disappearance of the deviation in the recumbent position.

A permanent (uninfluenced by position) long sweeping curve to one side without rotation of the vertebræ.

AFFECTION.

Spinal muscular debility from rickets or other causes and in convalescents who have maintained the horizontal posture.

Spondylitis deformans.

Caries of the spine (Pott's disease).

Lateral curvature of the spine (scoliosis).

Weak-spine often present in hysteria.

Retraction of chest observed in pleuritis and empyema.

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EXAMINATION OF THE MUSCLES OF THE BACK.

“The spine lies at the back of a more or less cylindrical muscular tube of which the abdominal muscles form the front” (Lovett¹²).

There are two kinds of muscles directly attached to the back, one group passing from one part of the spine to another part and to the head and another group running from the spine to the pelvis or shoulder girdle.

In diagnosis and in treatment by *muscular exercises*, the fact must be emphasized that the spinal movements are not affected by an individual muscle but by all the spinal muscles which act in unison.

The relative rigidity of the thoracic spine is dependent on the attachment of the ribs behind, between two vertebræ and to the sternum in front.

There are two feeble and movable parts of the spine (points where important muscles have a dividing line), viz. :

1. At the cervico-dorsal junction;
2. At the dorsolumbar junction.

The ligaments of the spine are loose and the surfaces of the articular processes are only in slight contact, hence the muscles of the back and trunk are the only agents for maintaining the spine erect. The moment the muscles are exhausted some relief is obtained by rotation and lateral flexion of the spinal column (which tightens the ligaments and brings the articular processes in closer contact) which eventuates in scoliosis.

RIGIDITY OF THE SPINAL MUSCLES.

The condition of the spinal muscles may be determined by the movements of the patient and by palpation. The

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former may be tested by directing the subject to jump, run, walk, pick up objects from the floor, etc.

The tests must include movements which necessitate flexion, extension and lateral bending of the spine.

By placing the palm of the hand on various parts of the spine and then directing the patient to make different motions, one may note during execution of the latter whether the vertebræ move or are fixed.

Special movements exclude definite joint-involvement.

Free and painless nodding of the head excludes implication of the occipito-atloid joint.

If the face can be easily turned from one side to another the atlo-axoid joint is not involved.

The lower cervical spine is not implicated if flexion of the head can be executed freely and painlessly.

The various voluntary movements must be adapted to the intelligence of the patient. Thus children who resist passive movements on a table will submit to manipulation in the arms of the mother.

A child will walk toward its mother and will incline the head in the direction of the latter—a useful test in determining the condition of the cervical spine.

By placing the patient in a recumbent position (with head slightly elevated), first on the right and then on the left side, the spinal muscles are relaxed and may be carefully palpated.

In the norm the muscles show no tenderness, are elastic and easily roll under the palpating finger.

SPASM OF THE SPINAL MUSCLE.

By the term "*spasm*," one refers to an abnormal muscular contraction due to an augmented reaction of the motor nerves. When the muscular contraction is prolonged it is known as

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a tonic spasm, in contradistinction to a clonic spasm, in which contractions of brief duration alternate with flaccid conditions of the muscle.

Spasm of the spinal musculature such as the author conceives the condition must be dissociated by the reader from the conventional twitchings and spasmodic movements of individual muscles or groups of muscles.

It is true that, the clinician has long recognized the almost intelligent function of muscles whether displayed in fixing a diseased joint or spine, or in protecting an inflamed serous membrane, but he has neglected to carefully palpate the spinal musculature for localized spasms which are usually tonic in character.

To detect such muscular contractions the patient must be placed on a table in the lateral posture to secure muscular relaxation.

The investigations of the author show that pressure at the vertebral exits of the spinal nerves will elicit muscular contractions in definite regions, and conversely, that pressure in the latter situations will evoke localized clonic or tonic spasm in definite spinal regions.

In disease the peripheral localized spasm may be present independent of the spinal spasm, but, as a rule, careful palpation of the spinal and peripheral musculature demonstrates that they coexist.

In the accompanying illustration (Fig. 19), the author has endeavored to present a composite picture as obtained in the norm.

The illustration shows the vertebral area involved in spasm during the time firm pressure is made in definite peripheral regions. Pressure made at these vertebral exits will provoke spasm of the peripheral musculature. The vertebral areas are only approximately correct inasmuch as the

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spasm of the spinal musculature is often diffused and exact localization is often impossible. The palpating finger may only feel a tremor or a sensation like a pulsation in the muscle. Not infrequently the contraction of the spinal muscle may be seen.

It will be noted that although pressure is only made on

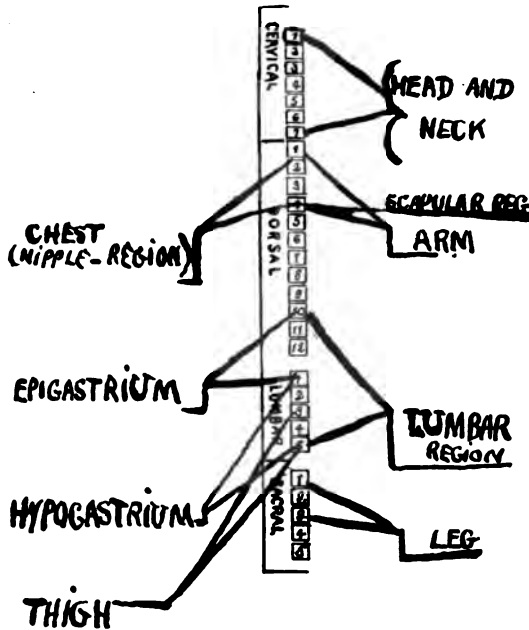


FIG. 19.—Vertebral areas involved in muscular spasm when different peripheral regions are firmly compressed or irritated.

one side of the spinal column the muscular contraction is often bilateral. If deep and firm pressure with the fingers of one hand is made on any of the peripheral points of spasm, the other hand will usually detect bilateral localized spasm of the spinal musculature corresponding to the vertebral areas indicated in Fig. 19.

While mere cutaneous irritation will induce contraction

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of the spinal muscles, the latter is less evident than when deep pressure is made on the peripheral muscles or when the peripheral area is painful. The recognition of these peripheral and spinal spasms is destined to be of considerable value in diagnosis.

Space will not permit the author to descant further on this subject, but he may be permitted to cite *meningismus* as a paradigm.

The latter affection occurs in association with suppurative diseases of the middle ear in children and adults and symptoms are present (notably rigidity of the neck-muscles) which simulate disease of the brain although no intracranial inflammation exists.

If the peripheral source of irritation can be inhibited by means of cocain, the rigidity of the neck-muscles will subside temporarily. Reference to the accompanying illustration (Fig. 20) shows the extensive anastomoses of the cervical plexus and explains the (when sought) of rigidity of the neck muscles in affections of the head and face.

There must also be a spasm of the spinal musculature as an expression of visceral disease and this is a subject worthy of investigation.

At present, however, we must rely on vertebral tenderness and the dermatomes of Head as indices of visceral disease (page 58).

STIFF BACK.

Stiffness and lack of mobility of the back may be caused by:

1. Pain (lumbago, vertebral disease, tonic spasm of the muscles);
2. Ankylosis of the vertebral column.

MUSCULAR RIGIDITY is one of the earliest signs of Pott's disease and persists until cure is effected. It is most pro-

C e r v i c a l P l e x u s

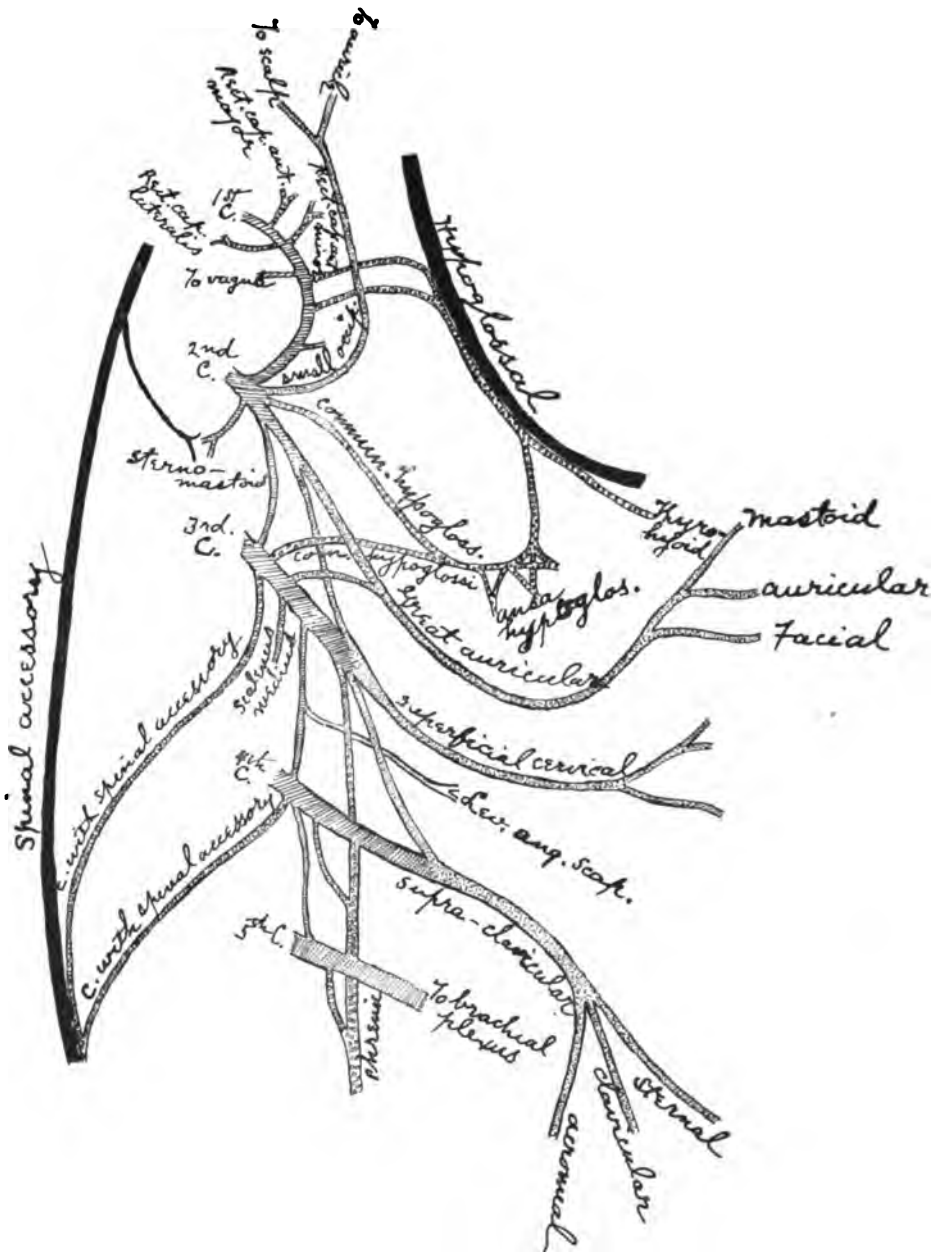


FIG. 20.—Plan of the cervical plexus (Gray).

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nounced in the neighborhood of the disease, but may extend some distance. If the patient is directed to bend forward and no rigidity nor spasm is associated with the movement and the outline of the spinal curve is even and not broken, Pott's disease may be safely excluded.

Muscular rigidity dissociated with spinal disease resists motion only in the directions directly opposed by the contraction of the muscles. If the spasm, however, is associated with spinal disease it resists motion in all directions.

A stiff back due to ankylosis of the vertebral column may be caused by any of the following diseases (*q. v.*): Spondylitis, Pott's disease, paralysis agitans and arthritis deformans.

MUSCULAR HYPOTONIA.

MUSCULAR FATIGUE is an invariable sign of neurasthenia. Fatigue of muscle is caused essentially by the consumption of material necessary for contraction and the storing up in the muscle of waste-products produced by its own activity. Some people tire more easily than others, owing to the fact that the waste-products responsible for the fatigue in the one are less readily removed or accumulate more easily.

Massage of the muscles rapidly removes the evidence of fatigue simply because the waste-products are washed into the circulation by this manœuver.

The fatigue in neurasthenia probably has its origin in the nervous system and only indirectly in the muscles.

If one tests the strength of the muscles in neurasthenia, although a diminished response is shown, it is by no means proportionate to the diminished vigor exhibited by the patient.

It has been shown that the time during which an individual can sustain a voluntary muscular contraction is determined by the endurance of the brain-centers engaged in the

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act of volition rather than by that of the muscles themselves. The very moment these centers are exhausted the contraction of the muscle gives way.

Volition can be fatigued when exerted in imagination as well as in actual muscle-effort.

BACKACHE, or a sensation of weariness, is a frequent symptom of neurasthenia and the older writers referred to this sign as spinal irritation (*vide* neurotic spine). It is known that when fatigue-signs are exaggerated they become painful and are described as "aches."

Many cases of backache in neurasthenics are caused by a faulty spinal attitude. Thus the attitude of children with round shoulders (page 96) will substitute ligamentous for muscular support. All our muscular groups are not equally and symmetrically developed and many deformities such as spinal curvatures, round shoulders, etc., bear witness to the truth of the foregoing statement (*vide* Exercises).

Decrease in the normal tone or elasticity of the muscles is designated by the word HYPOTONIA, and this condition is frequent in many nervous diseases.

It is difficult to measure muscular-force. The dynamometer and the ergograph yield valuable but inconstant information.

The muscles may be tested by noting the strength of the Galvanic current (read in milliampères) and Faradic current (measurement on the scale of the secondary spiral and expressed in millimeters of coil-distance) necessary to produce the minimal contraction.

The muscles of the healthy side may be used as a standard of comparison, otherwise we must be governed by the reactions observed in the average individual with normal musculature.

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One notes that when the muscles are weak, with the strongest current the contraction of the muscles may be no greater than with weak currents.

The implicated muscles do not contract *in toto*, but only a few bundles contract and appear as slightly prominent ridges.

The Faradic current provokes no tetany, but only several clonic contractions of the muscle-substance which succeed each other during the closure of the current (myoclonic contractions).

For strengthening defective spinal muscles the sinusoidal current (page 151) is very effective.

Very frequently individual muscle-groups are involved in hypotonia. Thus a faulty position of the scapulæ may be caused by the muscles which maintain the position of the latter. Similarly, scoliosis may be provoked by an hereditary hypotonia of the spinal muscles.

A lack of tone or relaxation of the muscles is an early sign¹⁴ of LOCOMOTOR ATAXIA. This hypotonia may be estimated as follows: With the patient in the erect position the distance from the floor to the greater trochanter and the 7th cervical vertebra is measured. If the patient is now instructed to bend forward (knees stiff) as far as possible and the distance in this position is again estimated from the floor to the 7th cervical vertebra, it will be found that in health, and in all affections (excepting tabes), it is impossible to bend the trunk sufficiently forward to permit the 7th cervical vertebra to be brought to or below the level of the trochanter. The hypotonia of the muscles in tabes, however, permits the vertebra in question to attain a distance of 21 or more cm. below the level of the trochanter.

P a i n - P e r c e p t i o n

PAIN.

Pain results from powerful stimulation of a nerve, and in accordance with the law of eccentric projection, it is a matter of little moment which part of the nerve is stimulated, the perception of pain being referred to the periphery.

According to the prevailing hypothesis pain-perception is the result of individual stimulations which accumulate probably in the cells in the posterior part of the gray substance of the spinal cord and it is the total of such stimulations which eventuates in a discharge which the patient interprets as pain.

The intensity of the pain is determined by the duration and amount of the stimulation and by the irritability of the nerve-fibers and ganglion-cells.

The expression of pain is no measure of its intensity. Animals as well as men show differences in their sensitiveness to pain. A frequent clinical error is to underestimate the intensity of pain and to question its reality simply because by diverting the attention of the patient the latter exhibits less evidence of his suffering.

Pain is usually worse at night for the very evident reason that in the daytime our attention is distracted.

It is also evident that the imagination of pain will accentuate its intensity. In estimating pain objectively the personal equation must always be taken into consideration, and by aid of the following method⁴⁵ one may determine the degree to which an individual is sensitive to pain. With the thumb, pressure is made over the styloid process in the neck. Some patients will complain of the slightest pressure, whereas others will tolerate considerable pressure without a pain-reaction (*vide* vertebral tenderness on page 71).

S p o n d y l o t h e r a p y

REFLEX PAINS.

As a rule the site of pain corresponds to the location of the lesion. In other instances peripheral pains may be caused by diseases of the spinal cord. Reflex or transferred

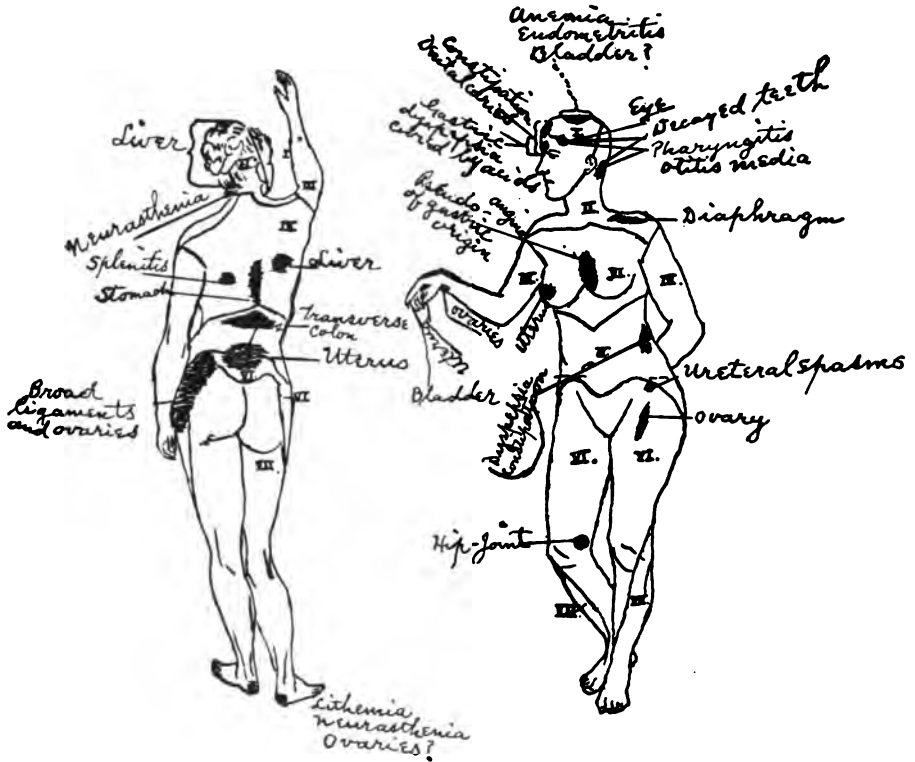


FIG. 21.—Diagrams showing the distribution of the cerebro-spinal strands of nerves and the location of transferred pains and neuralgia.

pains may be caused by an irritation at the origin of the nerve-trunk and the pain may be referred to its peripheral distribution.

The illustrations of Dana (Fig. 21) show the usual location of transferred pains.

Dana observed that the sensory nerves of these areas

Sympathetic Sensations

were correlated with the sympathetic ganglia innervating the areas in question.

SYMPATHETIC SENSATIONS.

Quincke has collected a number of sympathetic sensations associated with a circumscribed hyperalgesia of the skin, and one is constrained to conclude that the skin-areas are supplied by the same nerves as the organs.

According to Donaldson the splitting nerve-fiber sends one portion to the organ and one to the skin overlying it.

A pertinent illustration of cutaneous hyperalgesia is observed in affections of the heart when pressure of the skin over the heart-region elicits sensitiveness.

As a rule the skin overlying an organ is associated with it reflexly, and it is for this reason that one can explain how percutaneous therapeutic methods may influence visceral disease.

SYMPATHETIC SENSATIONS.

AFFECTION.	SYMPATHETIC SENSATIONS.
Disease of the middle-ear and mastoid process	Parietal pains.
Disease of the frontal sinus.	Trigeminal pains.
Irritation of the posterior wall of the auditory canal.	Tendency to cough (irradiation from the auricular branch of the vagus).
Pulmonary abscess (percussion of).	Pain in the larynx.
Angina pectoris.	Pain in the left arm.
Diseases of the stomach.	Pain in the back.
Intestinal worms.	Tickling in the nose.
Diseases of the liver.	Pains in the shoulder.
Diseases of the spleen.	Pains in the left shoulder.
Diseases of the bladder.	Pains in the genitalia and lumbar region.
Diseases of the uterus.	Pain in the epigastrium.
Coxitis.	Pain in the knee.

S p o n d y l o t h e r a p y

DERMATOMES OF HEAD.

While cutaneous pains are usually projected with great accuracy to the point stimulated, pain originating in the internal organs is located very inaccurately.

Head⁴⁶ and others have demonstrated that the different visceral organs bear a definite relation to certain areas of the skin, in other words, in visceral disease,* pain and disturbed sensation may be referred to definite cutaneous areas. Thus one may have a cutaneous expression of visceral disease

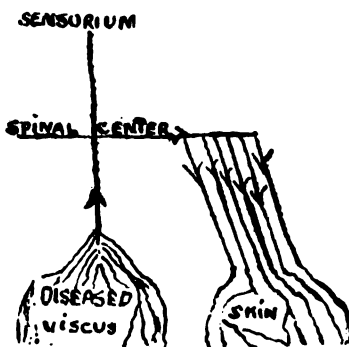


FIG. 22.—Illustrating cutaneous tenderness and the radiation of pain in visceral disease.

which I may call an *endogenetic skin reflex*. The cutaneous tenderness in visceral disease is explained as follows: When a stimulus is applied to an organ or tissue with diminished sensibility and which is centrally connected with an organ or tissue with a higher degree of sensibility, pain is referred to the organ or tissue which is relatively more sensitive.

Reference to Fig. 22 will elucidate this matter.

*Kast and Meltzer,¹⁵ found in animal experimentation that the sense of pain is present in normal organs, and that it is considerably augmented in inflamed organs, and that a subcutaneous or intramuscular injection of cocain is capable of completely abolishing the sensation in normal as well as in inflamed organs. They suggest that the anesthesia of the abdominal organs observed by some surgeons was due to the use of cocain.

D e r m a t o m e s

If the viscus is irritated, say as the result of inflammation, sensory impulses which are usually below the threshold of consciousness are conveyed to its sensory center or segment in the spinal cord. Now to the same segment is also connected a definite area of skin from which sensory impressions are habitually received, hence the sensations in consciousness are not referred to their true visceral origin but to the surface of the body.

Now Head found that in many visceral diseases, if the sensitiveness of the skin were tested by running a pin point over the cutaneous surface, definite areas could be demonstrated showing hypersensitiveness (hyperalgesia) to pain. Such areas on the surface of the body are known as skin-units or *dermatomes*. The latter correspond to the spinal segments, from which the posterior roots take their origin and not to their peripheral distribution.

The dermatomes are hypersensitive to heat and cold, but not to touch. Head concluded that when the dermatomes could be demonstrated they invariably indicated an affection of the organ to which they corresponded. The dermatomes or zones of hyperalgesia appear early and continue throughout the course of a visceral disease. If absent, say in appendicitis, they appear after palpation of the appendix. The author has found that if the zones are present they are practically always exaggerated after manipulation of a given organ.

As a rule the disappearance of a zone is associated with relief of a diseased organ. If, however, the symptoms increase or persist, the sudden disappearance of a zone is a sign of ill-omen.⁴⁵

There is no definite relation between the severity of the visceral lesion and the degree of cutaneous hyperalgesia. The absence of a zone does not exclude a lesion of a given

S p o n d y l o t h e r a p y

organ, but, if demonstrated, it is corroborative evidence that such a lesion is present.

It is important to remember that counterirritation over a zone of hyperalgesia is often surprisingly efficient in relieving the pain and underlying condition of the visceral disease.

The application of cold to the abdomen in acute abdominal affections owing to the anesthesia produced is equally efficient.

On the same theory Elsberg and Neuhof,⁴⁵ secure relief from pain in acute affections by anesthetizing the hyperalgesic area with menthol (50 per cent).

Reference to Figs. 23, 24, 25 and 26 shows, according to Head and Schmidt,⁴⁷ the segmental distribution of referred pain and cutaneous tenderness in visceral disease, and Fig. 27 shows the associated painful areas about the head related to visceral disease and areas of referred pain and tenderness in affections of the head and neck.

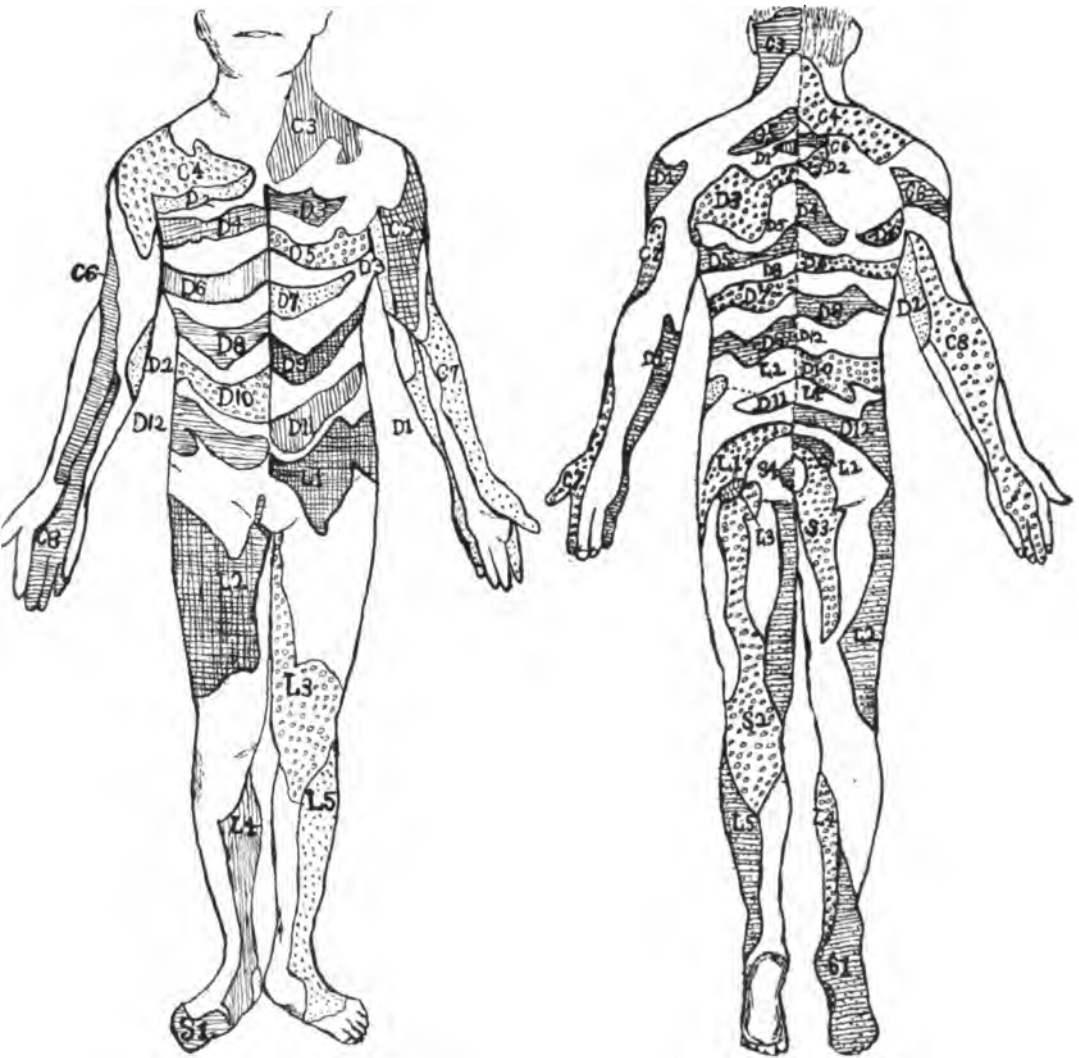
METHODS FOR ELICITING THE DERMATOMES.

Head tested the skin sensitiveness to pain by pinching up folds of skin or by stroking the skin with the point of a sharp pin.

I often employ the vibrations of a tuning-fork for demonstrating the zones and the vibration-sensation may either be increased (hyperalgesia) or diminished (hypalgesia).

The method of Elsberg and Neuhof⁴⁵ is as follows: A sharp pin is held between the thumb and index finger of the right hand, the nail of the index finger resting on the patient's skin. The pin is then made to traverse slowly the surface of the skin, care being taken that the nail of the index finger presses equally along the area examined. The patient must say "now" the moment the stroke of the pin becomes painful.

D e r m a t o m e s



FIGS. 23 and 24.—Sensory areas of the skin according to Head. Anterior and posterior views. C, cervical; D, dorsal; L, lumbar segments of the cord. Further description of these and subsequent figures on page 62.

S p o n d y l o t h e r a p y

SEGMENTAL DISTRIBUTION OF REFERRED PAIN AND TENDERNESS IN VISCERAL DISEASE.

SEE FIGS. 23, 24, 25 AND 26.

Heart.—Third cervical and first, second and third dorsal segments.

Lungs.—Third and fourth cervical and first to ninth (sometimes tenth) dorsal segments, especially the third, fourth and fifth.

Breast.—Fourth and fifth dorsal segments.

Esophagus.—Fifth, sixth and eighth dorsal segments.

Stomach.—Third and fourth cervical and sixth, seventh, eighth and ninth dorsal segments. Cardiac end from the sixth and seventh and the pyloric end from the ninth.

Intestines.—Down to the upper part of the rectum: Ninth, tenth, eleventh and twelfth dorsal segments. Rectum: Second, third and fourth sacral segments.

Liver and Gall-bladder.—Seventh, eighth, ninth and tenth dorsal segments and perhaps the sixth.

Kidney and Ureter.—Tenth, eleventh and twelfth dorsal segments. The nearer the lesion lies to the kidney the more is the pain and tenderness associated with the tenth dorsal segment. The lower the lesion in the ureter the more does the first lumbar segment tend to appear.

Bladder.—Mucous membrane and neck of the bladder: First, second, third and fourth sacral segments. Over-distention and ineffectual contraction: Eleventh and twelfth dorsal and first lumbar segments.

Prostate.—Tenth, eleventh and twelfth dorsal, first, second and third sacral and third lumbar segments.

Epididymis.—Eleventh and twelfth dorsal and first lumbar segments.

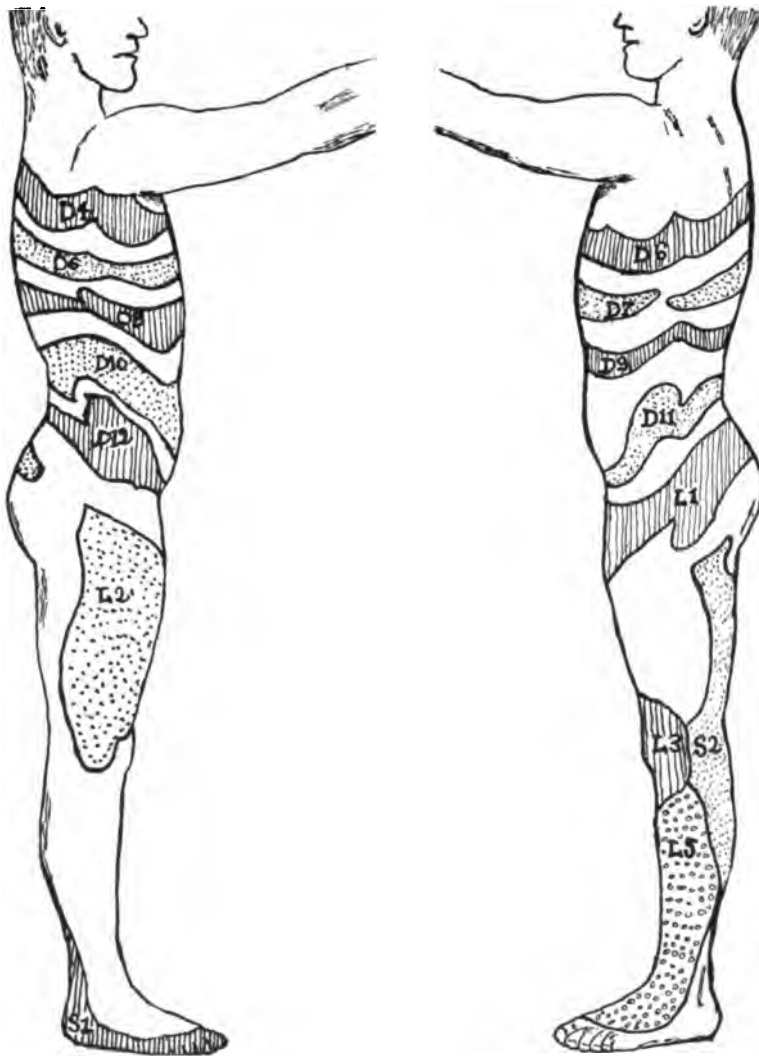
Testis.—Tenth dorsal segment.

Ovary.—Tenth dorsal segment.

Uterine Appendages.—Eleventh and twelfth dorsal and first lumbar segments.

Uterus.—In contraction: Tenth, eleventh and twelfth dorsal and first lumbar segments. Os uteri: First, second, third and fourth sacral segments, and very rarely, the fifth lumbar.

D e r m a t o m e s



FIGS. 25 and 26.—Sensory areas of the skin according to Head.

S p o n d y l o t h e r a p y

ASSOCIATED PAINFUL AREAS ABOUT THE HEAD RELATED TO VISCERAL DISEASE.

SEE FIG. 27.

AREA ON BODY.	ASSOCIATED AREA ON HEAD.	ORGANS IN PARTICULAR RELATION WITH THESE AREAS.
Cervical 3 and 4	Fronto-nasal	Apices of lungs, stomach, liver, aortic orifice (?).
Dorsal 2 and 3	Mid-orbital	Lung, heart, arch of the aorta.
Dorsal 4	Doubtful	Lung.
Dorsal 5	Fronto-temporal	Lung and occasionally the heart.
Dorsal 6	Fronto-temporal	Lower lobe of lung and heart.
Dorsal 7	Temporal	Bases of lungs, heart and stomach.
Dorsal 8	Vertical	Stomach, liver and upper part of the small intestine.
Dorsal 9	Parietal	Stomach and upper part of the small intestine.
Dorsal 10	Occipital	Liver, intestine, ovary and testicle.

AREAS OF REFERRED PAIN AND TENDERNESS IN AFFECTIONS OF THE HEAD AND NECK.

SEE FIG. 27.

ORGAN INVOLVED.	MAXIMUM POINT OF REFERRED PAIN AND TENDERNESS.	ORGAN INVOLVED.	MAXIMUM POINT OF REFERRED PAIN AND TENDERNESS.
Ciliary muscle (Disorders of accommodation)	Mid-orbital	Upper teeth	Frontonasal, nasolabial, temporal, maxillary, or mandibular.
Cornea	Frontonasal	Lower teeth	Mental, hyoid, superior laryngeal and in the ear.
Iris	Fronto-temporal, temporal, and maxillary	Tongue, anterior part	Mental.
Vitreous body (Glaucoma)	Temporal	Tongue, lateral part	Hyoid, superior laryngeal and in the ear.
Retina	Vertical	Tongue, posterior part	Superior laryngeal, hyoid, occipital.
Tympanic membrane	Hyoid	Tonsil	Hyoid and in the ear.
Middle ear	Vertical and behind the ear	Nose, olfactory portion	Frontonasal and mid-orbital.
		Nose, respiratory portion and posterior nares	Nasolabial (occasionally).
		Larynx	Superior and inferior laryngeal (in destructive lesions).

P a i n f u l A r e a s

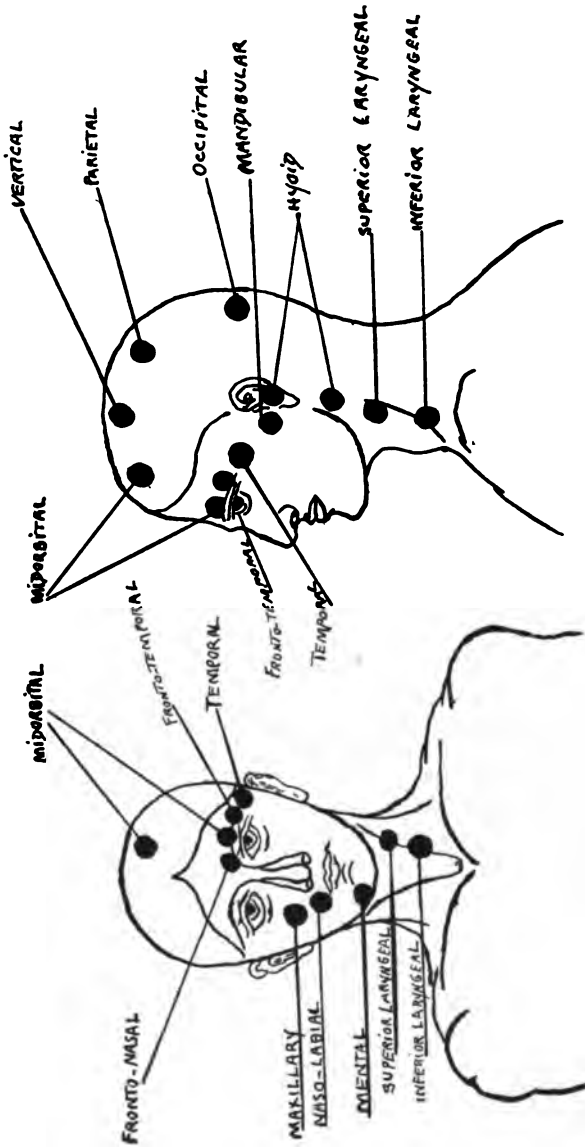


FIG. 27.—Painful areas about the head related to visceral disease and areas of referred pain and tenderness in affections of the head and neck. Further description on page 64.

S p o n d y l o t h e r a p y

Not infrequently, if the hyperalgesia is pronounced, the patient will scream as soon as the border of the zone is reached. Young children cannot give correct answers, hence with them this method is useless. The zones of hyperalgesia extend from the median line in front to the spines behind.

In Figs. 28 and 29 (Elsberg and Neuhof), the maximum areas of sensitiveness within the boundaries of a zone are deeply shaded.

VERTEBRAL PAIN.

This symptom may be determined in a variety of ways:

1. By pressure of the vertebral spines with the fingers or by percussion of the spines by means of the plexor and pleximeter (Fig. 2). The latter method is preferable. Very frequently no pain is elicited when a vertebral spine is pressed downward, yet, when the spine is pushed to one side or lifted, sensitiveness can be demonstrated.
2. By pressure alongside of the spine at points corresponding to the exit of the spinal nerves.
3. By pressure vertically down through the spine made on the head and again on the shoulders.
4. By firm pressure on the transverse processes so as to rotate the individual vertebræ and thus determine implication of the joints.
5. By aid of the hot-sponge test, which consists of passing down the spine a sponge wrung out in warm water. The latter must only be sufficiently warm so as not to be unpleasant to the healthy skin. In definite affections, notably *myelitis*, pain is experienced by the patient when the sponge passes over the site of the disease.
6. By testing pain-susceptibility (pallesthesia). In the norm, if a C (130 vibrations) or an A (440 vibrations)

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tuning-fork is placed on any of the vertebral spines, a trembling or whizzing sensation is perceived. The skin, as well as the bone, participates in the perception of the vibrations. Sensation is diminished or lost (bone-anesthesia) in the ataxic stage of tabes. Bone-sensibility may be increased in

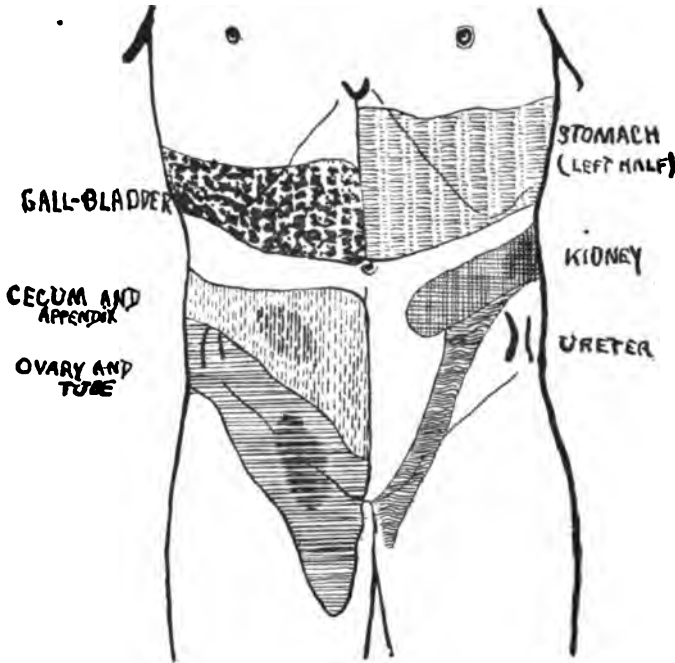


FIG. 28.—General location and outline of hyperalgesic zones for some of the abdominal organs. Anterior view. The maxima are deeply shaded.

incipient tabes and the vibrations of the fork produce a burning as well as the whizzing sensation.

Bone-sensibility is also altered in other nervous affections, thus in *hysteria*, the application of the fork is followed by the sudden disappearance of sensibility of the bone and skin.

If the vertebræ or corresponding spinal nerve-roots are

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sensitive, the vibrations of the tuning-fork are more keenly appreciated by the patient.

7. By finding painful centers.⁴⁰ For this purpose the patient's back is bared and a high tension Faradic coil is brought into use. Before applying this current the coil

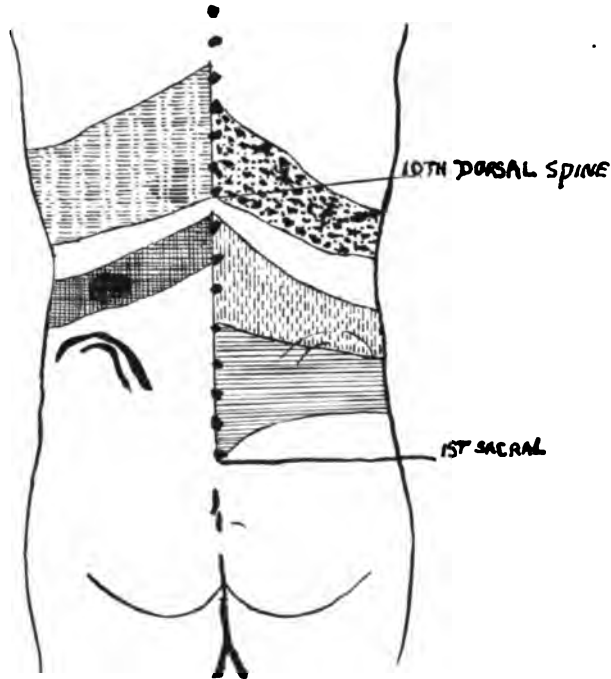


FIG. 29.—Posterior view of the zones in Fig. 28.

should be tested with a four-to-six inch Geissler tube. If the coil is capable of illuminating the tube, then it possesses the proper amount of penetrative power. For this diagnostic work the Kidder Manufacturing Company of New York make a special coil. One pole of the battery (it does not make any difference which) is attached to the 6 x 6 inch moist electrode and placed in front over the epigastric plexus. The other electrode (2 x 2 inches), well moistened, is passed

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lightly over the spinal column with a current-strength sufficient to be agreeably susceptible. This current is passed up and down the entire length of the spinal column with ordinary pressure eight or ten times and the electrodes removed when one will note vivid *red spots* on a white background. The latter become more prominent several minutes after the current is removed. Digital pressure upon these spots will elicit sensitiveness, whereas no pain will be complained of in the intermediate region.

These spots are pathognomonic of certain ailments and the clinician can almost make a diagnosis from the reflex centers involved.

8. Very frequently, if one pole of a Galvanic current (with the other electrode at an indifferent point) is passed along the spine, no appreciable sensation is felt until a sensitive area is attained.

9. It is known that many patients suffer from pains in the head and chest when exposed to draughts. The latter may be substituted by a current of cold air from an air-pump, which, when directed at the vertebral exits of the affected nerves, will reproduce the pains from which the patient suffers. Very often the pain is also reproduced when the air is directed on the site of the reflected pains.

Other methods for the elicitation of vertebral tenderness are described on page 72.

Having located by any of the foregoing methods the area of tenderness, it is well to employ some mark for future reference in treatment. For this purpose a stick of nitrate of silver, slightly moistened, may be used as a pencil, thus leaving a line which cannot be effaced. If one desires to remove the stain of the latter, apply a drop of tincture of iodine and then ammonia, or use potassium iodid solution.

S p o n d y l o t h e r a p y

DEDUCTIONS RESPECTING VERTEBRAL PAIN.

For the objective elicitation of pain, one must exclude cutaneous hyperesthesia, which is a dominant factor in the so-called *hysterical spine* and which is present in many neuroses. Here, when the skin is lightly touched or pinched without any pressure on the bone, pain is experienced. If the patient's attention is diverted the identical spot may be touched without eliciting any pain. Friction of the tender area with a rough fabric of cotton to induce irritation of the skin is often followed by disappearance of the painful areas.

Tenderness of the vertebræ, rather than pain, is rarely absent in neurasthenia and sensitive areas may be demonstrated in the latter affection as well as in hysteria.

These TOPOALGIAS may not disappear until treatment is directed to the general condition.

Topoalgia limited to the vertebral column is known as *rachialgia*. In the hysterical spine there is usually a history of traumatism and it must be recalled that hysteria long latent and unrecognized may be awakened into obvious activity by a blow or accident.

To determine whether a given sensitive area is real or simulated, the following signs may be employed:

1. Mannkopff's sign.—Take the pulse-rate before, during, and after pressure is made on the sensitive area. If the pulse becomes increased in frequency it is a proof that the pain is genuine.

2. Sign of Lœwi.—Dilatation of the pupil is in direct proportion to the intensity of the pain. Thus, if in a healthy man one exercises energetic pressure on the testicle, the pupil dilates, whereas in the tabetic in whom the testicle is insensitive, no pupillary dilatation is observable.

V e r t e b r a l T e n d e r n e s s

3. In neuroses the spine is not rigid at the points of sensitiveness.

In diagnosis one must look for other symptoms suggestive of a neurosis.

In children radiating pains dependent on vertebral disease are frequently misinterpreted, as headache, cough or stomachache.

In Pott's disease reflex muscular spasm is associated with pain. In disease of the cervical region the head is held stiffly or is supported with the hands.

In disease of the dorsal region the pain may radiate to the chest, respiration may be groaning and night cries occur.

In lumbar disease the pain is referred to the legs or lower abdominal region. In Pott's disease there may be absolutely no local pain on pressure, but spasm of the spinal muscles, especially on an attempted movement, is practically always present and is an early sign.

Angular deformity of the spine is a late manifestation of the disease.

Pains due to other causes are discussed later.

VERTEBRAL TENDERNESS.

The elicitation of the dermatomes of Head is a tedious method of examination and not always accompanied by satisfactory results for the reason that a great amount of experience is necessary. Alsberg¹⁶ in the examination of 200 women (with gynecological affections) found cutaneous areas of hyperalgesia in only seventeen, ten of whom were hysterical. Therefore, he could attribute no diagnostic import to the zones in question beyond commenting on the fact that hysterical stigmata must be excluded before the zones of hyperalgesia could be regarded as trustworthy.

There is no longer any doubt concerning the fact that

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spinal tenderness corresponding to different segments of the spinal cord is associated with visceral disease. To attain definitiveness of localization, however, it is necessary to carefully examine the vertebræ by percussion (page 66), or by palpation; place the patient in the recumbent position, first on the right and then on the left side, to secure muscular relaxation, for it is quite evident that a contracted muscle over a given area of sensitiveness will thwart the elicitation of pain.

If the patient is seated the muscles may be relaxed by having the patient lean backward.

Pressure with the finger (care must be taken that the pressure is equal) is next made over each intervertebral foramen and, if contracted muscular bundles or pain can be demonstrated by the palpating finger, vertebral tenderness is present.

The writer has frequently found that, firm pressure on the sensitive vertebræ may evoke pain in lieu of tenderness and what is of greater diagnostic import is the fact that, some of the sensations from which a patient suffers may be reproduced.

Many recent writers, notably Arnold¹⁷ and Ludlum¹⁸, found that the areas of vertebral tenderness correspond to the vaso-motor centers in the spinal cord and that there exists a compensatory relationship between the blood-vessels of the cord and those structures supplied by the posterior primary divisions of the spinal nerves.

The vaso-motor nerves are evidently not wholly concerned in vertebral tenderness. Physiology teaches that our conscious sensations do not originate in the viscera to which the afferent nerves are distributed and where they are stimulated. On the contrary, the nerves merely transmit the stimuli to the gray matter of the spinal cord (section of which

V e r t e b r a l T e n d e r n e s s

abolishes sensations of pain without affecting the tactile sensations), whereby through summation they produce changes in the cells of the gray matter. Such changes are identified with hyperesthesia and hence the vertebral tenderness.

It is known that frequently repeated painless tactile stimuli may eventually arouse the sensation of pain.

Again, a *neuritis* at first limited to a visceral nerve may pass upwards (ascending neuritis) and involve larger nerve-trunks or even the spinal cord. It is in this way only that one can explain the vertebral tenderness which persists after apparent recovery from a visceral disease.

In addition to the vaso-motor and sensory reflex phenomena in visceral disease there are also *motor symptoms*. The latter may be experienced by either an irritation or paresis. Thus, in *angina pectoris*, the constriction around the chest is dependent upon a contraction of the intercostal muscles. Paretic symptoms may attend a paroxysm and enfeebled power of the muscles of the left arm is present. In the inter-paroxysmal periods of angina, as well as in other cardiac lesions, sensory, motor and vaso-motor symptoms may be demonstrated in several segments of the spinal cord, and Mackenzie's conception of them is as follows: In cardiac disease (as a paradigm) a persistent irritation of the sympathetic nerve conduces to the irritation of the spinal segment at a site where the fibers of the heart connect with the spinal cord. Irritation of the sensory part of the spine conduces to the sensation which is projected into the periphery innervated by the nerves of the spinal segment (law of Muller). After this manner the motor and vaso-motor symptoms are of like segmental character. The following table fairly represents the areas of vertebral tenderness in visceral disease and corresponds to the distribution of the spinal segments.

S p o n d y l o t h e r a p y

VERTEBRAL TENDERNES IN VISCERAL DISEASE.

VISCERAL DISEASE.*	VERTEBRAL TENDERNES.
GASTRIC ULCER.	At the level of and to the left of the 10th to the 12th dorsal vertebra.
CHOLELITHIASIS (Gall-stones).	Somewhat to the right of the 12th dorsal vertebra. Painful area may persist for weeks after an attack.
CARDIAC DISEASES.	Usually to the left of the first four dorsal vertebrae.
PULMONARY DISEASES.	From the 3d to the 6th dorsal vertebra.
GASTRIC DISEASES.	From the 4th to the 10th dorsal vertebra.
PELVIC DISEASES.	At the 4th and 5th lumbar vertebrae.

The foregoing table is based on the observations of different writers on the subject and the author presents the following table of vertebral tenderness in visceral disease, which he has elaborated after palpation of the palpable organs and by aid of his visceral reflexes (Fig. 30). Thus, in *myocarditis*, the symptoms of this affection may be elicited by concussion of the four lower dorsal vertebrae (Fig. 5), which manœuvre provokes dilatation of the heart. If the counter-reflex of cardiac contraction is provoked by concussion of the 7th cervical vertebra, the area of vertebral tenderness disappears at once.

One may also note that the vertebral tenderness after palpation of an organ is of a few minutes duration only, and

**Vide* also the observations of the Griffin brothers (page 2).

Vertebral Tenderness

if present before manipulation of the diseased viscus it is accentuated after such manipulation. The point of tenderness is located either at the side of the vertebræ or at a point 4 cm. from the median line of the spinous processes or in both situations. It is better to determine vertebral tenderness before palpating the organs, for otherwise one is unable

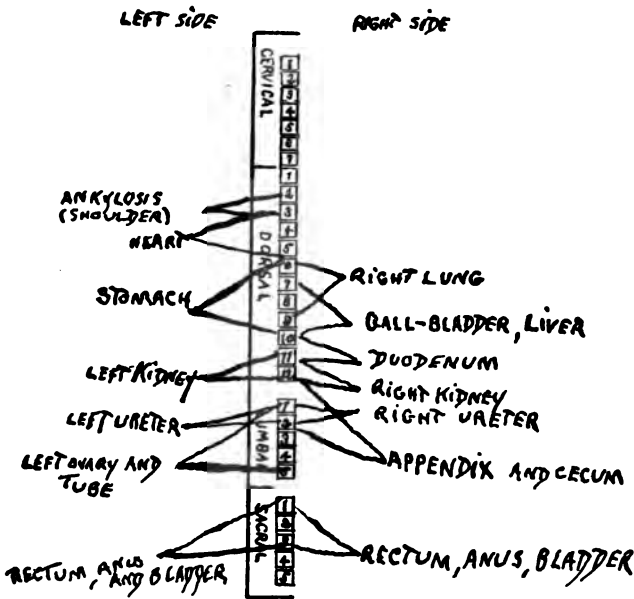


FIG. 30.—Vertebral areas of tenderness after palpation of the viscera. The localization is only approximate.

to say whether the tenderness in question was not already present.

A practical point in relation to these areas of vertebral tenderness after palpating a sensitive organ, joint or tissue is the following fact: If the area of vertebral tenderness is thoroughly frozen, the organ, joint or tissue may be manipulated for a time with either diminished or no pain. Even the subjective pain may disappear for hours after the freezing.

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If the sensibility of the skin over the painful organ, tissue or joint is tested with a pin before and after freezing, it will be noted after the latter manœuver that the skin is anesthetic. This anesthesia is likewise of variable duration. The citation of two observations will make my meaning more lucid.

I. The subject has gout located in the left metatarsophalangeal articulation of the big toe. The latter is exquisitively tender on manipulation. There are no vertebral points of tenderness. The toe is now manipulated and whenever it is moved a localized muscular spasm may be palpated at the side of the spine of the 11th dorsal vertebra. Within a minute two points of vertebral tenderness may be located corresponding to the left side of the 11th dorsal vertebra and another about 4 cm. to the left of the spinous process of the latter vertebra.

The vertebral areas of tenderness are now thoroughly frozen and within two minutes the big toe may be manipulated without pain. The skin over the toe in question is anesthetic. The anesthesia lasts only three minutes, but the patient is without pain in the joint until the following day. Again the vertebral area (which has been marked with a stick of silver nitrate to avoid a repetition of localization) is frozen and the patient is without pain for two days. Two more freezings sufficed to control the pain completely.

II. The subject has an ulcer of the stomach. A sensitive vertebral point is already present, but when the tender point over the stomach is subjected to pressure, the vertebral area becomes decidedly more sensitive. The latter area is now frozen, after which procedure the sensitive point over the stomach may be manipulated with scarcely any pain at all. The subjective pains of the patient disappeared for only six hours. Freezing was again executed and the pains evanesced for twelve hours.

V e r t e b r a l T e n d e r n e s s

Now to the average physician it would be ridiculous to assume that freezing over the area of vertebral tenderness was anything more than a palliative measure, yet sober thought endows *analgesia* with curative action.

The use of anesthetics to wounds will hasten their healing and by so doing we are executing what the author is pleased to call a "peripheral rest-cure." Rest of any kind in the treatment of painful organs or tissues is curative.

The author has seen abraded surfaces on the lips and mucous membranes, which having resisted treatment for months were regarded as clinically malignant. These abraded surfaces were constantly irritated by cauterization and the use of antiseptic lotions, yet in a few days a protective coating of collodion over the abraded surfaces sufficed to cure them.

One must also remember that the nerves which convey sensory impressions also carry trophic fibers.

Take again *coughs*. When the sinusoidal current is used with one electrode over the sacrum and the other applied alternately over the spinous processes, it will be found that a reflex cough can be excited in many instances over the spinous processes of the 6th, 7th, 8th and 9th dorsal vertebræ. Patients with persistent coughs will often show areas of vertebral tenderness corresponding to the vertebræ in question. If now, the tender areas are thoroughly frozen, it is an excellent means of inhibiting a cough. Inhibition of a cough is, in many instances, a curative measure and when we employ narcotics with discretion to subdue a persistent cough in bronchitis and other pulmonary affections recovery is hastened. Concerning the action of freezing for the relief of pain, *vide* page 172.

The author has also noted that areas of *vertebral tenderness* may be elicited when definite areas of the skin are irritated

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by pinching or by means of a point of a pin. Such areas of tenderness are likewise of short duration and appear on the same side of the vertebral column (or 4 cm. from the spinous processes) corresponding to the side of cutaneous irritation. The areas of tenderness may not appear for fully a minute after scratching or pinching a definite cutaneous area.

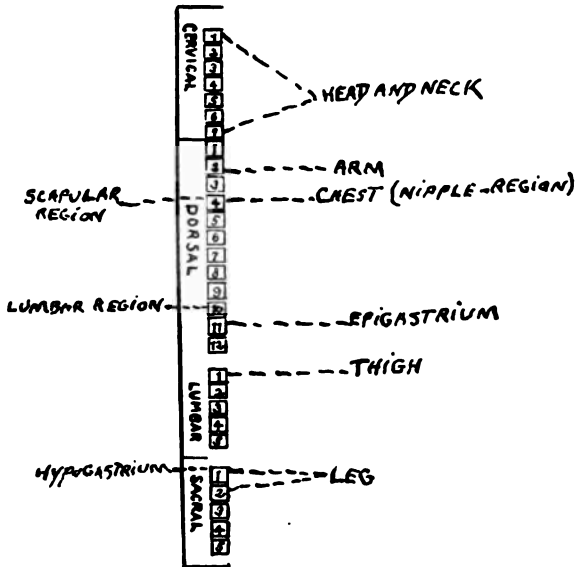


FIG. 31.—Approximate areas of vertebral tenderness elicited after irritation of cutaneous areas in different regions.

Localized spasm of the spinal musculature is associated with the tenderness, *i. e.*, each time the skin is irritated the finger detects a muscular contraction corresponding to the area where tenderness will subsequently appear. By this means one is now in the possession of an objective method for determining pain-reaction to cutaneous stimulation. The intensity of pain is an individual question and depends as much on the sensitiveness of the registering apparatus as it does on the degree of stimulation.

Vertebral Percussion

The localization of vertebral tenderness in the writer's experience cannot be governed by any fixed rules, the individual case only must serve as a criterion.

The various therapeutic methods discussed in a subsequent chapter (chapter V), when applied to the areas of tenderness are endowed with considerable value in influencing the visceral condition. This statement applies with special cogency to the vaso-motor and visceromotor fibers from a given segment.

INTERCOSTAL NEURALGIA is a frequent condition responsible for vertebral tenderness and is discussed at length on page 186.

VERTEBRAL PERCUSSION.

The tracheo-bronchial glands are enlarged in pertussis and in other infectious diseases, notably in children.

In every one of 127 cases of tuberculosis, Northrup found the glands enlarged.

BRONCHIAL PHTHISIS has been fully described in the literature but the scope of such description has been limited in regarding it as an affection peculiar to children with symptoms suggestive of increased intrathoracic pressure.

The author has portrayed¹⁹ a picture of bronchial phthisis occurring in adults which in all essentials tallies with the tableau of symptoms common to pulmonary tuberculosis with which it is frequently confounded. In an analysis by the author of 100 cases of bronchial phthisis the following diagnostic conclusions were formulated:

1. There is a history of cough which is spasmodic in character and almost suggests the brazen, metallic cough of aortic aneurism.
2. Tubercle bacilli may be found in the sputum after repeated examinations, and then only when the bronchial glands have suppurated and perforated the bronchus, or when tuberculosis is present elsewhere in the lungs.

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3. Dyspnea is out of all proportion to the signs obtained by physical examination of the lungs.

4. Dullness of the lungs anteriorly and posteriorly, corresponding to the bifurcation of the trachea (at about the level of the intervertebral disc between the 4th and 5th dorsal vertebræ).

5. The Smith and Hare sign, viz., when the patient throws the head well back a "purring" sound is heard when the stethoscope is placed below the suprasternal notch.

6. The Röntgen ray evidence (enlarged glands), viz., when the target of the tube is so placed that when the rays are traversing the chest, they will fall at a point corresponding to either the right or the left side of the vertebral column posteriorly corresponding to a point just below the bifurcation of the trachea.

Among the signs cited dullness over the manubrium sterni anteriorly and posteriorly corresponding to the 4th, 5th and 6th dorsal vertebræ is common.

It must be recalled, however, that the region corresponding to the 5th dorsal vertebra is normally dull, the dullness extending for a short distance on either side of the vertebral column but more to the right than to the left side. The shape and size of this square patch of dullness, if much modified, may indicate enlargement of the bronchial glands.

The enlarged bronchial glands often escape detection by percussion, owing to vibration of the sternum and spinal column.

Insomuch as the method of *vibrosuppression*²⁰ is of great value in topographic percussion of the chest, brief reference will be made to it at this time.

If one percusses the normal chest, say beneath the clavicle, a sound is produced which is the product of the vibration of the lung tissue and the thoracic walls. It is

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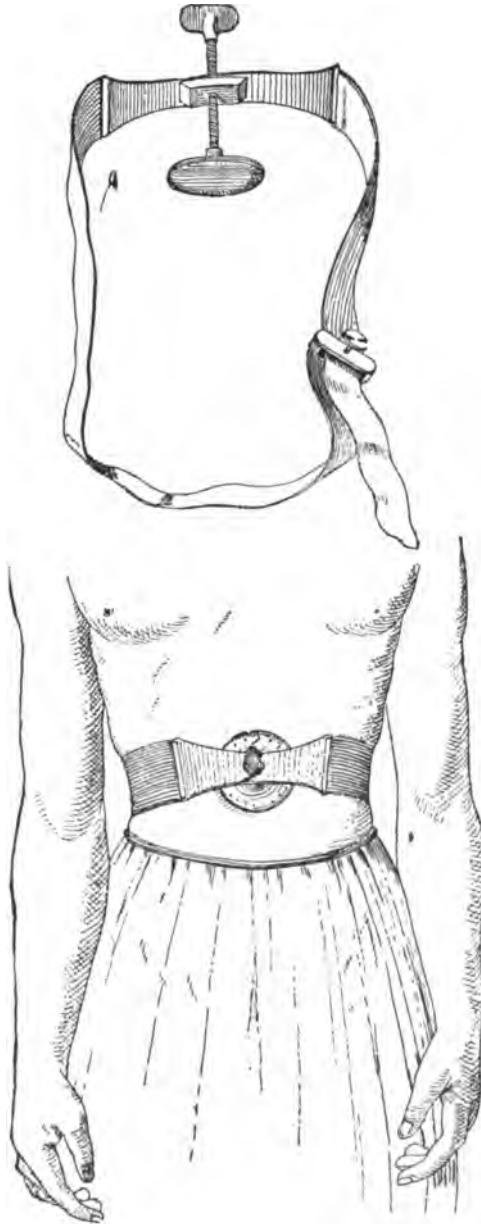


FIG. 32.—The vibro-suppressor and its application to the chest.

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the summation of this vibration which interferes with the elicitation of the dullness of the airless organs in juxtaposition to the lungs. If the vibration in question can be eliminated, the definition of the viscera will prove easy of attainment. Briefly, lung resonance is made up of two chief factors, viz., vibration of the air in the lungs and vibration of the sternum. The latter is essentially a sounding-board. Thoracic vibration can be eliminated as far as possible by percussion of the organs at the end of a forced expiration, when there is comparatively little air in the lungs to vibrate, and by suppressing the vibrations of the sternum by means of the vibrocompressor (Fig. 32).

The apparatus is modeled after a tourniquet, consisting of a pelote, screw, band (6 cm. wide) and clamp for fixing the latter. It is so applied that the pelote rests on the xiphoid cartilage of the sternum. The pelote is made to compress the cartilage by aid of the screw with all the pressure the patient can tolerate. Percussion is then executed during the time the apparatus is employed and preferably during suspended respiration after forced expiration. In the absence of the apparatus, *firm pressure made on the lower end of the sternum* by the hand of an assistant will aid topographic percussion during the time the patient has suspended respiration after forced expiration. More recently, the author has noted that suppression of the vibrations of the spinal column by aid of compression of the latter by the hand of an assistant is of material aid in percussing enlarged bronchial glands and defining the lower border of the liver, spleen and stomach. In many instances it is better to compress the sternum and spine simultaneously.

Among other signs of enlarged glands are those of Grancher (unilateral restriction of breathing) and Petruschky (area of tenderness between the shoulder blades).

CHAPTER IV.

SUMMARY OF SPINAL DISEASES AND SYMPTOMS.

BACKACHE—CHEST DEFORMITIES—COCCYGDYNIA—FAULTY ATTITUDES—LITIGATION BACKS—LUMBAGO—NEUROTIC SPINE—OSTEO-ARTHRITIS—POTT'S DISEASE OF THE SPINE—SACRO-ILIAC DISEASE—SACRO-ILIAC RELAXATION—SPINAL CURVATURES—SCOLIOSIS—KYPHOSIS AND LORDOSIS—ANGULAR CURVATURE—SPONDYLITIS—SPONDYLOLISTHESIS—TRAUMATISM OF THE SPINE—TUMORS OF THE SPINE—TYPHOID SPINE—VERTEBRAL INSUFFICIENCY—DIAGNOSIS OF SPINAL DISEASES—PAINS—DEFORMITY—COMPRESSION OF THE SPINAL CORD—PARAPLEGIA—TUBERCULOSIS—SYPHILIS—GONORRHOEA—RHEUMATISM—RICKETS—SPINAL MENINGITIS.

BACKACHE.

THE popular conception of the etiology of backache in men is the kidney, and in women pelvic disease.

As a matter of fact the kidney and pelvis are infrequently concerned in the etiology of this common affection.

It is practically axiomatic that organic heart-lesions as a rule are dissociated with pain and the same may be said of the average renal disease.

I adopt the following simple manœuvre for excluding the kidneys as factors in the causation of backache: Place the pleximeter first over one and then over the other kidney in the lumbar region and practice forcible concussion. The hands (Fig. 3) may be employed for a similar purpose.

By aid of this *transmitted palpation* of the kidneys no pain can be elicited in the norm, but if the pain from which the patient suffers is of renal origin the exact nature of it may be reproduced by this manœuvre. This method of transmitted palpation is equally efficient in determining the sensitiveness of the liver.

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The lumbar muscles (*lumbago*) are commonly concerned in the etiology of backache and they must be excluded in diagnosis (page 99).

When the muscles in question are involved, bending far forward suddenly will stretch the muscles and elicit pain.

Backache dependent on pelvic or renal disease would be uninfluenced by such a movement.

It must be remarked, however, that the latter movement and pain in LUMBAGO are influenced by the muscles involved. Thus, involvement of the *erectors* permits bending forward, but elicits pain when the vertebral column is straightened; when the *flexors* (quadratus and psoas) are involved, bending forward is painful and rotation of the thigh (psoas) causes distress; when the serratus posticus is involved, deep breathing and not spinal movements causes pain.

Backache may be located in the lumbar, lumbo-thoracic, sacral or coccygeal regions.

In women, the neurotic spine, sacro-iliac disease, constipation, hemorrhoids and pelvic disease are frequent causes of backache. If CONSTIPATION is present in either sex the pain is located in the regions of the ascending and descending colon and is associated with tympanites. The expulsion of gas brings temporary relief and the same may be said of carminatives, purgatives, enemata and a diet (non-amylaceous) which inhibits the formation of gastro-intestinal gases.

In GASTRIC TYMPANITES, backache may be felt in the left interscapular region. The writer has shown²³ how easily the heart may be dislocated by distension of the stomach. It is unnecessary to descant on the practical value of this observation. Heart-dislocation from stomach-dilatation is associated with a circumscribed area of dulness in the left interscapular region. Over this area, bronchial respira-

tion is heard. When the patient leans far forward, dullness and bronchial breathing disappear to reappear when the erect attitude is resumed (Fig. 34).

The foregoing syndrome may be reproduced synthetically by artificial distension of the stomach. An enormously distended heart may produce identical signs.

Artificial insufflation of the colon is incapable of producing the same degree of cardiac luxation. In gastro-intestinal affections, notably ulcerative in character, pain in the back

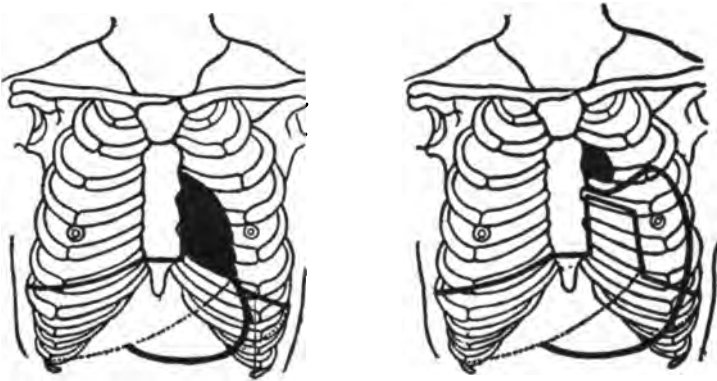


FIG. 33.—Radioscopic appearance of the heart before and after the administration of a Seidlitz powder. The silhouette of the heart is represented by the dark area.

often ensues within a few minutes after the ingestion of fluids and food.

I have employed the phrase **RESPIRATORY ATAXIA**, to designate many respiratory neuroses which, in my experience, are associated with a defective type of breathing and with inco-ordination of the muscles of respiration. In males, the type is costal instead of abdominal, and in women, abdominal instead of costal. These patients have one symptom in common: A paroxysmal tendency to “catch the breath.” There are, however, other symptoms, notably *backache*, syncope, dyspnea, cardiac palpitation and insomnia.

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Mere inspection makes the diagnosis, viz., the recognition of the reversed type of breathing. Auscultation elicits no respiratory murmur in the lower lobes of the lungs in males and the upper lobes in females. Encircling the chest with a rubber bandage to exclude costal breathing and the abdomen in females to exclude abdominal respiration brings immediate relief, whereas re-education of the type of respiration results in cure.

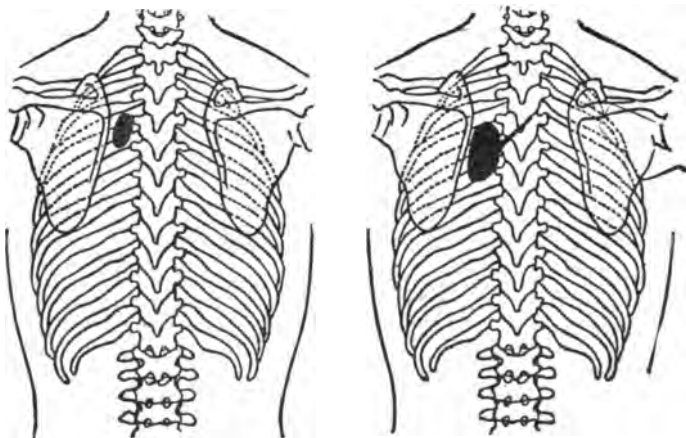


FIG. 34.—Patch of dullness and area of bronchial respiration in dislocation of the heart upward after artificial distension of the stomach. The adjoining illustration shows an increase in the area of dullness when the same patient is leaning backward.

A nasal anomaly may be the exciting factor and this may be demonstrated by the immediate relief of the symptoms following cocainization of the nasal mucosa.

HEMORRHOIDS may induce reflex pains running to the back but more often down the left leg, thus simulating sciatica. As a rule such hemorrhoids have abraded surfaces and for this reason, an ointment containing a large percentage of *orthoform* is effective as a local anesthetic and, in this action a diagnosis may be made.

If, for instance, the pains in the back are ameliorated

after the application of the salve to the hemorrhoid, we know that the latter is concerned in the etiology of the pains. More radical measures addressed to the cure of the hemorrhoids are equally efficient and the author can highly recommend the daily application of Monsel's solution to the hemorrhoids by means of a brush once or twice daily.

Other rectal affections, notably *fissures*, may be excluded by the local application of a 5 or 10 per cent solution of cocain.

One must also think of the **POST-OPERATIVE-BACKACHE** provoked by the straight dorsal position of the patient during a protracted operation. This may be prevented by flexing the limbs and body and using cushions under the shoulders, knees and small of the back during an operation.

Rose²¹ directs attention to a chronic **PERIOSTITIS** of one of the spinal processes (lumbar and sacral usually) as an important cause of backache. The latter may be detected by the pain produced by pressure with the finger on the implicated spine. Immediate relief is secured by one application of leeches to the spinal process and cure, by the daily application of iodine-tincture and potassium-iodid internally. When over-distended **SEMINAL VESICLES** cause backache, immediate relief is often achieved by stripping the vesicles.

PROSTATIC DISEASE may cause backache which is often misinterpreted as sciatica or lumbago. This is due to the intimate association existing between the pudic nerve from which the prostate receives its spinal fibers and the roots of the lumbar and sacral plexuses.

A **PENDULOUS ABDOMEN** may cause backache and this may be demonstrated by the relief secured by raising the abdominal walls with both hands. If the latter manoeuver is effective, a proper abdominal support must be worn. Here the pain is probably caused by traction of the mesentery

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on the spine. The drag of the abdomen in obese subjects will cause lordosis and strain on the sacro-iliac articulations.

In chronic APPENDICITIS backache may be present and is increased in severity after fatigue. Byron Robinson has shown that the appendix is frequently in contact with the psoas muscle and may, therefore, be bruised by the action of this muscle. With the patient in the recumbent posture sudden extension and flexion of the thigh on the trunk will often elicit severe pain. On the other hand, the pain is relieved when both thighs and knees are partly flexed in recumbency.

ANEURISM of the thoracic aorta is characterised by sharp paroxysmal and lancinating pains. Anginal attacks are not infrequent when the aneurism is located at the root of the aorta. The pains often radiate down the left arm, up the neck or along the upper intercostal nerves. In aneurism involving the descending aorta, one of the most frequent symptoms is pain and Huchard, referring to this form of aneurismal neuralgia, says that when one is dealing with persistent pain of long duration which cannot be explained, which resists ordinary medication and which is either increased or diminished in severity in certain attitudes of the patient, one should always consider aneurism as a probable diagnosis and, if no tumor can be demonstrated, one must have recourse to the x-rays for additional evidence in diagnosis.

If backache is caused by PELVIC DISEASE, palpation of the ovaries and movements of the uterus should reproduce the pains from which the patient suffers. The pain from uterine affections is often located in the upper sacrum and is described generally as a dragging sensation. In such instances retro-flexion is the most common cause.

Referring to the pains of pelvic inflammations, Kelly

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makes the following pertinent observation: Inflammatory pain has a definite habitat. . . . The pain of inflammation is a fixed point; it is never in one place to-day and then at some remote part of the body to-morrow, one day in the shoulder and the next in the foot or calf of the opposite leg. . . . It is a safe working hypothesis to conclude that a patient who complains of a definite pain and who from day to day and week to week is definite in her complaint as to the character and seat of the pain, has some gross lesion. Garrigues²² divides pelvic backaches into two varieties:

1. When pain and tenderness are located at the 4th and 5th lumbar vertebræ (spinal-center for the internal pelvic organs);
2. When a tender spot can be located on either side of the 2nd sacral vertebra.

The latter variety is caused by a cellulitis of the utero-sacral ligaments.

Garrigues contends that in the norm the utero-sacral ligaments are so elastic that the uterus can be brought forward bimanually until arrested by the pubic bones. When the ligaments are inflamed, any movement of the uterus forward causes acute pain in the back.

Many persistent backaches in women owe their origin to improper methods of DRESS. Here an important element is the pressure of corsets.

In the developmental period of some of the ACUTE INFECTIONS, notably small-pox, dengue and influenza, backache is a frequent concomitant, the pathology of which is obscure.

Associated with what is known as INDURATIVE HEADACHE (which, according to Edinger, is regarded as the most frequent form of headache) there are also pains in the neck

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and back caused by indurations within the bodies of the muscles due to a chronic myositis.

The indurations are painful on palpation and may feel like grains of shot. They are most frequently located in the muscles of the head and neck, although other sites are not exempt (Fig. 35).

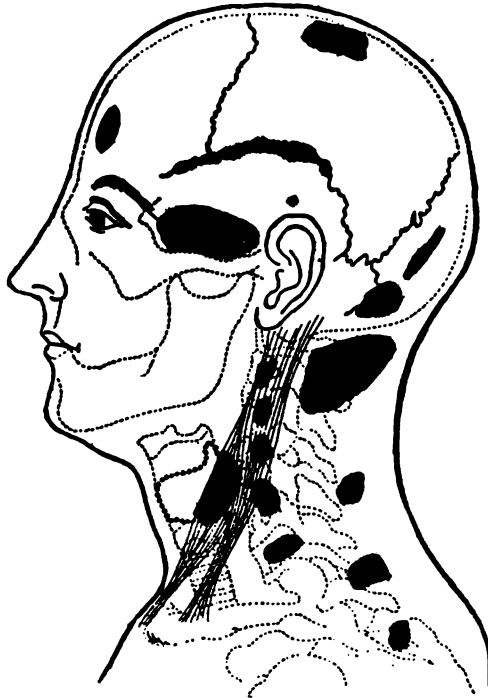


FIG. 35.--The most common sites of indurations (modified from Edinger by Yawger).

Several months may be necessary to effect a cure and this may be attained by removal of the indurations by means of vibration and Galvano-therapy but most effectually by massage.

This subject is more exhaustively discussed elsewhere.³⁶
One must remark, however, that fibrous indurations are

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not essentially rheumatic inasmuch as they may also follow infections and local injuries or strain of the muscles. In my experience, the indurations are best detected by relaxing the affected muscle and then rubbing the skin with vaselin when firm pressure with the finger will demonstrate the nodules. After a few séances of massage the indurations will become more defined.

Depage, of Brussels, directs attention to the infrequency of backache (in 10 to 15 per cent of the cases) in *floating kidney* (nephroptosis) and observes that, notwithstanding nephrorrhaphy, the pains in the back continue. Here, as in backache referred to other causes, the following condition has been overlooked by clinicians, viz., owing to deformity of the ribs, the 10th or 11th rib comes in contact with the crest of the ilium either on one side or the other and the rubbing thus provoked gives rise to a dull, intermittent pain which is accentuated by movements. The false position of the ribs may occur as a result of scoliosis. The 10th and 11th ribs are painful on palpation and there is little or no space between the lower ribs and the crista ilei. Resection of the anterior ends of the ribs in question resulted in cure when mechanotherapeutic methods failed.⁵⁵

SYNOPTIC TABLE OF BACKACHES.*

DISEASES OF THE SPINAL CORD.

LOCATION OF PAIN.	CONCOMITANT SYMPTOMS.
In distal parts of the body dependent on the pain-fibers that are irritated.	No spinal rigidity nor vertebral tenderness. Dependent on the segment of the cord involved, motor and sensory disturbances are present with loss of reflexes.

*The essential facts of this table have been gleaned from a paper by Dr. C. M. Cooper of San Francisco, which was kindly placed at the disposal of the author prior to its publication.

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DISEASES OF THE SPINAL-ROOTS AND MEMBRANES.

May occur either in juxtaposition to the lesion or in distal parts and is intense and shooting in character.

Pains occur in definite anatomic zones and are inclined to encircle half the trunk or shoot into the extremities. Spinal rigidity and tenderness are usually absent, thus excluding vertebral disease. If a single nerve-root is involved it may be the precursory symptom of *herpes*.

DISEASES OF THE VERTEBRAL COLUMN.

Pains are root-like in character with or without vertebral tenderness.

Deformity may or may not be present. Usually spinal rigidity and impaired mobility corresponding to the vertebræ implicated. The nature of the spondylitis (*q. v.*) must be determined.

EXTRA-VERTEBRAL ARTICULAR DISEASES.

Pains may be confined to the region of the ribs, scapulæ or ilia. In abnormal sacro-iliac mobility (*vide* sacro-iliac disease), pain is referred to the sacro-iliac joints or sacrum.

Backache is worse in the recumbent posture and referred pains innervated by the lumbo-sacral cord are frequent.

DISEASES OF THE MUSCLES AND LIGAMENTS OF THE BACK.

Usually described under the generic term *lumbago*. Pains are increased by movements which contract the muscles. Muscles tender when compressed by the fingers. The Faradic current is useful in diagnosis (page 99).

Rigidity of the back-muscles may be present but no pain can be elicited by percussion of the vertebræ and there are no nerve-root pains.

BACKACHES FROM STATIC ERRORS.

In taking the strain off of distal anomalies, the muscular fatigue graduates into pains. Rotary or lateral curvature may be present.

The diagnosis is established when the flat-foot or knock-knee is remedied by some orthopedic maneuver.

BACKACHES FROM VISCERAL DISEASE.

Usually referred pains, which are sharp, aching or stabbing. Hyperesthesia over zones corresponding to the areas innervated by the disturbed spinal-segments (Figs. 23, 24, 25 and 26) and tenderness and rigidity of the muscles innervated by the same segment. Location of pain suggests organ involved: 1, between the shoulders, *gastric pains*; 2, right shoulder blade or tip, *hepatic* disease; 3, left shoulder blade, *overloaded heart*; 4, dorso-lumbar region, *varicocele, loaded colon, ovarian or testicular disease*; 5, angle between lowest rib and erector spinæ muscle, *kidney-stone*; 6, loin, *kidney disease*; 7, base of sacrum, *prostatic or uterine* disease; 8, sacro-iliac synchondrosis, distended *seminal vesicles, inflamed utero-sacral ligament, pelvic and rectal diseases*.

The visceral stimuli may be:

1. Spasm in a hollow muscular organ (ureteral colic);
2. Distension of a capsule (enlarged spleen, liver or kidney)
3. Inflamed serous coverings (adherent appendix);
4. Insufficient blood supply (abdominal arteriosclerosis);
5. Excessive functioning (excessive venery);
6. Pressure (tumors and aneurisms);

Visceral pains are dissociated with excessive vertebral tenderness or stiffness or by movements which call the fasciæ and ligaments into play as in lumbago.

SPECIAL BACKACHES.

1. POST-OPERATIVE BACKACHE.—After operations in the supine posture due to improper support of lumbar arch with muscular relaxation during anesthesia. The backache in women occurring at night is due to improper support of the lumbar arch and may be prevented by a pillow under the loins during sleep.

2. PROFESSIONAL BACKACHE.—Observed in dentists and surgeons who assume a constrained posture and the

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remedy consists in raising the right leg and placing the right foot on a stool; thus the lumbar spine is partly unarched and strain is removed from the stretched ligaments.

3. HYSTERICAL BACKACHE.—*vide* hysterical spine.
4. COCCYODYNIA (page 95).

CHEST-DEFORMITIES.

The configuration of the thorax is frequently modified as a sequence of curvature of the spine and the deformities are as follows: kyphotic, scoliotic and scolio-kyphotic. Such deformities are readily recognized by the short thorax, low stature and the exaggerated breadth of the shoulders.

The RACHITIC chest is especially characterized by the keel-shaped prominence of the sternum (pigeon-breast) and may be associated with deformities of the spine, notably scoliosis and kyphosis. The BOAT-SHAPED chest (*thorax en bateau*) has only been observed in syringomyelia and consists of a depression in the median line of the upper portion of the anterior chest-wall.

In the ALAR or PTERYGOID chest there are prominent scapulæ.

Projection of one scapula indicates the presence of a lateral curvature.

In 1743, Hunauld described the condition known as CERVICAL RIB. The anterior limb of the transverse process of the 7th cervical vertebra has an independent center of ossification and may develop into a separate bone (known as a cervical rib), which may not extend beyond the transverse process or may form a complete rib attached anteriorly to the sternum. A cervical rib may be present either on one or both sides. Since the employment of x-rays in diagnosis, the cervical rib is more frequently recognized and is not an uncommon condition in explaining many vascular

C o c c y g o d y n i a

and nervous symptoms referable to the upper extremity and neck. A supposititious osseous growth of the neck may be a cervical rib or exostosis emanating from it.

A cervical rib may exist with or without symptoms. In the former event, the symptoms are associated with pressure on the subclavian artery (aneurism, gangrene of the hand and minor vascular affections) and on the brachial plexus (neuritis). The symptoms may develop suddenly in children and adults.

COCCYGODYNIA.

This is a neuralgia of the coccygeal plexus and is also known as coccydynia. The chief sign of this affection is pain in and around the coccyx which is accentuated in the sitting posture (sitting-pain), by rising, walking, urination, defecation, coitus and during pregnancy. Pressure on the coccyx is painful. The pain may be intermittent or continuous and dull or neuralgic. With the patient in the dorsal or the left lateral position by grasping the coccyx between the index finger (in the rectum) and thumb and moving the coccyx, the pain from which the patient suffers may be reproduced and in this sense such an examination is diagnostic.

The affection is chiefly confined to women and is occasionally observed in children. In quack literature the affection is often described as the "elongated spinal column."

Occurring rarely in males, it owes its origin to some sexual anomaly.

The etiology is obscure, the predominant factors being traumatism (horse-back riding), pregnancy, labor, rheumatism and pelvic diseases.

Many writers regard the affection as a neurosis or neuralgia and the success attending Graefe's method of treatment would suggest the latter hypothesis as correct in the majority of cases. Graefe cured all his cases within

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twelve séances by applying one pole of the Faradic current to the sacrum and the other pole to the coccyx and surrounding tissues.

FAULTY ATTITUDES.

Above the age of twelve years the normal attitude may be roughly estimated by aid of the plumb-line held against the back of the sacrum; this line approximates the convexity of the dorsal spine.

The **FLAT BACK** is observed in children with a tendency to scoliosis and the **HOLLOW BACK** (lordosis), unless due to disease, is usually an anomaly of conformation. **ROUND SHOULDERS** are associated with the following attitude: head is flexed and carried forward, the shoulders are drooping, the chest is narrow and flat, the scapulæ are prominent and the physiologic curve in the dorsal region is accentuated. The age of puberty is the usual time for the occurrence of round shoulders. The etiology is identified with general muscular weakness (especially of the posterior shoulder-muscles), defective hygiene, supporting the clothing from the shoulders in lieu of the waist, and protracted spinal flexion from incorrect school furniture which lends no support to the back.

In **PARALYSIS AGITANS** the attitude is characteristic: head and body are bent forward with trunk flexed on thighs and fore-arms on the arms. The other essential points in diagnosis are: tremor at rest ceasing upon voluntary movements, mask-like face, monotonous voice and rigidity of the back.

In **CERVICAL CARRIES** the head is held to one side, supported by one or both hands in a fixed position. In **PSEUDO-HYPERTROPHIC MUSCULAR PARALYSIS**, the enlarged though feeble muscles, and the attitude (legs far apart, shoulders

L i t i g a t i o n B a c k s

thrown back, abdominal protrusion and lordosis) are characteristic.

In SHOULDER MALPOSITIONS, with drooping of the shoulder forward, rotation of the scapula lowers the glenoid cavity, thus causing the humerus to rest against the ribs and by so doing, the axillary structures are compressed, resulting in circulatory disturbances in the hand and pains in the distribution of the brachial plexus.

LITIGATION BACKS.

As a result of accident, many individuals suffer from symptoms referred to the back which in reality do not exist and which often evanesce after a favorable verdict by a jury.

It is easier for a patient to simulate a disease which gives little objective evidence, hence the nervous system is a prolific field for the malingerer.

Simulation of organic nervous disease is extremely difficult, and for this reason, the symptomatic picture is essentially neurasthenic. Simulation can only be excluded by the physician after a thorough objective examination of the nervous system. The behavior of the patient, when his attention is diverted from his symptoms, must be carefully noted. Disease of the cord and membranes may be excluded if the reflexes are intact and if there is no distal spasm, paralysis or anomaly of sensation.

Vertebral implication is excluded if there is no vertebral tenderness, deformity or limitation of spinal movement.

If unilateral spasm is present it cannot be feigned.

In real PARALYSIS, any change in the condition of the muscles cannot be feigned. In simulated paralysis, movement of the involved limb may show some muscular stiffness if it is suddenly raised or dropped, or, if motion is secured by

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painful stimuli such as the prick of a pin or a powerful Faradic current.

Under anesthesia the patient may execute movements of a simulated paralyzed extremity and in one case of malingering, the author induced the malingerer to move his limb during hypnosis.

ANESTHESIA is easier of simulation than the preceding symptom, for the reason that sensibility varies even in the norm. Thus women are more tolerant to pain than men and even in healthy criminals analgesia is frequently observed. Polish Jews are said to show anomalies in the perception of pain. Bailey²⁵ asserts, that there are many individuals who can suppress any evidence of pain as long as their attention is fixed upon this object.

The "human pin cushions" in museums really suffer pain, but in consideration of the salary they receive, willingly submit to the thrusts of the pin.

In making a sensory examination, the eyes must be blindfolded and the tests must be executed without any fixep system. Thus, when one leg is being examined, prick the anesthetic leg quickly or employ a Faradic current and suddenly use the full force of the battery. Again, mark with a pencil on the skin the areas of anesthesia and examine later to observe if the areas correspond.

Feigned anesthesia is not limited to the exact distribution of the peripheral nerves, nor to the sensory distribution of the spinal-segments.

To determine objectively the existence of PAIN, the signs noted on page 000 may be employed.

The REFLEXES are not under control of the will, hence, if modified or lost, feigning may be excluded. It is true, however, that the knee-jerk may be inhibited if the patient firmly contracts the knee-muscles.

L u m b a g o

LUMBAGO.

A muscular rheumatism (*myalgia*) limited to the muscles of the loins and their tendinous attachments is known as lumbago.

An attack of lumbago may occur suddenly after stooping, or a sudden twist, hence the phrase, "kink in the back" or "*Hexenschuss*" (witches' shot), as the Germans call it.

The differentiation of pain located in the muscles or vertebral ligaments is often difficult of attainment, yet, one may say, that if the pain is worse in straightening up, the erector spinæ muscles are involved, whereas implication of the ligaments is probably present when the greatest pain is experienced when the patient bends far forward.

Schreiber notes than an intense dull pain extending from the sacrum to the 3rd dorsal vertebra dissociated with any limitations in the movements of the spine, indicates the involvement of the fascia lumbo-dorsalis. Difficult bending forward suggests implication of the flexor muscles (psoas and quadratus). Involvement of the psoas is indicated by the pain evoked in rolling the thigh outward. Pain in the region of the 4th and 7th ribs uninfluenced by bending the spine but accentuated by breathing, suggests involvement of the serratus posticus.

In general, muscular pain is diagnosed when the muscles are tender on pressure and passive stretching or active contraction accentuates the pain.

When the muscles cannot be grasped between the fingers, muscular contraction may be provoked by the Faradic current and after this manner, the areas of sensitiveness may be elicited. This current is therefore equally efficient in differentiating myalgia from pains of other origin.

Myalgia, in contradistinction to neuralgia, shows no

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periods of exacerbation, but becomes accentuated from pressure and active and passive movements and the muscles may show changes in volume and consistency. From vertebral disease, the diagnosis is usually not difficult (*vide* backache). It must be emphasized, however, that persistent lumbago may be a symptom of masked Pott's disease.

Lumbago caused by fatigue is ameliorated by massage, which removes the fatigue-toxins.

Myalgia may also be provoked by an intramuscular neuritis or by pressure on the intramuscular nerves by the indurated connective tissue of the muscles (page 89).

Myalgia of rheumatic origin yields to the salicylates and when associated with a toxemia dependent upon some digestive anomaly, small doses of calomel followed by a saline is an effective measure.

Strapping would be equally efficient in pain of muscular or vertebral origin, whereas acupuncture (page 146), if efficient, is practically diagnostic of a myalgia.

By means of strips of adhesive plaster (preferably zinc oxid) properly applied to the lumbar muscles without including the spine, immediate relief is often obtained in myogenic pain. Almost miraculous in action is freezing (page 172) of the skin overlying the affected muscles. Unless relief is immediate after the use of freezing no results can be expected from its repetition.

Myalgia of gouty origin demands the employment of remedies addressed to the gouty state.

In URIC ACID LUMBAGO dependent on a supposed precipitation of uric acid in the muscles of the back the local application of OIL OF WINTERGREEN (by massage) is, according to Haig, both diagnostic and curative. For purposes of massage I employ an electric massage-apparatus, which is illustrated in Fig. 36.

The author does not seriously consider the so-called uric-acid theory of disease, yet he feels that in a book of this character, he dare not obtrude his personal opinion nor



FIG. 36.—Electric massage-apparatus for inunction.

demolish a theory which has won favor. Therefore, a few words are pertinent respecting this theory. Many causes have been assigned for the uric-acid diathesis, but in reality

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the essential cause may be thus summarized: excessive eating and drinking with deficient muscular exercise.

There is practically no known remedy for eliminating uric-acid from the blood and one is constrained to have recourse to a diet with the object of diminishing the ingestion of foods containing uric acid. Adams suggests the following diet-lists in cases of uric-acid intoxication.

MAY BE EATEN.

White Meat of Chicken, Sparingly.	Raw Cabbage, "Slaw."
Fat Bacon or Fat Pork or Ham.	Corn on the Cob or from the Tins.
Macaroni, Spaghetti, Vermicelli.	Cucumbers, Lettuce, Parsley.
Barley, and all Cereals and "Flaked" Breakfast Foods.	Dandelion, Beet and other "Greens."
Potatoes in all forms but Fried. Sweet Potatoes.	Beets, Turnips, Squash, Pumpkins.
Kale and Spinach, Sparingly.	Puddings of Crackers, Bread, etc., without eggs.
Flounders, Fresh Cod, Hake or Haddock.	Rice, Sago, Tapioca.
Fresh Fish, Soup or Chowder.	Milk, Buttermilk, "Cereal Coffees."
Vegetable Soups, with Barley.	Chestnuts, Almonds, Walnuts, Pecans, Grapes, Raisins, Figs, Apple Sauce, Pears, Lemons.
Game, once a week, Sparingly.	Grape Fruit, Oranges.
Cheeses of all kinds. Very useful.	Dried Fruits in Sauces, Sweetened only when cold and ready to eat.
Stale Bread, Crackers, etc.	
Rusks, Cake without Eggs.	

TO BE AVOIDED.

Eggs, and foods containing them.	Pickled, Salted or Preserved Fish.
Beef.	Salmon, Bluefish, Mackerel or any Oily Fish.
Veal.	
Pork.	Mushrooms.
Mutton.	Celery, Kale.
Lamb.	Tomatoes, Rhubarb.
Beef Tea.	New Bread or Biscuit.
All Soups made with Meats.	Made Dishes, as Puddings with

N e u r o t i c S p i n e

Potted or Preserved Meats.	Eggs.
Lobsters, Crabs, Clams, Oysters.	Hot Griddles, Waffles, etc.
Dark Meat of Chicken or Fowl.	Beer, Wine, Whiskey and all
Liver, Sweetbreads, Kidneys, etc.	Alcoholics.
Beans, Peas or Lentils, Dried, in	Tea, Coffee, Cocoa and Chocolate.
Soups or Baked.	Peanuts.
Bananas, Gooseberries.	

TRAUMATIC LUMBAGO often follows injuries of the vertebral column and is dependent on strain or laceration of the tissues which protect the spinal cord. Injury of the spinal cord is excluded by the absence of paralysis, anesthesia and loss of sphincter-power. In this form of lumbago there is pain in the back, aggravated by motion. Painful areas may be detected over the vertebral spines and muscles, and the latter are usually in a condition of spasm.

Vide osteo-arthritis (page 105) which is often falsely designated as lumbago.

NEUROTIC SPINE.

In hysteria and neurasthenia, spinal symptoms may predominate conducing to a condition known as spinal irritation or spinal neurasthenia. Among the symptoms are: weakness and pain in the back and intercostal-like neuralgic pains, which shoot down the legs.

The rachialgia may only appear after exhaustion or movements of the spine or it may occur spontaneously. In practically all cases areas of tenderness may be elicited on the spine.

The diagnosis of the neurotic spine is based on the diagnosis of neurasthenia and hysteria.

In neurasthenia, the chief symptom is tire, without which sign the disease cannot be said to exist.

Amyosthenic symptoms are present (page 52), and it is

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evident, that if the back-muscles (which are the only agents in maintaining the spine erect) are involved in the hypotonicity, backaches must be of frequent occurrence.

Respecting the diagnosis of hysteria, one searches for the stigmata (anesthesia, hyperesthesia, etc.).

According to the modern conception of hysteria, the so-called stigmata are of artificial production, evoked by the suggestion of the physician during his examination; hence the stigmata are characterized by mobility, variability and incertitude.*

If anesthesia is present it may be revealed by certain manœuvres. In the method known as TRANSFERENCE, if a coin or any metal is placed on an anesthetic area, the latter will show a return of sensibility, whereas another area with normal sensibility may become anesthetic. The manœuver may be reversed by placing the coin over an area of normal sensibility; this in turn becomes anesthetic and sensibility is restored in another anesthetic area.

Janet suggests an ingenious manœuver. The patient, let us assume, has an anesthetic area on the back. He is told to say "yes" each time he feels the prick of the pin and "no" when it is not felt. The examination must be conducted rhythmically so as to give the patient no previous warning. If the patient says "no" when the anesthetic area is touched, the nature of the anesthesia is revealed inasmuch as the patient could not say "no" if tactile sensation were not present. In hysteria, the psychic origin of the disturbed sensations is further revealed by the fact that they bear no relation to the distribution of the sensory nerves nor to the segments of the spinal cord.

The neurotic spine is frequently associated with diseases

*This conception merits modification in traumatic neuroses (page 377).

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of the pelvis inasmuch as areas of hyperesthesia are frequently located over the ovaries (ovarian tenderness).

In the majority of instances the ovaries are not implicated and, if bimanual examination of the pelvis is made and the finger in the vagina is made to approximate the finger on the area of tenderness, it can easily be demonstrated that the pain is located in the abdominal walls and not in the pelvic organs.

OSTEO-ARTHRITIS.

Synonyms.—Rheumatoid Arthritis; Arthritis Deformans; Chronic Rheumatic Arthritis; Rheumatic Gout.

In this affection pronounced structural changes in the joints and cartilages are present. When the spine is involved, there is hypertrophy and overgrowth of bone.

The x-rays have been a valuable aid in the recognition of these changes which, when present, exclude rheumatism, inasmuch as the latter affection is unattended by pathologic alterations in the cartilage and bone.

The affection usually occurs between the ages of thirty and fifty years and women (notably those who have pelvic disease or are sterile) are as frequently affected as males.

The affection is neither related to rheumatism nor gout.

It was formerly held, that the disease was dependent on lesions of the spinal cord owing to the occurrence of muscular atrophy, pain, neuritis, increase of reflexes, etc., but the modern theory is in favor of a chronic infection resulting from gonorrhoea, influenza and other infectious diseases. In *children*, Still has described a form characterized by enlargement of the joints and swelling of the lymph-glands and spleen. The onset usually occurs before the second dentition and girls are more frequently affected than boys. The children are puny and show arrest of development.

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Nathan⁴⁸ describes a metabolic form of osteo-arthritis which is characterized by a symmetrical involvement of many joints with swelling and increasing deformity. Radiograms show a peculiar punched-out rarefaction in the early stages, and absorption and distortion in the late stages without the presence of proliferative processes or bony ankylosis. It is interesting to observe that in such cases the employment of the *thymus* shows a remarkable effect. One begins with two five-grain tablets thrice daily. In a couple of weeks the dose is increased to three tablets and after a month three tablets four times a day are given.

A *toxemic factor* has been recognized in the etiology of arthritis deformans and treatment directed toward a pyorrhea alveolaris or albuminous putrefaction of the intestines has been followed by satisfactory results. In the latter condition, indicanuria is present. Intestinal putrefaction is combated by interdicting meat in the diet, the use of intestinal anti-septics, the employment of laxatives to produce daily movements of the bowels and the use of soured milk (one or two pints daily). The latter may be substituted by tablets containing lactic acid bacilli, but care must be taken that the products are reliable.*

It is the VERTEBRAL form of this affection which is of particular interest to us. Here there is a progressive ankylosis of the vertebræ conducing to spinal rigidity (poker-back). This condition has been described as SPONDYLITIS DEFORMANS, of which there are two varieties; that of Von Bechterew, which is either hereditary or secondary to a trauma in which nerve-root symptoms (anesthesia, pain and muscular atrophy) predominate and the spine alone is involved. In the Strümpell-Marie type, also known as

*This subject is more fully discussed on page 344.

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SPONDYLOSE RHIZOMÉLIQUE, the spinal signs are less characteristic and the shoulder-joints may be involved as well as the hip.

When the spine in the lumbar region is involved, the pains may simulate sciatica or lumbago; in the cervical region the pains are referred to the neck and arms and in the dorsal region along the intercostal nerves.

My friend, Dr. S. J. Hunkin, who has had an extensive experience, contends that probably most lumbagos and sciaticas are of osteo-arthritic origin. Spondylitis deformans is about three times as frequent in men as in women and the ages of predilection are from twenty-five to forty-five years.

The LABORER'S SPINE (*duplicature champêtre* of Marie), occurring in laborers who must adopt the stooping posture, must not be confused with this affection. In the laborer's spine, the entire spine is never "welded together" and there is no exostosis nor decided ankylosis of the joints of the extremities.

In the diagnosis of osteo-arthritis, mention has been made of the x-ray plate for revealing the osseous overgrowth. The latter may also be revealed by palpation, which shows thickenings or nodes.

If the affection implicates the spine, the range of motion is limited and the lordotic curve instead of ending at the 10th or 11th dorsal vertebra, runs up to the 7th or 8th dorsal vertebra or perhaps higher (Hunkin). Involvement of the vertebræ is further noted by limitation of the hip-movements and stiffness of the back. The normal curves are accentuated, notably the lumbar and dorsal ones, and the patient is bent in walking. If there is any ankylosis between the ribs and the spine the breathing is abdominal, owing to deficient expansion of the chest. Diminution or absent chest-expansion shows implication of the articulation of the ribs.

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If there is any motion in the spine it is painful and may be associated with crepitus. It is necessary to distinguish loss of motion due to muscular spasm and locking of the joints by the osteophytes.

Little nodules (Heberden's nodosities) may be felt upon the sides of the distal phalanges.

Although this disease is regarded as incurable, *thiosinamin* may be tried or anesthesia employed.

Fibrolysin is preferable to thiosinamin and is used hypodermatically. The drugs in question soften scar tissue.

Anesthesia is effective for a dual reason; if the ankylosis is fibrous it may be forcibly overcome.

Again, Marshall²⁸ has recently shown the following reaction after ether-anesthesia in the usual manner from a cone for fifteen minutes in osteo-arthritis without apparent infection; complete subsidence of pain, restored motion in the involved joints and partial disappearance of periarticular swellings. Amelioration may not occur for twenty-four hours and the relief between anesthesia and the return of pain is from two days to two weeks. Acute, show more decided changes than chronic cases. If the patient is made worse by the anesthesia the arthritis is probably of infectious origin. The therapeutic value of repeated anesthetics was not determined, owing to the insufficient number of cases.

Relief of pain in the early stages of the disease is secured by fixation of the spine, but later, such immobilization is not indicated owing to ankylosis, which must be prevented by active and passive movements.

POTT'S DISEASE OF THE SPINE.

This refers to a progressive tuberculosis of the vertebral bodies or discs, eventuating, as a rule, in ankylosis and kyphosis. The disease is localized in order of frequency as follows:

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- 1.—Dorsal;
- 2.—Lumbar;
- 3.—Cervical portion of the vertebral column.

The great majority of cases occur before the age of fourteen years and one or several vertebræ may be simultaneously involved. The disease is equally common in the male and female. Heredity, traumatism and the diseases of children which enervate the vitality, are frequent etiologic factors.

The tuberculous lesion in this disease is usually located in the body of the vertebra leading to disintegration of the osseous structure which may terminate in caries or suppuration. In consequence of softening and absorption of the vertebræ they cannot sustain the superimposed weight, hence deformity (kyphosis) results.

When the disease involves the last vertebra, the deformity resulting causes the lower lumbar vertebræ to project over the brim of the pelvis like a roof (*vide* spondylolisthesis).

MUSCULAR SPASM is an early and characteristic symptom manifested by anomalous attitudes, lateral deviations of the column and reduced flexibility of the spine.

Muscular rigidity is so important an early sign that the following rules of Lloyd²⁷ are apropos:

1. If stiffness is present when the patient is told to nod the head affirmatively, there is occipitoatloid disease.
2. If stiffness is noted when the patient is directed to look far to the right or to the left, there is atlo-axoid disease.
3. When the shoulders are firmly fixed to the back of the chair and the eyes are carried back along the ceiling, any stiffness suggests disease below the second cervical vertebra.
4. Place the patient prone on the lap and indicate the tip of each spinous process with a pencil, after

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which direct the child to stand straight and note if any of the pencil-marks approximate; if two or more marks do not approach each other approximation is prevented by rigidity and the disease is in the dorsal region.

5. To detect lumbar rigidity, place the nude patient upon a couch and grasp the ankles and raise the pelvis. If the lumbar spine is flexible the pelvis is lifted without raising the chest from the couch and the movement deepens the hollow of the loin. If the lumbar spine, however, is stiff, the trunk is raised and there is no alteration of the outline of the lumbar spines. In Pott's disease, when the child is directed to pick up an object from the floor, the knees (not the back) are bent.

PAIN, usually dull, may be located at the site of the disease or referred to the peripheral distribution of the irritated nerves, and it is for the latter reason, that the child may be treated for some visceral affection.

Bilateral pains (sciatica and intercostal neuralgia) are suggestive of vertebral disease and chronic bilateral belly-aches in children are diagnostic according to Lloyd. Pain and tenderness in the back suggest abscess-formation. Very often the pain of dorsal disease may be assuaged by raising the shoulders and in cervical disease by lifting the head.

DEFORMITY, especially when angular and in the median line, is pathognomonic of this disease. Angular deformity is noted more often in regions where the normal curves are posterior than when they are anterior.

A skiagram is invaluable in the early diagnosis of Pott's disease.

When the disease has subsided, there is no longer any tenderness of the spine to vertical pressure, and jarring of the column in various ways causes no inconvenience. Rigidity

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may continue as a result of the welding together of the affected vertebræ.

In adults and less often in children, Pott's disease may occur without deformity and the only symptoms may be the signs of a spinal abscess and implication of the cord and spinal roots.

SACRO-ILIAC DISEASE.

Synonyms.—Sacro-coxitis; Sacro-coxalgia.

This is either an acute or chronic tuberculous disease of the sacro-iliac articulations,* commencing either in the synovial membrane or bone, and is practically identical with Pott's disease of the spine. It occurs most frequently in early adult life and the predisposing cause is identified with occupations (equestrians) exposing the joints to traumatism.

The pain in this disease may be confined to the affected joint or may be referred to the distribution of the dorsal or sciatic nerves. It usually begins on getting up after a night's rest and is accentuated by all movements which jar the joint. Examination *per rectum* will reveal tenderness over the joint. The pathognomonic sign is the following: pain in the joint when the sides of the pelvis are pressed together. In walking, the steps are cautiously made to avoid all jars to the joint and the patient walks chiefly upon the ball of the foot and the body is inclined toward the sound side with tilted pelvis. Examination of the joint shows swelling and elevation of local temperature.

SACRO-ILIAC RELAXATION.

The sacro-iliac joint is a true joint and may be the site of the same diseases as other joints.

*The two superior posterior spinous processes of the ilium are on a line with the third sacral spine, below which are the sacro-iliac joints.

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Goldthwait,²⁸ refers many backaches in women to luxation of the sacro-iliac joints. Even in the norm, the latter show definite motion which, during pregnancy and menstruation, is augmented. These joints are also relaxed in consequence of traumatism and general weakness. The so-called "stitch" in the back, from strain or overwork, represents a strain of the joint in question. The backache occurring in the morning after sleep and after operations is referable to the general relaxation following the dorsal posture which strains the lumbar spine and draws the sacrum backward.

It is suggested that the backache thus produced is commonly relieved by stretching upon first waking, which draws the lumbar spine forward.

Drag of the abdomen in obese individuals is often a source of sacro-iliac weakness in consequence of the lordosis and pelvic-joint strain.

The most frequent symptom in sacro-iliac relaxation is backache referred either to the sacro-iliac articulations or the sacrum. The backache may develop during sleep, owing to the recumbent posture. The lumbo-sacral cord passes directly over the upper part of the sacro-iliac articulation and the pressure thus induced accounts for the referred pains in the lower extremities. Objectively, one may note when the patient stands, an obliteration of the lumbar curve of the spine.

The diagnosis of sacro-iliac relaxation is often made by the therapeutic results. Thus relief at night is attained by lying on a firm bed with a firm hair-pillow under the hollow of the back. If the joints are strained or only relaxed, some support to the pelvic bones, like adhesive straps or a wide webbing belt fixed to the base of the corsets and kept up by the insertion of light steels, may be employed. If

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luxation of the upper part of the sacrum is present, it may be corrected by extending the spine; legs on one table and head and shoulders on another table with the face downward and the unsupported body hanging between. After this manner, the sacrum is replaced and a plaster-jacket is applied.

Sacro-iliac relaxation is frequently confounded with sciatica and lumbago. It is differentiated from the former, by the absence of pain on pressure along the sciatic nerve and from the latter, by the absence of pain on pressure over the lumbar muscles and free motion of these muscles. In the diagnosis of relaxation of the sacro-iliac joint, one must not forget that a rectal examination will often reveal a tender point on either or both sacro-iliac joints. If certain movements cause pain and the cause is sacro-iliac relaxation, the same movements may be made without pain during the time the sides of the pelvis are compressed by the hands of the physician.

SPINAL CURVATURES.

The curves of the normal spine have already been discussed (page 39). The chief varieties of curvature are:

1. Scoliosis or lateral curvature.
2. Posterior curvature, also known as kyphosis, gibbosity or excurvation.
3. Lordosis or anterior curvature.
4. Angular curvature from caries of the spine.

SCOLIOSIS.

This refers to a lateral deviation of the spinal column with or without rotation of the vertebræ on their vertical axes.

Scoliosis is the most frequent of all orthopedic affections

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and is more common in girls than in boys (four to seven girls to one boy).

The largest percentage of cases occurs before the age of fourteen years and very few cases occur thereafter.

The most frequent curve is toward the right in the dorsal region, owing to the fact that the right is used more often than the left arm.

Scoliosis is usually acquired and the most frequent causes are general muscular debility and rickets.

Scoliosis may result from an empyema with adhesions and the concavity of the curvature is toward the affected side. Caries and spinal tumors may eventuate in scoliosis.

In SCIATICA, scoliosis is frequent, the body being inclined toward the healthy side (convexity of the spinal column toward this side) or, more rarely, the trunk is inclined toward the affected side, or even more rarely the trunk may alternate in being inclined toward one side and again toward the other side (alternating sciatic scoliosis). The probable cause of scoliosis in sciatica is unilateral reflex contractures of the muscles of the back.

Other varieties of scoliosis are :

1. HABIT SCOLIOSIS, due to habitual faulty positions, and in this category may be included vocational scoliosis resulting from faulty postures during occupation and observed in dentists, barbers, dressmakers and others.
2. STATIC SCOLIOSIS, due to inequality as a result of alterations in the extremity. Thus, in shortening of one leg an obliquity of the pelvis results in the opposite direction with a primary deviation of the lumbar vertebræ.

It is not difficult to recognize scoliosis when all the clothing is removed and the child stands. Scoliosis is made

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evident by marking the spinous processes with an anilin pencil. Numerous scoliosometers are used for measuring and recording the degree of the deformity.

It may happen that in neurasthenics, the spines of the vertebræ are tender on pressure and here mistakes arise in the incorrect diagnosis of spinal caries. In the latter affection, spinal rigidity is the essential factor in diagnosis due in the early stages to involuntary muscular spasm and in the latter stages to ankylosis.

When the spine is flexible and curvature can be combated by manipulation, the case is one of scoliosis. Scoliotic curves however, may be rigid, but only after having been present for many years.

There are cases of functional lateral deviation of the spine which are easily corrected and must not be confused with true scoliosis. In the latter, flexion of the spine increases the deformity and in the former it is obliterated. Functional deviation, if neglected, may be converted into a true scoliosis.

Respecting prognosis in scoliosis one may say, that when there is no deformity of the bones, *i. e.*, when the physician can by traction and manipulation, correct the deformity, and when the spinal muscles are intact, a cure can be predicted. There is no antagonism between scoliosis and tuberculosis as was at one time supposed.

If scoliosis is caused by a shortened extremity, a thick-soled shoe is indicated. Muscular nutrition is effected by correct exercises, massage, electricity and central sinusoidalization (page 158).

KYPHOSIS AND LORDOSIS.

When the normal dorsal curve is increased it is known as kyphosis or posterior curvature, and increase of the

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lumbar curvature is called lordosis, anterior concavity or saddle-back (Fig. 37). Compare the latter with Fig. 16 showing the divisions and contour of the normal spine.

Kyphosis and lordosis may co-exist. Lordosis is frequently an act of compensation to counteract the center of gravity going too far forward. This *compensatory lordosis* is noted in pregnancy, in obese individuals, from abdominal enlargement, in rickets, etc.

A paralytic variety of lordosis is observed in muscular atrophy and pseudohypertrophic paralysis.



FIG. 37.—A, increase of the dorsal curve or kyphosis; B, increase of the lumbar curve or lordosis.

Adolescent kyphosis is frequently noted in young women who have been overworked in the workshop or field.

As a rule, the deformity cannot be overcome by voluntary effort, and, in consequence of compensatory changes in the bones, it becomes permanent.

MUSCULAR KYPHOSIS may result from muscular weakness due to faulty attitudes and is observed in tailors, carpenters, shoemakers and others.

SENILE KYPHOSIS is caused by absorption occurring in the intervertebral discs.

RACHITIC KYPHOSIS is most pronounced in the lumbar region and disappears in the recumbent posture and in suspension.

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In all recent cases of kyphosis, the deformity disappears when the patient lies upon the stomach.

Kyphosis is differentiated from the angular curvature of spinal-caries by the absence of rigidity of the spinal-muscles and pains when the vertebral column is percussed.

LUMBAR BULGING must not be confounded with kyphosis. It is usually a swelling on either side of the spine and is commonly associated with some renal affection (tumors, pyonephrosis, etc).

ANGULAR CURVATURE.

This may result from any disease of the vertebral bodies, notably, tuberculosis, osteomyelitis, syphilis, secondary carcinoma of the vertebræ, etc. Insomuch as this condition usually results from tuberculous caries of the vertebral bodies, the reader is referred to the description of Pott's disease (page 108).

SPONDYLITIS.

Spondylitis deformans has already been described (page 106).

The vertebræ are implicated in various diseases usually of infectious origin. The following forms of spondylitis may be differentiated.

1. TRAUMATIC SPONDYLITIS.—This affection follows an injury and bears a close resemblance to Pott's disease. The vertebræ between the 3rd and 7th dorsal are most frequently implicated. The pain which is present may be located in the injured area or may be referred, and is accentuated by pressure and movements. Kyphosis may also be present. The injury may be associated with fracture and the spinal cord may be ultimately involved in this affection. Whereas traumatic spondylitis is non-tuberculous, it must not be

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forgotten that Pott's disease may follow traumatism. In tuberculous disease of bone, here as elsewhere, the injury creates an area of least resistance in which the bacilli are deposited or a latent area of tuberculosis may be aroused into activity.

2. **INFECTIOUS SPONDYLITIS.**—This is observed in actinomycosis, syphilis, gonorrhœa, osteomyelitis and typhoid fever (page 121).

SPONDYLOLISTHESIS.

This refers to a deformity of the spinal column produced by the gliding forward of the lumbar vertebræ in such a way that they overhang the brim of the pelvis and obstruct the inlet of the latter (spondylolisthetic pelvis).

It is an uncommon affection and results from malformation, strain or violence.

The diagnosis is established by:

1. A history of injury during the developmental period with pain in the lower part of the back.
2. Shortening of the body in the lumbar region.
3. Lordosis with separation of the ilia.

A like deformity of the pelvis known as SPONDYLIZEMA is produced by caries of the last lumbar vertebra and the top of the sacrum.

TRAUMATISM OF THE SPINE.*

It is an undeniable fact, that spinal injuries may prove an exciting factor in the development of many chronic diseases, notably, general paralysis of the insane, locomotor ataxia, etc.

Whether traumatism can be regarded as a cause of the latter affections is still a debatable question insomuch as

**Vide* litigation backs (page 97) and neurotic spine (page 103).

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they may have existed unrecognized prior to the injury. Schlesinger, shows that the symptoms ascribed to a traumatic neurosis may be due in many cases to some pre-existing affection. He examined one hundred victims of various accidents within ten days of the accident and was amazed

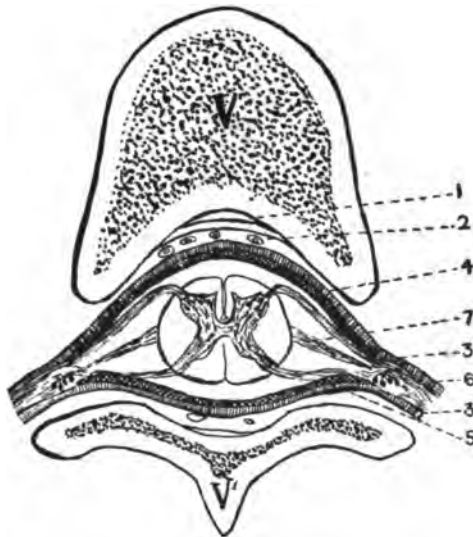


FIG. 38.—Relation of the spinal cord to the surrounding structures. V, body of vertebra; V', spinous process; 1, ligament; 2, vessels; 3, dura mater with the arachnoid lying directly beneath it; 4, anterior root; 5, posterior root; 6, spinal ganglion; 7, ligament (Dana).

at the large proportion of pathologic conditions found. Only twenty-two of the one-hundred persons were found normal.

It is likewise difficult to dissociate true from fictitious nervous symptoms following a simple strain which is often associated with the term traumatic lumbago (page 103).

A spinal sprain may result from direct or indirect injuries and the lumbar region is usually involved. According to the nature of the injury SPINAL SPRAINS may be differentiated as follows:

S p o n d y l o t h e r a p y

1. Simple sprain.
2. Sprain with nervous symptoms.
3. Sprain with spinal cord symptoms.

The relation of the spinal cord to the surrounding structures may be noted in Fig. 38.

A simple sprain is pathologically associated with some injury to the spinal-muscles and ligaments or both. The dominant symptom is pain moderated by rest and accentuated by motion. The spinal-muscles are in a condition of compensatory spasm to immobilize the vertebral column. Areas of tenderness may be present and simulation of pain may be excluded by the signs of Mannkopff and Loewi (page 70).

NERVOUS SYMPTOMS, usually neurasthenic or hysterical in character, may co-exist with the symptoms of a simple sprain and when cord-symptoms (paralysis, anesthesia, changes in the reflexes, girdle pain and sphincter-changes) follow the sprain, one must suspect concussion of the cord (when the symptoms abate within a week), hemorrhage within the cord (hematomyelia) or the development of a meningitis.

Simulation is a constant factor in spinal injuries and in diagnosis one must not forget Charcot's conception of a trauma in etiology. The latter taught that functional symptoms following an injury, were related to like symptoms which could be made to appear and disappear by hypnosis. The shock of an injury is tantamount to an hypnotizing agent (suggestion) which directs the attention of the patient to the injured part and suggests the symptoms (*traumatic suggestion*).

There are many neurologists who assume that the symptoms of a traumatic neurosis can be produced by one idea and removed by another idea, in other words, all is referred

T y p h o i d S p i n e

to suggestion and that there can be no purely functional troubles in the absence of anatomic lesions.

OSTEOPATHIC TRAUMATISM.—In the author's experience, the mechanic manipulations of many osteopaths often conduce to severe spinal sprains for, if the osteopath regards a dislocated vertebra as the cause of disease or supposes that a vertebra is compressing a vessel or nerve, he is inclined to conciliate his conviction with more force than discretion.

TUMORS OF THE SPINE.

Tumors of the spine are usually carcinomatous and less frequently sarcomatous. Carcinomata are rarely primary. They are secondary in nature and due most frequently to metastases from carcinomata of the breast and occur therefore with greater relative frequency in women.

Secondary deposits in the lumbar spine are relatively frequent in individuals with cancer of the breast and a group of symptoms designated by the term *paraplegia dolorosa* accompany the deposits, viz., lancinating pains, hyperesthesia and occasionally paralysis of the bladder and rectum.

In malignant disease of the spine the following are characteristic signs: rapid course, cachexia, local tenderness and severe pain, deformity, rapid emaciation and anemia, absence of fever, paraplegic symptoms, antecedent history of a malignant growth and localization in the lumbar region.

The iso-hemolytic power of the serum may yet serve of diagnostic value as a characteristic reaction of cancer.

TYPHOID SPINE.

Bone-lesions (periostitis, caries and necrosis) are occasional sequelæ of typhoid fever.

In 1889, Gibney described a condition of the spine

S p o n d y l o t h e r a p y

occurring during the course of the disease in protracted cases and more often during convalescence, in which pain is felt either in the lumbar or sacral regions, especially after a slight injury or shock. Usually the condition is a neurosis with a good prognosis, but in rarer instances, the pathologic process may be a periostitis with or without a subperiosteal abscess or spondylitis.

Among the symptoms are stiffness, localized pain and weakness of the back.

The total number of cases thus far reported is about seventy-four.

VERTEBRAL INSUFFICIENCY.

This condition has been described by Schanz in individuals between the ages of 20 and 40 years who complained of severe pains in the back. The spinous processes of the vertebræ are painful on percussion and the bodies of the lumbar vertebræ are equally sensitive. The latter is demonstrated by deep abdominal palpation when the fingers attain a point where the pulsations of the abdominal aorta are perceptible. Another sign is the difficulty experienced in changing the dorsal for the ventral posture.

Vertebral insufficiency is frequently regarded as an expression of neurasthenia and often it has been misinterpreted as a tuberculous spondylitis, but the immediate results of the treatment exclude neurasthenia and spondylitis. Some of the patients date the symptoms from the moment corsets have been discarded. The treatment consists of rest, massage and particularly the use of an orthopedic corset.

ORTHOSTATIC ALBUMINURIA.—In this affection, which occurs most frequently in children, albuminuria is present when the patient is up and about but disappears after rest in bed. The condition is not associated with nephritis.

M a l - A l i g n m e n t

Jehle³⁹ regards *lordosis* as an invariable concomitant of this condition and he has induced albuminuria in healthy children by provoking a curvature of the spine. It is supposed that the incurved vertebræ protrude into the space between the kidneys, thus twisting them around on a vertical axis and causing circulatory disturbances. It is further assumed that when the children are up, the weakness of the spinal muscles causes a lordosis. The albuminuria may be corrected by a supporting corset or by strengthening the muscles of the back and by making the sole of the shoe a little thicker.

MAL-ALIGNMENT OF THE CERVICAL VERTEBRÆ.⁵¹

As observed on page 42, our conception of the movements of the spine is too limited and if the current opinion is entertained, that the vertebræ are firmly bound together to form an elastic whole or entity, it is impossible to credit such a condition as mal-alignment of the cervical vertebræ without the presence of a traumatic dislocation.

Bates⁵¹ observes, "the muscles are designed and attached to each vertebra so as to enable it to contribute its proportionate share to any of the movements of the neck as a whole, and this arrangement guarantees it a certain amount of individual mobility; which is needed for the execution of the more complicated motions of the head and neck."

Reference has been made on page 47 to the author's observations on spasm of the spinal musculature provoked by peripheral sources of irritation. The muscles, in a condition of spasm by exercising traction on the cervical vertebræ, may force them out of the normal alignment.

Now the osteopath contends that, in consequence of the spasm of the muscles and mal-alignment of the vertebræ,

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compression of the vessels and nerves ensues which conduces to definite systemic anomalies.

The recognition of cervical spasm and mal-alignment is not difficult. The former may be recognized by palpation; the muscles are painful and in a condition of contraction.

Mal-alignment is noted by deviations from the normal articular line of the head and vertebral column.

Dr. Geo. Gould comments on the frequency of mal-position of the head, torticollis and spinal curvature due to eye-strain.

The author has noted even in the norm that, when the physician directs a patient to make strained movements of the eyes (without moving the head), and at the same time palpates the muscles of the neck on either side of the spine, the muscles in question contract spasmodically. It is not difficult to conceive then that, if the peripheral irritation is persistent, the muscles can pass into a state of tonic contraction.* Now a bit of conservatism is necessary in estimating the results attained in the treatment of these cases. It is difficult to conceive, at least, theoretically, how any manipulation of the muscles will bring benefit until the source of peripheral irritation is eliminated. However, one must regard with tolerance the observations of those who contend that relaxation of the contracted muscles and releasing "locked out vertebræ" suffice to cure.

For the sake of completeness, the author desires to describe the methods employed by osteopaths for the "adjustment of muscular lesions" and the "adjustment of cervical vertebræ."²

*Dr. Louis C. Deane, recently referred a patient to me for diagnosis, who in consequence of a severe injury to the head, suffered from diplopia and vertigo. The condition was one of muscular asthenopia. In this patient the muscles of the neck were in a state of tonic contraction and the head almost approximated the shoulder. Suggestion made during hypnosis sufficed to remove the diplopia after a single séance and when corrected the head was again held in a normal position.

V e r t e b r a l A d j u s t m e n t

ADJUSTMENT OF MUSCLES.

1. Pressure with quiet and slight rotation usually in a direction at right angles to that of the muscular fibers.
2. Relaxation is attained by stretching the muscle with the object of separating the origin and insertion of the muscle.
3. By approximating the origin and insertion of the muscle.

The foregoing methods are infrequently employed alone, but are usually used in combination.

ADJUSTMENT OF CERVICAL VERTEBRAE.

1. With the patient in the recumbent posture, the physician at the head of the table grasps with the fingers of each hand the tissues along the region of the arches of the vertebræ with the thumbs on the transverse processes; the lesion is exaggerated by pushing with the left hand directly to the right the tissues overlying the lateral arches; simultaneously the patient's head is forced against the abdomen of the physician to steady the movement. Next, reverse pressure is applied over the right lateral arch and rotation is achieved by movement of the hands and body of the physician.

2. With the patient in the same position as in the foregoing method, pressure is effected after the same manner but the fingers on one side and the thumb on the opposite side grasp the postero-lateral arches and with the hand upon the crown of the head, manipulation is made for purposes of rotation. Pressure is made downward upon the head in the direction of the axis of the vertebral column so as to fully relax the muscles and other tissues.

S p o n d y l o t h e r a p y

CONGESTION OF THE SPINAL CORD.

According to some authorities, areas of *vertebral tenderness* are associated with congestion of the spinal vaso-motor centers. The pathologist, however, is unable to confirm this clinical observation. On the contrary, anemia does cause changes in the cell-bodies of the cord with degeneration. It is an undeniable fact that, any interference with the motions of the spine resulting from weakness of the spinal musculature is associated with venous stasis which must necessarily interfere with the nutrition of the cord. The spinal muscles in the lumbar region are supplied by the lumbar arteries and in the dorsal region by the intercostal arteries. Branches from these vessels enter directly into the spinal canal on a level with each vertebra.

The SPINAL VEINS have no valves. The venous plexuses upon and within the spine are as follows: 1. Those placed on the exterior of the column (dorsal spinal veins); 2. Those located in the spinal canal between the vertebræ and the membranes (meningo-rachidian veins); 3. The veins of the vertebral bodies; 4. The veins of the spinal cord (Fig. 39).

DIAGNOSIS OF SPINAL DISEASES.

In the differential diagnosis of spinal diseases the genesis of PAIN* and DEFORMITY must be determined. Then one must decide if the membranes and spinal cord are implicated and also the character of the lesion. The following tables will aid in the differentiation of pain and deformity.

**Vide* backaches and lumbago (pages 83 and 99).

S p i n a l V e i n s

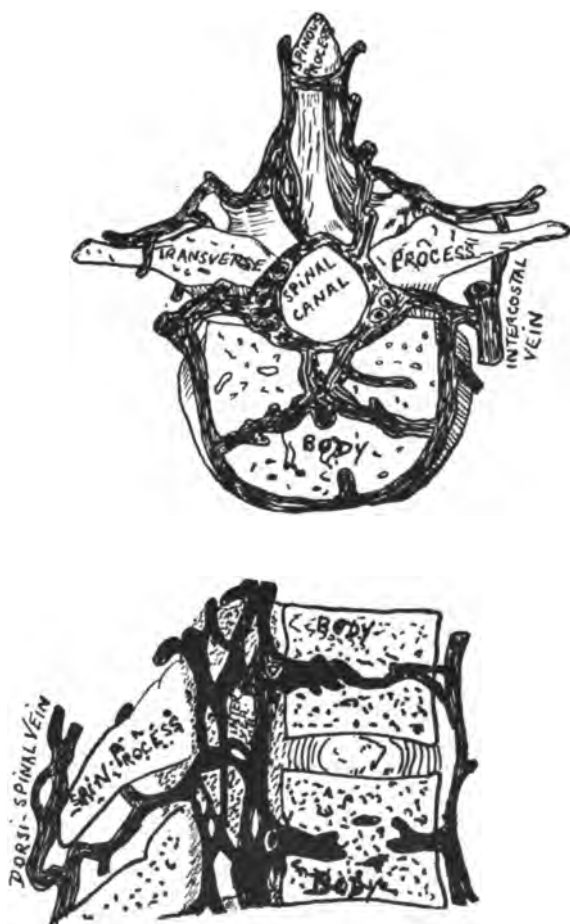


FIG. 39.—The upper figure represents the transverse section of a dorsal vertebra showing the spinal veins. The lower figure is a vertical section of two dorsal vertebrae showing the spinal veins.

S p o n d y l o t h e r a p y

PAINS.

DISEASE.	CONCOMITANT SYMPTOMS.
ANEURISM (thoracic).	Sharp paroxysmal lancinating pains when the aneurism erodes the vertebræ. Pain radiates down the left arm, to neck and upper intercostal nerves. Also anginoid pains. Signs of intrathoracic pressure. In spinal curvature, dislocation of the heart may cause displacement of the aorta, causing the latter to pulsate to the right of the sternum.
COMPRESSION MYELITIS.	<i>Nerve-root symptoms.</i> —Radiating pains, anesthetic areas, trophic disturbances and atrophy of the muscles. <i>Cord symptoms.</i> —Cervical region—Retropharyngeal abscess, spasm of the cervical muscles, dilatation of the pupil and unilateral flushing or sweating. <i>Thoracic region.</i> —Paraplegia of the spastic type (exaggerated reflexes) and when the compression is complete (rare), reflexes are abolished. <i>Lumbar region.</i> —Paraplegia with implication of the sphincters.
HIP-JOINT DISEASE.	Often confounded with lesions of the lumbar region. Pain in hip, front of thigh, or at inside of knee. Limitation of motion of the hip-joint, unilateral atrophy of the muscles (especially the adductors), lameness, swelling

S p i n a l P a i n s

DISEASE.	CONCOMITANT SYMPTOMS.
	confined to the front and back of hip-joint and attitude of limb (abducted and everted).
INTRASPINAL TUMORS.	Symptoms vary with the segment involved. Radiating pains from the level of the lesion. Usually paralysis of the leg on one side and sensory disturbances on the opposite side and jerking movements of the lower extremities. A radiogram may show infiltration of the vertebræ by the growth. At the level of the growth, pressure at the side of the spinous processes may elicit the pains felt by the patient.
LATERAL CURVATURE.	Severe cases in the lumbar region may simulate malignant disease of the spine. The latter is excluded by the long duration of the disease absence of cachexia, presence of compensatory curves and the unilateral deformity.
LEUKEMIA.	The sternum and spinal column are exquisitely tender on pressure.
LUMBAGO.	Usually occurs after a sudden muscular effort in a gouty or rheumatic subject or after exposure to cold or wet. Patient usually in excellent health and pains yield as a rule to treatment. Lumbago resisting treatment may be symptomatic of an organic lesion of the spine (Pott's disease, tumors).

S p o n d y l o t h e r a p y

DISEASE.	CONCOMITANT SYMPTOMS.
LOCOMOTOR ATAXIA.	Lightning pains usually of a few seconds duration are most common in the legs and about the trunk. History of syphilis, ataxia, absence of knee-jerk, Argyll-Robertson pupil and sensory disturbances in the legs.
NEUROMIMESIS (Hysteria).	The spinal symptoms (spinal irritation) of hysteria and neurasthenia may simulate locomotor ataxia. The spinal tenderness is general, the pains are fugitive and evanescent and are not limited to definite anatomic territories. The patients are usually women and the history is corroborative.
OSTEOARTHRITIS.	<i>Vide</i> spondylitis deformans (page 106).
OSTEOMYELITIS.	Local symptoms of swelling and rigidity of the spine, constitutional symptoms of sepsis, sudden in onset and suppuration always occurs. Usually secondary to some distant suppurative focus.
PLEURODYNIA (Muscular rheumatism of the intercostal muscles, pectorals and serratus magnus).	Pain usually on left side and accentuated by breathing and coughing. Affected muscles painful on pressure. Often mistaken for pleurisy and intercostal neuralgia (page 186).
SCIATICA.	A bilateral sciatica is always suggestive of a cord-lesion, notably pressure on the nerve-trunks of the cauda equina. Sciatica is

S p i n a l D e f o r m i t y

DISEASE.	CONCOMITANT SYMPTOMS.
SPINAL MENINGITIS.	often secondary to a chronic arthritis of the spinal column and may be unilateral in the lumbosacral roots in Pott's disease. The root-pains are often confounded with Pott's disease. In the latter disease, the root-pains are relieved by rest and accentuated by movement and the erect posture. In meningitis, there is a lymphocytosis of the cerebro-spinal fluid, whereas in Pott's disease (tuberculosis outside of the membranes) the fluid is normal.
DEFORMITY.	
DISEASE.	CONCOMITANT SYMPTOMS.
ACROMEGALY.	This dystrophy manifested by hypertrophy of the bones of the face and extremities is characterized by kyphosis.
ANEURISM.	Deformity due to eroding into the bodies of the vertebræ occurs late in life and other symptoms of aneurism co-exist.
CHONDRODYSTROPHIA rickets).	(Fetal Rigid kyphosis without spasmodic muscular contraction. Deformity of the chest and premature ossification of the epiphyses of extremities.
MALIGNANT DISEASE OF THE SPINE.	Deformity absent or rounded without bursa. No suppuration, rapid course, cachexia, severe localized pain and paraplegia.
OSTEOMYELITIS (vertebral).	Acute onset, rapid suppuration, constitutional signs of sepsis and rigors.

S p o n d y l o t h e r a p y

DISEASE.	CONCOMITANT SYMPTOMS.
PAGET'S DISEASE (Osteitis deformans).	The dorso-cervical kyphosis is associated with forward projection of the head, prominent clavicles, triangular-shaped face and shortening of the stature.
POTT'S DISEASE (caries).	Kyphosis is sharp and angular and usually gradual in development with muscular rigidity of the spine. Kyphosis as a rule, when not due to caries, shows soft erector spinæ muscles and the absence of pain on concussion transmitted to the back.
PULMONARY OSTEOARTHROPATHY (Hypertrophic).	Kyphosis may be present. Enlargement of the articular ends of the bones, enlarged terminal phalanges and incurvation of the nails. Usually associated with pulmonary diseases.
RICKETS.	Kyphosis most pronounced in lumbar region and disappears in recumbency and suspension. Other signs: open fontanels, enlarged abdomen, rachitic rosary, enlarged epiphyses and deformity of the long bones.
SCURVY (Barlow's disease).	Kyphosis is not frequent in infantile scurvy and is associated with other joint-lesions, swollen gums, ecchymoses, swelling of the epiphyseal junctions and pain on moving legs and thighs.
SENILITY.	Kyphosis occurs in elderly persons from flattening out of the vertebral discs from pressure.

Compression Myelitis

DISEASE.	CONCOMITANT SYMPTOMS.
SPONDYLITIS DEFORMANS (Rheumatoid arthritis).	Occurs late in life with stiffness and arching of the spine without kyphosis, muscular spasm and suppuration.
SYPHILIS.	Congenital and acquired syphilis by causing kyphosis may lead to the erroneous diagnosis of Pott's disease, but syphilitic and not tuberculous symptoms are present.

COMPRESSION OF THE SPINAL CORD.

(COMPRESSION MYELITIS).

Spinal diseases may, or may not, be associated with interruption of the functions of the cord by slow compression.

Among the causes of compression are the following:

1. Caries (Pott's disease).
2. Malignant growths (vertebral and retroperitoneal).
3. Aneurisms.
4. Syphilis.
5. Trauma.
6. Parasites in the spinal canal (echinococcus and the cysticercus).

The symptoms of compression are:

1. VERTEBRAL.—Spinous processes tender on pressure, muscular rigidity of the spine and pain. The latter is accentuated when the spine is concussed or twisted.

Kyphosis associated with vertebral disease is rarely the cause of compression, for the reason that the latter is more often the result of inflammation of the spinal meninges and the presence of inflammatory products between the involved vertebræ and meninges. The relation of the spinal cord to the surrounding structures is shown in Fig. 38.

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2. NERVE-ROOT SYMPTOMS.—Caused by compression of the nerve-roots as they emerge between the vertebræ and consist of pains in the region innervated by the nerves whose roots are compressed.

Additional symptoms are: Sensory and trophic disturbances, herpes; and when the ventral roots are compressed, there is wasting of the muscles supplied by the affected nerves.

3. CORD-SYMPTOMS.*—They are dependent on the region involved.

i. CERVICAL REGION.—Retropharyngeal abscess, spasm of the cervical muscles, dilatation of the pupils, unilateral sweating and flushing of the face and paralysis of all four extremities.

ii. THORACIC REGION.—Disturbances of sensation in the lower extremities, girdle sensations and pains in the course of the intercostal nerves and paraplegia (usually spastic) with exaggerated reflexes.

iii. LUMBAR REGION.—Paraplegia without exaggerated reflexes and involvement of the bladder and rectum.

PARAPLEGIA.

This is a symptom of many special diseases and may require a careful differentiation. Following a TRAUMA, it occurs almost instantly or it may be partial and in the course of a brief period it may be complete as a result of a destructive hemorrhage or from additional laceration of the cord from a fractured vertebra.

The paraplegia associated with the following affections demands differentiation:

*The site of the lesion is easily determined (page 30).

P a r a p l e g i a

1. Rickets.
2. Barlow's disease.
3. Syphilis.
4. Hysteria.

i. RICKETS.—The pseudo-paresis of this disease results from muscular weakness plus the pain caused by movements of the extremities. The muscles may atrophy from disuse, but there is no *reaction of degeneration*. The latter is also absent in cerebral paralyses but the reflexes are exaggerated and there are brain-signs and spasticity of the extremities.

ii. BARLOW'S DISEASE (infantile scurvy).—The pseudo-paralysis of this affection is likewise caused by muscular weakness and pain as well as by the subperiosteal extravasation of blood which causes tenderness in the shafts of the bones. Scurvy and rickets may co-exist. In both affections the electric reactions are unaltered. In scurvy, antiscorbutic treatment (fresh cow's milk, meat-juice and orange-juice or lemon-juice) yields prompt results and, in this sense, it is equally diagnostic and curative.

iii. SYPHILIS.—In children there is a syphilitic pseudo-paralysis known as Parrot's disease, in which sudden loss of motion may occur in either the lower or upper extremities or both and is caused by a separation of the cartilage at the end of the bone. Crepitation and pain follow movement of the affected extremity.

iv. HYSTERIA.—The disturbances of motility are essentially paralyses of function or will-power.

In one class of cases, movements like standing and walking are impossible, whereas all other functions may be executed by the same muscles. The reflexes are intact or exaggerated, the electric reactions are normal and there is no muscular atrophy. Symptoms of the bladder common in organic paraplegia are usually absent in the hysterical form.

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If the affected muscles offer any resistance to passive movements, it is suggestive of hysteria.

HOOVER'S SIGN for the detection of malingering and functional paralysis of the lower extremities is as follows: In the norm, when a person lying on a couch on his back is requested to raise the right foot off the couch with the leg extended, the left heel digs into the couch as the right leg and thigh are elevated; in other words, the left heel is used to fix a point of opposition.

If a normal person is requested to press the right leg against the couch there will be a counter-lifting force shown in the left leg. This complemental opposition is present in the norm and in genuine paresis or paralysis (even though feebly expressed) but its absence in the malingerer and in hysteria signifies the existence of cerebral inhibition.

The sign of Beevor³⁰ is based on the fact that, in functional paralysis the patient is unable to inhibit the antagonistic muscles. This condition is often noted in the knee and for this purpose the patient lies with the face downward and the leg is put up at right angles to the thigh and the patient is directed to extend the knee against resistance. In the norm the hamstrings should be relaxed at once, but in functional paralysis these muscles can be seen and felt to contract along with the extensors. The limb must be fixed and prevented from moving, otherwise as the joint is extended or flexed, the antagonists may be passively drawn on and give the impression that their muscles are actively contracting.

Anesthesia from the waist downward without involvement of the genitalia is usual. The latter condition may be reversed; anesthesia of the genitalia, whereas the other parts may retain their sensibility.

According to Kahane, neuroses are favorably influenced

N a t u r e o f L e s i o n

by the high-frequency current, whereas hysterical subjects react unfavorably and new symptoms are added to the old ones even after a single application. In fact, latent hysteria has been detected after this manner.

NATURE OF THE LESION.

TUBERCULOSIS.

Respecting the relative frequency of tuberculous joint-disease, the following statistics of Young³¹ are apposite:

Vertebræ	46.7 per cent.
Hip.	34.4 "
Knee	12.2 "
Ankle.	5.1 "
Elbow.	0.8 "
Shoulder.	0.5 "
Wrist.	c.3 "

In etiology, a history of heredity is important. Acquired predisposition is developed in consequence of conditions which diminish resistance and predisposition to tuberculosis.

Environment is a cogent predisposing factor. The absence of sunlight and fresh air predispose to infection.

During the first decade of life, the bones, meninges and lymph-glands are more frequently involved. A surgical operation may convert a localized into a generalized tuberculous process, notably, acute miliary tuberculosis.

As a rule, practically all tuberculous joint-lesions are referred to some injury and all authors agree that only mild injuries result in tuberculosis.

In severe traumatism, the process of repair is so active that the tubercle bacilli are destroyed. Experiments by inoculation confirm the latter clinical observation. Thus Krause, after inoculating animals with tuberculous material and then contusing the joints, obtained typical joint-lesions.

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If, however, the traumatism were severe there was no secondary involvement of the joint.

Tuberculous involvement of the vertebræ usually occurs during childhood (before the age of 14 years).

Several joints may be simultaneously involved in tuberculosis, notably, the hip and spine and the knee and spine.

Asthenia, fever, night-sweats and emaciation are the characteristic symptoms of tuberculous infection. The x-rays may prove of some value in early diagnosis, but as a rule, the skiagram only demonstrates lesions which have attained some magnitude.

Respecting the diagnosis of tuberculous lesions by aid of TUBERCULIN, the latter can only prove of value as a negative test (showing the absence of tuberculous foci in the body) and rarely as a positive test, owing to the fact, that vertebral involvement is usually secondary to a tuberculous lesion elsewhere in the body.

The reaction with tuberculin is based on the fact, that in tuberculosis the tissue-cells develop a hypersensitiveness to the poisons of the tubercle bacillus (*allergistic reaction*).

In cachectic individuals, in acute tuberculosis, and in all those far advanced in the disease, tuberculin tests are usually negative owing to the fact, that the organism is so overwhelmed by the poisons that it is unable to react.

The tuberculin test may at first be negative, but when repeated it is positive. In such instances it is assumed, that there are latent tuberculous foci which have not been in contact for a long time with the poisons of the tubercle bacillus and that the first test stimulates immunization which favors a reaction when the subsequent test is applied. A positive reaction with the subcutaneous method is obtained in from 50 to 80 per cent of clinically healthy individuals.

In the presence of fever, the cutaneous or conjunctival

S y p h i l i s

method is preferable to the original hypodermic method. In the latter the puncture-reaction (red area of infiltration, edema and pain at point of puncture) is even more diagnostic than the febrile reaction. The MORO TEST is harmless and consists of rubbing into the unbroken skin of the abdomen a mixture of equal parts of tuberculin (old) and anhydrous lanolin. The rubbing should continue for about two or three minutes. The reaction, if positive, is manifested in from 12 to 48 hours after the inoculation by small papules and redness of the anointed area. The latter reaction is fairly reliable.

The presence of tubercle bacilli in the circulating blood in tuberculosis, demonstrable after the simple method of Rosenberger,³⁸ may prove of greater value in diagnosis than the tests with tuberculin. Many authorities, however, have been unable to confirm the observations of Rosenberger.

Snow, finds that the employment of the *static current* gives prompt relief in non-infected joint-conditions, but produces negative results or aggravates the condition in tuberculous infections.

SCROFULA is an attenuated tuberculosis of the lymph-glands and practically in all cases of acute tuberculosis the source of infection is from unhealed foci in lymph-glands (tuberculous adenitis).

SYPHILIS.

Tardy hereditary syphilis of the bones may occur in adults, but is most frequent between the ages of 6 and 10 years.

The pains of this affection may be regarded as rheumatic and the associated syphilitic fever may suggest typhoid fever.

The bones of the extremities are notably involved, usually at the shafts or in juxtaposition to the articulations, and swelling and deformity ensue. The tibia is most frequently

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implicated, resulting in a forward projection of the bone (saber-bladed deformity). The surface of the bone may show irregularity due to the presence of nodes.

Syphilis of the spine resembles Pott's disease.

The following signs of congenital syphilis suggest the diagnosis:

1. Nasal catarrh (snuffles).
2. Depression at root of the nose.
3. Cutaneous lesions.
4. Fissures at the angles of mouth (rhagades).
5. Alopecia (hair of head and eyebrows).
6. Tardy development (infantilism).
7. Deformed teeth.
8. Interstitial keratitis.
9. Ear-affections.

The therapeutic test is fairly conclusive if employed with circumspection. Here nutrition must be maintained to get the best results.

Syphilis with lesions of the bones responds favorably to Gibbert's syrup:

Binioidid of mercury	1 grain.
Potassium iodid	½ ounce.
Water.	2 ounces.

Dose.—Five to ten drops three times a day gradually increased and continued for months.

The Wassermann reaction is extremely valuable in the diagnosis of syphilis, but the reaction is too complicated for the practitioner and in consequence has been supplanted by the simplified method of Noguchi³⁷: To 0.1 c. c. of spinal fluid in a tube or not over 1 cm. diameter, add 0.5 c. c. of 10 per cent butyric acid; heat till bubbling and while hot add 1 c. c. of 4 per cent sodium hydrate solution. The fluid becomes flocculent in a few moments, whereas normal fluids are only opalescent or cloudy.

GONORRHEA.

Many obscure bone-lesions incorrectly diagnosed as rheumatism owe their origin to the gonococcus, the result of systemic gonorrheal infection.

Gonorrheal arthritis is characterized by involving joints which are not usually implicated in acute rheumatism, viz., sacro-iliac, intervertebral, temporo-maxillary and sterno-clavicular articulations.

A history of gonorrhea suggests the character of the lesion.

The employment of a gonococcic vaccine³⁴ promises to prove of diagnostic value in gonococcic infections. The gonococcus reaction usually appears in from 8 to 12 hours after the injection and lasts about 24 hours. The most constant feature of the reaction consists of an increase of pain and tenderness in the affected joints and a slight pyrexia following the injection.

It is well to recall the remarkable cures of gonorrheal arthritis reported by Fuller, who insists that the infectious material is derived from a gonorrheal vesiculitis and by opening and draining immediate relief of the arthritis occurs.

RHEUMATISM.

An acute *arthritis deformans* may be mistaken for acute rheumatism and the diagnosis is often established when the affection has lasted for weeks and with subsidence of the fever, periarticular indurations and deformities persist.

Implication of the smaller joints and the early deformities exclude acute rheumatism.

An acute *osteo-myelitis* may also be confounded with rheumatism, but the following signs are characteristic of osteo-myelitis:

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1. It is most common in infants or children, *i. e.*, during the period of active growth of bone.
2. Severe constitutional symptoms of septic absorption.
3. Involvement of the epiphyses rather than the joints.
4. The condition is sudden in onset and pus forms rapidly.
5. In osteo-myelitis of the vertebræ angular deformity is rare (differentiation from Pott's disease).

The use of salicylates is a valuable aid in diagnostic pharmacotherapy. Failure in the treatment of rheumatism with the salicylates frequently results from their faulty administration. The usual doses are absolutely inadequate.

If sodium salicylate is given at regular intervals until its physiologic action is manifested (tinnitus or deafness), then stopping its use and resuming it when the latter have abated, usually on the second day there is a decided fall of temperature and relief from pain in acute rheumatism. The joint-swelling usually disappears by the fourth day.

McCrae and Clarke have directed attention to the diagnosis of various forms of arthritis by the use of salicylates. The true rheumatic can tolerate from 150 to 300 grains of sodium salicylate before toxic symptoms occur, whereas in other forms of arthritis such symptoms develop after smaller doses. Thus in *gonococcic arthritis*, the average amount to produce toxic symptoms was 131 grains.

In true rheumatism, the fever, pain and swelling disappear in two or three days, whereas in other forms of arthritis, while the temperature may fall to normal, there is no change in the swollen joints. Doctor Lees, in a paper contributed to the Proceedings of the Royal Medical Society, also believes, that in most instances where the salicylates fail to relieve arthritis, the condition is not one of acute articular rheumatism but of some other form of infection.

R i c k e t s

Rheumatism *in children* is unattended by typical joint-symptoms and a heart-lesion may be the only manifestation of the disease. The following signs may also suggest the disease in children: tonsillitis (initial symptom), growing pains, chorea, myalgia, pleurisy, frequent attacks of bronchitis and anæmia. In children the salicylates must likewise be given in large doses: For a child of from 7 to 12 years, from 10 to 100 grains daily, and for a child under 7 years, from 5 to 50 grains daily, with twice the amount of sodium bicarbonate in each case. The latter drug is employed to counteract the toxic symptoms of the salicylates. In all cases when the salicylates are given in large doses one must carefully watch for the development of drowsiness, acetone odor of the breath and disturbances of the respiration.

RICKETS.

The associate symptoms of this affection are diagnostic;

1. During incubation, local sweatings (head and neck) and nocturnal fever preceding the period of bone-change.
2. Deformation of the bones is marked by hyperesthesia or tenderness of the latter and pain on voluntary movement.
3. Deformity of the thorax; changes in the epiphyseal junction of the ribs (rachitic rosary, characterized by a series of bead-like enlargements); pigeon-breast or chicken-breast.
4. Deformity of the spine, exaggeration of the normal curves, scoliosis and lordosis, which are accentuated by the large size of the abdomen.
5. Deformity of the head: oblong or square head, anterior fontanel open (closed in the norm about the 18th month); softened spots in the occiput (cranio-tabes), early decay of the teeth and retarded cerebral development.
6. Deformity of the extremities: an increase in the size of the epiphyses (wrist, elbow, ankle, knee) which suggests

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a joint (hence the popular expression "double-jointed") and bending of the long bones.

Recovery may occur within a few months, the bones remaining thick and hard with firm and short muscles and partial disappearance of the deformities.

SPINAL MENINGITIS.

A chronic meningitis may be confounded with a tumor of the spinal cord or disease of the vertebral column and Horsley⁸⁶ has seen a number of such cases which he has treated by laminectomy, opening the theca and washing it out with a mercurial solution.

The cases occur most often in adults with syphilis or gonorrhoea as possibly etiologic factors.

In differential diagnosis the following points are of value: A tumor of the cord exhibits pain usually localized to one nerve-root, but in meningitis, the pains spread gradually to the front and back of the thigh and cause painful cramping and twitching of the muscles of the right leg. Other signs are tightness and numbness of the thigh and a progressive loss of power in the legs eventuating in a progressive paraplegia.

Abdominal Supporters

CHAPTER V.

GENERAL SPONDYLOTHERAPY.

ABDOMINAL SUPPORTERS — ACUPUNCTURE — COUNTERIRRITATION —
ELECTROTHERAPY—EXERCISES—RE-EDUCATION OF CO-ORDINATED
MOVEMENTS—SPINAL HYDRO-THERAPY—LUMBAR PUNCTURE —
MASSAGE — PSYCHROTHERAPY — THERMOTHERAPY — VIBRATORY
MASSAGE.

ABDOMINAL SUPPORTERS.

Reduced intra-abdominal tension conduces to a condition described by the author as *intra-abdominal insufficiency*, and the latter contributes to a group of symptoms made up of backache and neurasthenia.

Minor grades of insufficiency may be detected by the following signs, which the writer has described more fully elsewhere:³⁸ first, auscultate the heart-tones, palpate the pulse, determine blood-pressure and define by percussion the borders of the heart and the upper border of the liver while the patient is standing. Next, direct an assistant standing behind the patient to firmly and forcibly lift the abdomen, exerting the pressure in a direction upward and inward. While the latter pressure is maintained, the foregoing methods of examination are again executed and if abdominal tension is reduced the following are noted: the heart-tones become stronger, the pulse fuller, the blood-pressure augmented from 5 to 30 mm. and the percussion areas of the heart and liver become higher and more pronounced.

The heart is prolapsed (cardioptosis) as well as the liver in diminished abdominal tension.

The author has frequently noted a systolic aortic murmur when the abdomen was pendulous which disappeared during

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the time the abdomen was raised by an assistant and re-appeared when the abdominal wall was dropped. This murmur is probably caused by traction on the aorta by a prolapsed heart, the result of an intra-abdominal insufficiency.

Many of the local symptoms of reduced abdominal tension are at once relieved by raising the abdomen in the manner suggested and if an abdominal support is employed, its value may be tested by noting the effects on the pulse, blood-pressure and position of the heart before and after its application.

Those who object to mechanic supports will find in the method of Kellogg, an excellent means of strengthening the abdominal muscles and thus securing a natural increase of intra-abdominal tension; the electrodes of a sinusoidal current are placed on either side of the spine about four inches apart and just below the inferior angles of the scapulæ. When the current is sufficiently strong, all the abdominal muscles will be thrown into vigorous contraction.

ACUPUNCTURE.

The author has already portrayed his conception of many diseases as expressed in the antagonism of muscles (page 111). This theory is in accord with our percutaneous methods of treatment and refers with special cogency to spondylotherapy. In the foregoing pages the following fact has been elaborated, viz., that throughout the spinal region one may arouse definite reflexes and that every reflex has its counter-reflex. Thus our therapy by peripheral methods resolves itself into the following: either an abnormal reflex is inhibited or it may be antagonized by a counter-reflex. In a word, peripheral stimulation signifies irritation of centrifugal or centripetal nerves. In arousing the former

A c u p u n c t u r e

to activity we stimulate motor, secretory, trophic, inhibitory and thermic nerves, whereas stimulation of the centripetal nerves predicates an action on the reflex-motor, reflex-secretory and reflex-inhibitory nerves.*

Lumbago (*myalgia lumbalis*), may be confounded with many reflex troubles and affections of the vertebral column. If the lumbar pains originate in the muscles alone, acupuncture, by its almost miraculous curative action, is diagnostic of lumbago.

The method may be made painless by local anesthesia before ordinary sterilized bonnet-needles are forced into the painful points of the lumbar muscles and allowed to remain for about ten minutes. It may be necessary to repeat the manœuvre. A number of smaller needles may be passed through the skin into the muscular tissue. The method is equally efficacious in the treatment of myalgias elsewhere and appears to be more successful in those who have bilateral pain.

Sir James Grant supposes that the needles set free an excessive storage of electricity which has accumulated in the muscles.

An intramuscular injection of morphine (1-6 grain) and-atropin (1-60 grain), or a few minims of chloroform, may also give immediate relief, but here it is difficult to differentiate the action of the medicament and the acupuncture.

*The excitability of certain nerve-centers is diminished by calling other centers into action. Franck, in the "Dictionnaire Encyclopédique des Sciences Médicales" observes, that when one considers the normal functions of the nervous system, one finds that there exists a necessary equilibrium between the different parts of this system. This equilibrium may be destroyed by the abnormal predominance of certain centers which seem to divert to their own advantage too great a proportion of the nervous activity; thus, the functions of the other centers appear to be disturbed. The *ankle-clonus* depends on an exaggerated excitability of the calf muscles. If now, I excite with the sinusoidal current the spinal segment (page 30) presiding over the muscles which antagonize the calf muscles, for a time, at least, the ankle-clonus can no longer be elicited. This method has been employed successfully by the author in overcoming spasms of definite groups of muscles.

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COUNTERIRRITATION.

Counterirritants are valuable agents for the relief of pain if applied in correct situations. As we will notice in the subsequent chapter on PSEUDOVISERAL DISEASES, the pains usually experienced in the thoracic and abdominal walls are

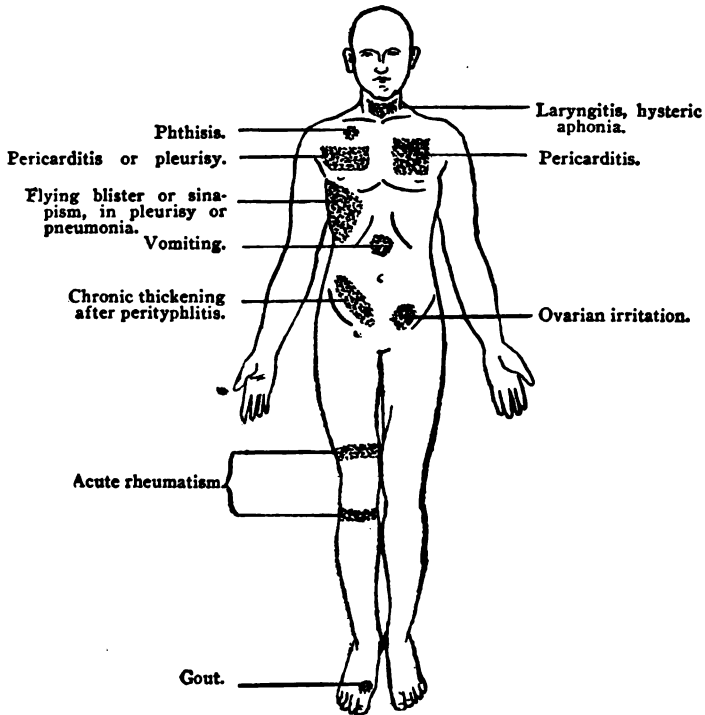


FIG. 40.—Diagram of the body showing some of the areas where counterirritants are usually applied. Front view.

pains referred to the periphery, whereas the actual site of the lesion is alongside of the spine at the vertebral exits of the affected nerves. It is evident then, that if the counterirritant is applied at the point where the pain is felt rather than at the site of the lesion, no result is achieved. It was the custom of Trousseau to trace a neuralgia along the course

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of a nerve to the spine from which it made its exit, at which site the painful point was blistered.

In diseases of the hip, pain is felt in the knee, yet the

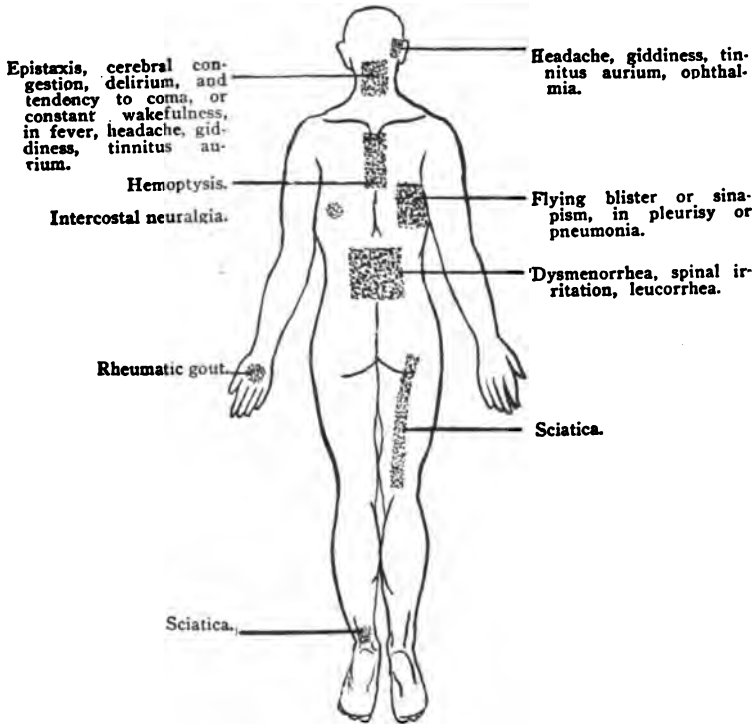


FIG. 41.—Diagram of the body showing some of the areas where counterirritants are usually applied. Back view.

counterirritant, to be effective, must be applied to the hip.

Insomuch as counterirritants achieve their analgesic effects by influencing the distribution of blood in a part either reflexly through changes in the caliber of the vessels or by anemizing the morbid structures, *leeching and cupping* may, in many instances, achieve like effects. It may be necessary in some instances to accentuate counterirritation and for this purpose an escharotic or the actual cautery is used.

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The observation of Head (page 58) shows that the viscera and definite areas on the surface of the body receive their nerve-supply from the same segment of the spinal cord and that irritation of the one reacts favorably upon the other.

It will be noted in the accompanying figures (40 and 41) from Brunton, that the areas established empirically for applying counterirritants to influence the viscera nearly correspond to the dermatomes of Head.

Nothing in my experience equals freezing (*vide* psychrotherapy) for the purpose of counterirritation in spondylotherapy and for this reason, I employ freezing to the exclusion of all other methods.

Cantharides is the usual vesicant employed, although many preparations on the market are useless. Before applying cantharidal collodin or a plaster, wash with soap and water and then dry the skin thoroughly with alcohol and if a plaster is used, moisten it with a few drops of acetic acid. Vesication occurs in about eight hours. At the end of that time, carefully remove the plaster to avoid rupturing the bleb and puncture the latter at its most dependent part with an antiseptic needle and dress with dry absorbent cotton. After the latter fashion the skin rapidly forms under the blister. If the latter is broken, sprinkle the surface with *orthoform*, which renders the healing painless.

Cantharides is readily absorbed from the skin and toxic symptoms (strangury, priapism and nephritis) may follow, hence blistering must be achieved with other drugs.

Methyl iodid has no unpleasant action on the urinary organs. About 15 to 30 drops of the liquid is poured on a piece of blotting paper which has been cut to the desired size and then fastened to the cleansed skin by adhesive plaster. Blisters appear in from 3 to 18 hours.

A blister may be produced in several minutes by saturat-

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ing a piece of lint with chloroform and after its application covering it with oiled-silk or a watch-glass.

Equal parts of lard and ammonia will blister in about five minutes.

ELECTROTHERAPY.*

It is yet customary to regard the results obtained from electric treatment as dependent on suggestion. Mœbius tells us that four-fifths of all electric cures are dependent on mental influence. Even Beard, who, in his time, was one of the leaders in electrotherapeutics, is quoted by Kellogg as saying: "If you expect to get definite results from electrical applications, you must be sure that your patient has faith, otherwise the application will do him no good."

Electrotherapy is now founded on a scientific and, what is more important, a utilitarian basis. All currents do not show the same physiologic and therapeutic effects any more than do the various alkaloids derived from opium, although the same plant is the common source of all. The discovery of the SINUSOIDAL CURRENT is accredited to D'Arsonval, although Kellogg's description of the current in 1888, preceded the publication of the former.

The sinusoidal current does not produce the unpleasant and painful effects of the Faradic current and is decidedly more effective for the average therapeutic purpose than is the Galvanic current. The Faradic current is alternating in character in which the break in the direction of the current occurs at the maximum point of intensity. The Galvanic current is continuous and any change in the direction or in the interruption of the current is a sudden break associated with a painful shock.

*Only the sinusoidal current will be described, as it is used by the author almost exclusively in the diagnosis and treatment of spinal diseases.

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The preceding conditions with the sinusoidal current do not exist. It is probable that the rapidity of alternations is so great that the sensory nerves fail to appreciate the impressions of such high frequency. The current gradually rises from the base line, zero, to the maximum, then equally gradually returns to zero, then likewise rises to the maximum in the opposite direction, and returning to zero repeats the rhythm at the rate of many thousand alternations per minute (Fig. 42).

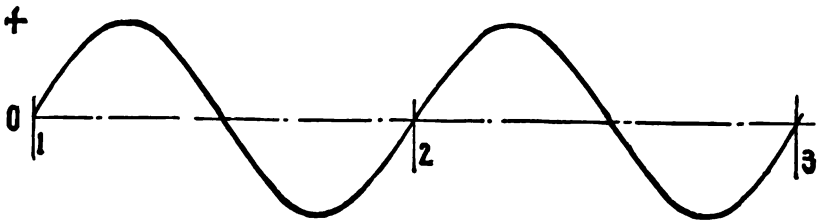


FIG. 42.—A true sine curve from which the sinusoidal current obtains its name. The length of the sine being from points 1 to 2, which is one complete cycle and two complete alternations. In what is called the 60 cycle current, which goes through this change sixty times per second, this distance from 1 to 2 represents one-sixtieth of a second and in the 125 cycle variety, $\frac{1}{125}$ of a second. These currents are sometimes spoken of as having 7,200 and 15,000 respectively' alternations per minute, since there are, of course, two alternations (one each way) in each cycle and 60 seconds in a minute. The distance of this curve above or below the horizontal neutral line represents at each instant the potential or degree of polarity at that point, the points above the line being positive and those below negative, and this degree of polarity determines the strength of the current at that instant and the direction of its flow.

Many of the sinusoidal apparatuses on the market are such in name only and do not achieve the results cited in this work.

With the original Kenelly machine, one could obtain a frequency up to 150,000 alternations per minute. The latter machine is, however, too expensive for general use and with less costly apparatus equally efficient results can be attained.

The author's (Fig. 43) apparatus is simple in construction

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and has, therefore, few of the faults of more complicated machines.

By screwing the plug attached to the cord into a lamp-socket, it is ready for use. The number of alternations is



FIG. 43.—The author's sinusoidal apparatus.

determined by a rheostat and varies from 2,000 to 20,000 per minute. It is especially constructed for the direct street-current, although it can be made available for the alternating current. With an alternating current-supply only, the value

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of the current obtained is very much restricted. The Galvanic current may also be obtained from the same apparatus.

Doctor J. H. Kellogg's sinusoidal apparatus* (Fig. 44) embodies Kellogg's discoveries and is a very efficient apparatus for obtaining sinusoidal effects. It is provided with a finely graduated rheostat, by means of which the powerful



FIG. 44.—Sinusoidal apparatus of Dr. J. H. Kellogg.

currents generated may be reduced to the smallest requirement. It consists essentially of a specially constructed magneto-generator operated with an electric motor. A slowly alternating current designated as SS (slow sinusoidal), is usually employed for muscular effects, and the rapidly alternated current RS (rapid sinusoidal), is used to induce powerful tonic contractions and to secure analgesic action or other nerve-effects.

Another efficient apparatus (Fig. 45) for sinusoidal purposes is the outfit made by the Victor Electric Company of Chicago. In the multiplex outfit of the latter company one can adequately control the length of the sine wave and the voltage as well. The apparatus can be attached to any

*Made by the Modern Medicine Company, Battle Creek, Michigan.

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electric-light socket and it is calculated for the direct current. It is also supplied for connection to the alternating current, but when employed in this way its value is very much restricted.

When the Victor apparatus is employed for eliciting the vertebral reflexes, the author suggests only the employment of the rapid sinusoidal current.

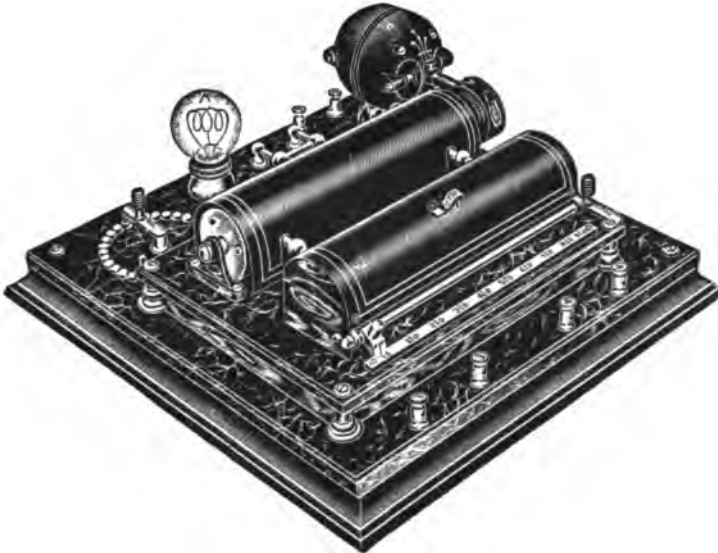


FIG. 45.—Sinusoidal apparatus made by the Victor Electric Company.

DIAGNOSTIC AND THERAPEUTIC APPLICATION OF THE SINUSOIDAL CURRENT.

This subject will be discussed in detail in special chapters devoted to visceral diseases. One of the most important properties possessed by this current by its cutaneous application alone, is the powerful and demonstrable action on the internal organs. Thus, with one electrode at an indifferent point (the author prefers the sacral region), and the other over the regions of the various organs, visceral reflexes may

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be elicited. If both electrodes are applied to the abdomen it reduces intra-abdominal congestion.

By aid of this current, as will be demonstrated later, toxic intestinal and hepatic products are brought to resorption and excreted in the urine.

The various vertebral reflexes (page 7) can be elicited by this current, but for therapeutic purposes, concussion (page 175) often exceeds it in value.

The current has a specific action in hyperesthetic conditions whether superficial or deep-seated, and is of all

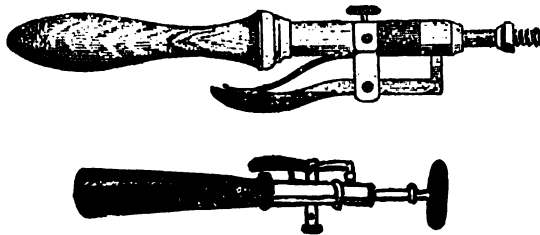


FIG. 46.—Interrupting electrodes.

currents the most available for inducing analgesic effects.

It is very often the most efficient current for developing weakened muscles and not infrequently it will provoke muscular contractions in degenerative lesions when Faradism produces no response.

In applying this current for diagnostic and even for therapeutic purposes the moistened indifferent pad (usually large) is placed over the sacrum, whereas the interrupting electrode (Fig. 46), which permits one to close and open the circuit, is placed over specific regions.

To induce muscular contractions it is not necessary, as in the use of other currents, to find the motor points (points of greatest excitability). To obtain the maximum contraction of the muscles of the back, the latter must be relaxed.

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To excite the *muscles of the back* for diagnostic or developmental purposes strong currents must be used. Referring to Fig. 47, the effects of a strong sinusoidal current are noted



FIG. 47.—Muscles of the back showing Triangle of Petit (shaded triangular area). The *trapezius* retracts the scapula and braces back the shoulder; when the head is fixed, the upper part of the muscle will elevate the point of the shoulder (electromotor point, E.M.P., A), whereas the lower fibres depress the scapula (E.M.P., B); with fixed shoulders, action of one trapezius will draw the head to the corresponding side (E.M.P., C). The *latissimus dorsi* when the arms are fixed raise the lower ribs and assist in forcible inspiration (E.M.P., D). Application of the electrode at any of the points marked E, E, E, will accentuate the lordosis in the lumbar region and, at F, on the right side, scoliosis is produced to the left side, and, at a corresponding point on the left side, scoliosis to the right side. By marking the tips of the spinous processes or by noting the spinal furrow, the scoliotic changes are best observed. G, electromotor point which causes an approximation of the scapula to the spine.

when one pole is applied over the sacrum and the interrupting electrode is placed at various points indicated by circles. The effects of this current can be more easily demonstrated

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if the spinous processes are marked with a pencil, thus indicating any deviation of the vertebral column. Changes in the curvature of the spine are naturally less evident in adults than in children.

This current is specially indicated when the development and strengthening of the spinal muscles are the objects in view. Here the electrodes must be placed at corresponding points on either side of the spine so that the muscles on one side should not exceed in development or strength the muscles on the other side. By inducing the central reflexes (page 11), a symmetrical development is easily achieved.

A *backache* is very frequently a weak back; the muscular tire graduating into pain and here the remedy is muscular development.

It is difficult to devise any exercises which will bring into action the thirty-one muscles of the back which are subdivided into five layers.

Not infrequently, the so-called *uric-acid* diathesis is a localized intoxication; the unused muscles favoring the precipitation of uric-acid or other products of defective metabolism and creating what is popularly called "stiff-back." To destroy such products, it is necessary to bring a greater supply of blood to the parts, for more circulating blood means more oxygen and more oxygen means better nutrition. Sinusoidalization of the muscles of the back is more efficient than any exercises. The author has investigated the output of urea before and after sinusoidalization of the muscles of the back in many cases of backache and noted the pertinent fact that, as a rule, there was an augmented excretion of urea after sinusoidalization. Voit has shown that work does not increase the elimination of nitrogen by the urine, hence the increased output in my cases was due to the removal of urea stored up in the muscles.

E x e r c i s e s

It is evident to the reader that in the event *muscular rigidity* is present, muscular contraction is less readily elicited by the current than when the muscles are relaxed, hence in this respect, the current subserves a diagnostic use.

EXERCISES.

About one-half of the body-weight is dependent on the muscular system which, even in a state of rest, holds about one-quarter of the total quantity of blood. When the muscles are in activity the amount of blood which they hold is very much augmented.

Muscular exercises subserve the following objects :

1. They increase the frequency and amplitude of the respiratory movements.
2. By increasing pulmonary capacity they aid the work of the right heart.
3. By determining an increased quantity of blood to the muscles* certain congested areas are depleted.†
4. Waste-products are increased in the blood and there is augmented excretory activity of the kidneys, skin and lungs.

In prescribing exercises, one must never forget their baneful effects on the nervous system when carried to excess.

When a muscle is fatigued by voluntary contraction, it involves not only the muscle but the nervous system, and the latter to a larger degree than the former. It is erroneous to suppose that a healthy nervous system can be acquired by vigorous muscular exercises. The latter always means an expenditure of nerve-force which may, or may not, be beyond

*Oliver has shown that the relative quantity of the corpuscles is increased in the blood of an exercised limb.

†The same author has demonstrated that while, after a period of rest, a relatively large amount of blood can be expressed from the abdomen into the systemic vessels, no such result can be attained by abdominal compression after exercises.

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the capacity of the individual. Many nervous wrecks are recruited from this fallacious argument.

Spinal exercises achieve the following objects :

1. Increased flexibility of the spine.
2. Strengthening the muscles which hold the trunk erect.
3. Combating a faulty attitude.

Supports and plaster-jackets in the treatment of curvatures are only indicated in acute inflammatory affections of the bone. Otherwise they conduce to ankylosis in a deformed position with muscular atrophy from disuse.

Impaired mobility of the spine is frequently the cause of distressing backaches, sciaticas and other affections. Here passive movements of the spine are often curative. The patient sits on the bed and the physician can repeatedly force the body forward or he can execute any degree of traction on the arms.

Exercises for the muscles of the back are most often prescribed in the treatment of *round shoulders* and *lateral curvature*.

ROUND SHOULDERS.*

This condition is more frequently encountered in girls than in boys, owing to the fact that in the adjustment of clothes there is a drag upon the shoulders equal to several pounds on either side. Here, as Goldthwait suggests, the weight must be removed from the outer part to the inner or rigid part of the shoulder at the base of the neck. The patient should be taught to assume a correct position, chest-deformities must be corrected by breathing, gymnastics, and the following exercises recommended by Lovett are indicated :

*Vide page 96.

E x e r c i s e s

1. The patient hangs from a bar by the arms.
2. In the recumbent position, with a hard roll under the scapulæ, the arms are extended and stretched and pulled above the head upwards and backwards by an assistant.
3. The patient sits on a stool with the hands behind the head and the elbows squared; during the time the elbows are pulled backwards, the knee of the manipulator presses forward against the spine on a level with the shoulders.

LATERAL CURVATURE.

Here muscular exercises constitute the essential part of the treatment. At least one hour daily must be devoted to their execution, and as Robert Jones suggests, the arms should always be moved by direct muscular effort and not allowed to swing.

Ridlon⁴⁹ employs the following exercises :

1. The patient lies upon her back upon a table of convenient height, width and length. The Swedish table known as the plinth is perhaps the most convenient. With her arms at the sides of her body, and the palms upwards, she breathes slowly and deeply ten times. In patients who present a projection of the ribs below the breast, it is of advantage for the surgeon to make pressure downwards with his hands upon these projecting ribs as the patient takes a full breath.
2. The patient grasps a bar of steel shafting 3-4 ft. in length and 10-20 lbs. in weight. With the elbows straight, she swings this from the thighs forwards and upwards above the head until the bar reaches the level of the table. From here she swings it downwards again to the thighs, and this is repeated ten times.

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3. The arms are then stretched directly outwards from the sides of the body, and in this position, as in (1), she breathes deeply ten times while the projecting ribs are held down by the surgeon.
4. Again, the iron bar is swung from the thighs to the table above the head and back ten times.
5. Then the arms are stretched upwards by the side of the head to the fullest reach, care being taken that the lower shoulder is raised as far as the other. The arms are held in this position, and the patient breathes deeply ten times, the ribs again being held down.
6. Then an iron bar of the same length, but double the weight of the former, is placed in the patient's hands as she lies upon her back, and she raises it directly upwards from the chest, fully straightening the arms, and repeats the exercise ten times.
7. Still lying on the back, with the knee held straight and rigid and the foot extended, the patient circles the limb from the hip-joint, making as large a circle as possible with the foot ten times. Then the other limb is circled in the opposite direction ten times.
8. Still lying on her back with hands grasping the top of the table, both limbs are lifted, while the knees are held straight and the feet extended upwards to the fullest point, if possible to the vertical position, and repeated five times.
9. The patient then turns on her face, is pushed out so that the body extends beyond the end of the table by the surgeon, and she, holding the head and shoulders as high as possible, makes with her arms the motion of swimming, the forward stroke of which should be particularly vigorous. In this position ten strokes are taken.

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10. The patient is then pulled back upon the table, and lying face downward with the knee straight and the foot extended, she circles first one leg and then the other, making the largest possible circle with the foot, ten times.
11. The patient is again pushed out with the body beyond the end of the table, and with the arms in the key-note position, she bends the body downwards and raises it upwards as far as possible. This is repeated five times.

The key-note position consists of such a position of the arms as places the back in the straightest line. For an ordinary dorsal curvature with a convexity to the right, the key-note position consists of pushing the left arm as far as possible up beside the head and holding it there close to the ear, while the right arm is stretched directly outwards with the palm turned upwards; but the key-note position must be determined for each particular case.

12. With the patient again pulled back and lying comfortably upon the table, she takes a 5-lb. dumb-bell in each hand, and swings them outwards and upwards, that is, backwards, as far as possible, ten times.
13. The patient, still lying on her face on the table, places her arm in the key-note position; then as she counts aloud one, two, the legs are held down, she raises the head and shoulders upwards and backwards as far as possible; then, counting three, four, she bends the head and shoulders as far as possible towards the convexity of the curvature; then counting five, six, she twists the head and shoulders around towards the side of the convexity, as if in an effort to look over the shoulder; then, counting seven, eight, she swings and turns back into the straight position from which she started, and this exercise is repeated five times.

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14. The patient then sits astride the narrow end of the table, while the surgeon sits astride the table behind her, steadying her hips with his knees. Then, with arms in the key-note position and the spine as straight as possible, she bends forward from the hips freely, and then backwards against the resistance exerted by the hands of the surgeon. This is repeated five times.
15. Then, with the arms stretched out from the side, she twists the body freely towards the side of the concavity; then she twists backwards towards the side of the convexity against the resistance afforded by the hands of the surgeon, one hand resting against the ribs forming the convexity of the curvature at the back and the other against the ribs that are prominent below the breast in front. This exercise is repeated five times.
16. The patient is then bent backwards and to the side of the convexity of the curvature over the knee of the surgeon, so that her waist rests through the bulging ribs across his knee, while the shoulder on that side is twisted still further backward. In other words, the position assumed is the one, both as to flexion and rotation, which most nearly corrects or over-corrects the spinal deformity. Lying lax in this position, the patient breathes deeply ten times.

In the early months of treatment greater improvement will be gained if the patient exercises in the prone position. Patients with lateral curvature are able to lie with the spine straighter than when they sit or stand, and the success of the treatment depends greatly upon making muscular effort while the spine is at its best.

Klapp's "*Creeping Exercises*" are not only useful in scoliosis but are equally efficient in expanding the chest by mobilizing the thoracic vertebræ.

Re-Education of Movements

The patient kneels, the thighs perpendicular, the elbows bent so that the arms imitate the bow-leg position of the dachshund while the head is bent far back. The pelvis is thus above the shoulders and the thoracic portion of the spine is in lordosis; this position must be maintained during the creeping. The arm is advanced and stretched before the hand touches the floor. This hand then turns and the elbow is bent as the trunk is advanced until the upper arm forms a right angle with the trunk. The arm thus forms the axis over which the thoracic vertebræ are levered by the drawing forward of the other arm, the scapula of the supporting arm forming the fulcrum of the lever. This exercise loosens up the thoracic vertebræ and spreads the ribs apart, and corrects torsion of the spine if present. The thorax expands more, the more correctly the lordosis of the thoracic vertebræ is localized during the sideward bend.

RE-EDUCATION OF CO-ORDINATED MOVEMENTS.

In *locomotor ataxia*, co-ordination exercises are of great value in regaining control of the voluntary movements which have been lost. The exercises in question exert no effect on the lesions and the best results are attained when the motor tract is intact. It is not necessary to employ the apparatus of Fränkel to achieve results; in fact, good results are equally achieved without apparatus.⁴¹

In executing the exercises the following rules must be observed:

1. One must begin with simple exercises; first with the eyes open and later with the eyes closed. Each movement must be executed with precision.
2. Fatigue must be avoided, hence the exercises should be taken in the recumbent and later in the sitting and erect postures. Fatigue may be avoided by

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counting the pulse which, when increased in frequency beyond the norm, indicates that the exercises must be temporarily suspended. At first the séances should not last longer than about ten minutes and later the entire exercises, including resting periods (to enable the pulse to become - normal) should not exceed thirty minutes.

3. A trained assistant for supervising the exercises is equally as important as the patient's perseverance.

Respecting the nature of the exercises, each physician will suggest his own methods. After the patient succeeds in executing simple movements with his ataxic extremities, then walking exercises like the following are indicated :

1. Line-walking in a straight line.
2. Walking at a mark which is placed on a wall at a limited distance.
3. Obstacle-walking. By placing books on their long edges about 20 inches apart and then directing the patient to walk over them.
4. Stair-walking. Ascending and descending steps.

SPINAL-HYDROTHERAPY.

The spinal-coil has replaced the Chapman bags. The former consists of thin rubber tubes through which a continuous current of water of any desired temperature is permitted to flow and is applied to the spine (never directly upon the skin) upon a thin moist compress. The bags of Chapman consist of the usual rubber bags (long and narrow) which can be filled with ice or water of any desired temperature and are placed upon the vertebral column. Cold applied to the cervical spinal-region (used in asthma and cardiac irritability) has a primary stimulating action succeeded by sedation. Cold applied to the lumbar spine,

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determines an increased flow of blood toward the lower extremities and the pelvic organs. Heat applied to the lumbar spine is said to diminish the flow of blood to the pelvic organs hence it is indicated in excessive menstruation. Cold applied to the entire spinal column reduces general reflex irritability and is employed in spinal neurasthenia.

In the rational employment of hydrotherapy, heat or cold water must be applied by means of a douche to definite vertebræ to elicit specific reflexes. The author, however, regards electricity and vibra-massage as more convenient methods insomuch as the object to be attained irrespective of the method employed is to evoke definite reflexes. Winternitz suggests the use of cold water poured over the back of the neck for relieving nasal congestion. He ascribes the result to action on the vaso-motor center. Elsewhere (page 284), the author directs attention to a more certain and permanent method for achieving the same object.

LUMBAR PUNCTURE.

Lumbar puncture is usually made just below the tip of the fourth lumbar spine (fourth interlaminar space) with a sterilized needle about three inches in length attached to a syringe or with a small trocar and canula.

If a horizontal line is drawn across the back on a level with the highest points of the iliac crests it will cross the spine at the level of the tip of the 4th lumbar spine.

The patient should lie on the left side with knees drawn up and the trunk bent forward. The skin at the site of the puncture may be frozen. The physician places his finger on the tip of the 4th lumbar spine and introduces the needle half an inch below and to the right of the 4th lumbar spine, and directs it horizontally forwards and a little inwards until the arachnoidal space is reached. When the syringe is

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detached, the fluid escapes in drops and the amount permitted to escape at a single séance should not, as a rule, exceed 5 cc.

Lumbar puncture is indicated for the relief of headaches of various origin due to augmented intracranial pressure. Thus, the pains secondary to herpes zoster have been relieved by the withdrawal of 20 cc. of fluid and it was therefore assumed that hypertension of the fluid existed.

Vertigo and tinnitus dependent on increased pressure of fluid in the internal ear are likewise relieved.

MASSAGE.

The pressure exerted by massage influences all the tissues within its reach. It increases the power of endurance and abolishes fatigue. Experiments on frogs show that, after the muscles have been exhausted, their loss of vigor is soon restored by massage, whereas rest without massage has no effect.

Massage increases the flow of blood and lymph. Brunton has shown that the blood passes three times more rapidly through a part while it is being masséed than when it is not. In many cases there is an increase in the number of red corpuscles and in the hemoglobin. Upon the nervous system, massage, if properly done, has a sedative effect.

Therapeutically, massage accomplishes the following:

1. It assists the peripheral circulation and lessens the work of the heart.
2. In tissues accessible to manipulation it hastens the resorption of exudations and separates adhesions in joints and tendon-sheaths.
3. It augments the oxidizing powers of the blood, thus modifying disturbances in its composition.

4. By stimulating the sympathetic nervous system it promotes secretions and various reflexes, and thus gives relief in functional derangements.
5. By augmenting the flow of blood in the muscles it diminishes congestion of the viscera.
6. Wright has demonstrated that the effect of massage on an infected joint, by discharging a number of bacteria into the circulating blood, is to raise the opsonic index, after temporarily lowering it in the first place.

In the manipulation of joints any elevation of temperature signifies extreme caution in manipulation, in fact, any increased temperature is a contra-indication for the employment of massage in affections of the joint. When it is a question between a functional and an organic joint-lesion the experience of the author shows that if fever follows passive movements of the joint it suggests an infectious lesion and the leucocyte count, as a rule, is increased.

Dowse observes that ten minutes massage of the spine will increase the volume of the pulse and the temperature generally more than one hour's work at the body as a whole; the spine being omitted.

Fig. 48 demonstrates a series of visceral reflexes excited by deep pressure at the vertebral exits of the various spinal nerves. The foregoing figure has been elaborated after a series of very careful clinical observations by the author. Firm pressure is usually made with the thumb of one hand and it is indeed remarkable how, in many instances, the symptoms may be relieved and even cured by such deep and firm pressure over definite regions. It is evident to the reader that if such pressure is executed promiscuously, counter-reflexes are evoked which nullify the reflexes sought. In fact, the symptoms by such promiscuous manipulation may

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be accentuated. One may observe quite frequently that when pain due to a spinal neuralgia is associated with a point of vertebral tenderness, temporary inhibition of the pain may be achieved by deep pressure on the sensitive vertebral area and, in this respect, pressure may accomplish in an emergency almost as much as psychotherapy. If the pains are of visceral origin and are associated with a point of vertebral tenderness, pressure upon the latter point is decidedly less

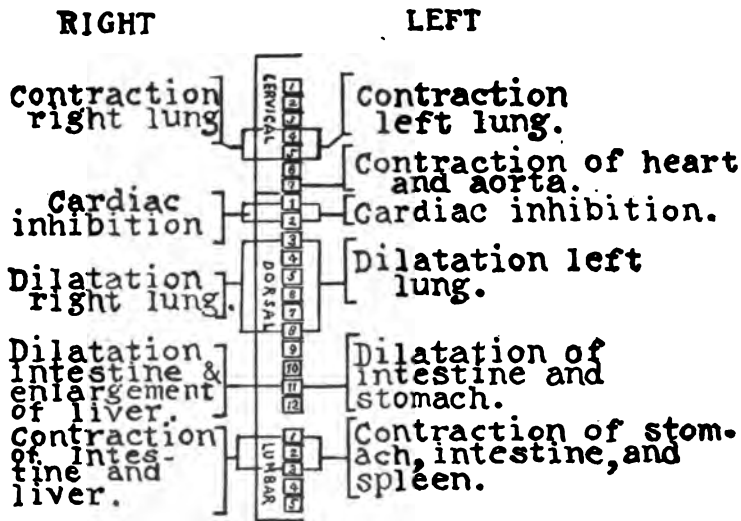


FIG. 48.—Visceral reflexes elicited by firm pressure at definite vertebral areas.

effective in relieving the pains. When it is necessary to make more forcible compression at the vertebral exits of the sensitive nerves the author employs his vibro-suppressor (Fig. 32) with a smaller pelote or he makes pressure with one end of the rubber of a pleximeter. The latter is shown in Fig. 2.

Assuming that a patient has a neuralgia of the cervico-occipital nerves, one seeks for a sensitive point at the vertebral exits of the cervical nerves usually on one side of the spine. As a rule, muscular spasm of the cervical muscles

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is associated with such a vertebral area of tenderness. Hence, before pressure is exerted by the thumb over the area of sensitiveness, the head is thrown backwards so as to relax the muscles. As a rule, pressure is primarily painful, but it soon yields to continued pressure and the neuralgic pains cease at once. A repetition of such manipulation may be necessary on successive days before the pain is permanently relieved.

The author has observed that pressure exerted after the foregoing method at the vertebral exit of a spinal nerve has usually only a slight effect on the cutaneous sensitiveness in the normal subject. If, however, the nerve is the site of a neuralgia, a decided effect can be observed on a given area of skin-tenderness.

Many osteopaths exercise great discretion in their manipulations insomuch as they do not massage the parts affected, but exert pressure upon the exits of the spinal nerves which are correlated to the parts involved. Thus the parts implicated are merely placed at rest and not manipulated until the acute symptoms have subsided.

The POINT OF ELECTION for pressure at the vertebral exits of the spinal nerves may be determined (if spasm or tenderness is absent) by noting the site of spasm of the spinal musculature (page 47), when an organ or tissue peripheral to the region of the spine is manipulated or by the development of an area of vertebral tenderness* (page 71) after such manipulation.

The *conductivity of a nerve* may be temporarily diminished

*The area of vertebral tenderness is often more conspicuous on the side of the spinal column *opposite* to the source of cutaneous irritation and this fact must be taken into consideration in employing our therapeutic manœuvres. The foregoing observation aids in solving the dubitable question concerning the propagation through the spinal cord of sensory impressions received by the skin; in all probability, the impressions after entering by the posterior horn ascend on the same side, whereas other impressions cross to the opposite side.

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or abolished by external pressure (familiar example of the limbs "going to sleep") without annihilating its physical integrity.

As remarked on a previous page (page 72), some writers associate the areas of paravertebral tenderness with the vaso-motor subcenters in the cord and claim that when the areas have become chronic, the paravertebral tissues are infiltrated and thickened. Here deep massage of the affected areas is indicated.

PSYCHROTHERAPY.

In the treatment of localized areas of vertebral tenderness, nothing in the experience of the author exceeds cold as a remedial measure. To attain any result, however, the skin overlying the area of tenderness must be distinctly whitened and frozen and this condition must be maintained for one or two minutes. Very often a single application suffices for the cure of a neuralgic affection but, in other instances, the process must be repeated on several successive days.

The author has never noted any bad effects from such radical freezing as a remedial measure. The hyperemia resulting may be assuaged by a simple dressing of zinc ointment on lint fixed to the part with adhesive plaster. Among the agents used for freezing are *rhigolene* and *ether* which are used in an atomizer and directed on the part to be frozen.

Recently the author has been unable to obtain rhigolene, hence ether was employed in its place. Other freezing agents are *ethyl chlorid Bengué* and *Kéléne*, which are sold in glass tubes and by holding one of the latter in the hand a fine jet is projected on the area to be frozen. The nozzle is held from 6 to 8 inches from the skin. The latter first becomes pink, then a deep red and finally white, like parchment. The latter degree must be reached and maintained for several minutes.

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The author has also used for freezing a preparation of *benzine* (freezes between 35 and 45 degrees C.), which is a cheap and efficient fluid for freezing. The odor of the latter, like ether, may be objectionable, but this may be corrected by the addition of some essential oil to either preparation.

Many preparations of ether on the market are quite inefficient, but if ethyl chlorid is first used until the skin is whitened, almost any preparation of ether will maintain the freezing *ad libitum*. Ethyl chlorid or Kéléne are too expensive if used extensively, hence, in the absence of a reliable ether preparation for freezing, first freeze with ethyl chlorid or Kéléne and then maintain freezing with practically any preparation of ether.

The foregoing liquids are inflammable and should not be used near a light.

In an emergency, a piece of ice sprinkled with fine salt and held against the skin by means of a towel will freeze the part.

The author has had no personal experience with either liquid air or carbonic acid snow for freezing purposes and for information on this subject the writer is referred elsewhere.⁴³

In intractable pains due to lesions at the vertebral exits of the nerves, the author has had recourse to what he calls *reinforced freezing*. It consists of injecting sterilized water beneath the skin over the part to be frozen or directly into the tissue until an appreciable bulging is produced. If the freezing solution is now directed on the protuberant part, a lump of ice is formed under the skin or in the tissues. Respecting the rationale of congelation the author directs the reader elsewhere⁴² to his investigations on the subject. *Vide* page 187, concerning the use of freezing in spinal neuralgias.*

**Vide* page 367, concerning the employment of concussion for the relief of pain.

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THERMOTHERAPY.

This refers to heat as a therapeutic agent. Media having a temperature above that of the body are referred to as hot

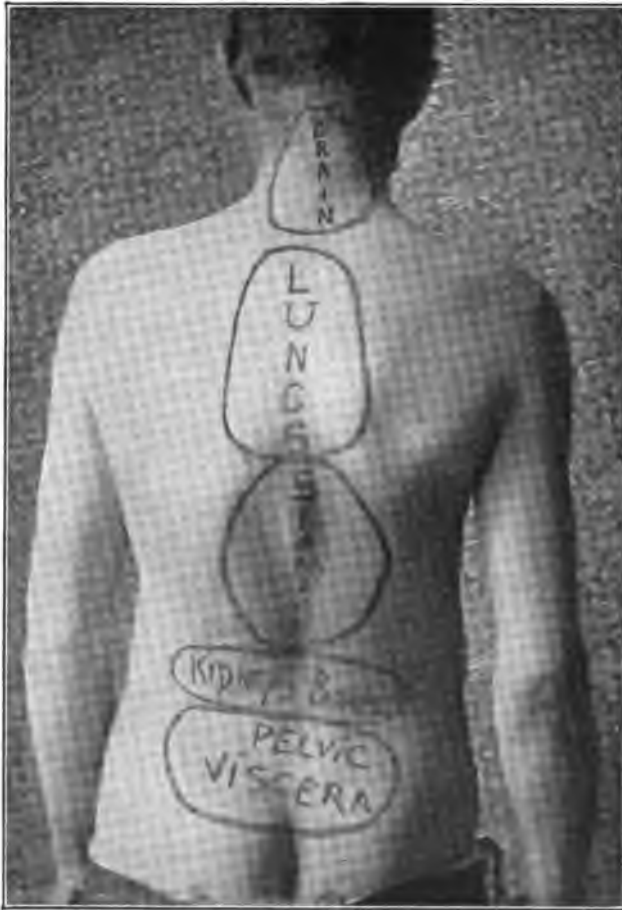


FIG. 49.—Cutaneous areas for influencing the viscera.

and as very hot, when the temperature exceeds 104 degrees F. (40 degrees C.).

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Respecting the physiologic effects of heat, it suffices to say, that a prolonged application of a high temperature is primarily an excitant, and secondarily, a depressant; a brief application, however, is strongly excitant and the depressing effects, if any, are imperceptible.

The viscera are influenced reflexly through cutaneous areas (Fig. 49) which have been definitely established and are of great clinical importance. As a rule, the cutaneous reflex areas overlie the individual viscera, but in the author's experience, the most pronounced effects are achieved by the application of heat (very hot water in small rubber bags) over the different vertebral regions; a brief application to secure stimulating effects and a prolonged application to achieve sedative action.

Von Bernd, by means of an apparatus which consists of a transformer, a high frequency current is obtained from the usual electric supply and which, when passed through the tissues, subjects the latter to any degree of heat which can be modified at will. With this apparatus the gonococci in an infected joint have been killed within one-half hour.

ELECTRO-THERMAL PADS of any size, attachable to an electric light socket, are now purchasable and supply a uniform source of heat. They are also made to contain material used for cataplasms, thus obviating the necessity of changing the latter to secure a constant supply of warmth.*

VIBRATORY MASSAGE (SISMOTHERAPY).

Vibra-massage or mechanic vibration has achieved some distinction as a remedial measure, but owing to its indiscriminate application without regard to physiologic principles, most of the results attained by its use must be attributed to

*Made by the F. R. Whittlesey Co., 591 66th Street, Oakland, Cal.

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suggestion. The author only seeks to discuss vibra-massage with reference to its spinal application, and it will be evident to the reader if he has given careful consideration to the vertebral reflexes (page 7), that the manipulation of definite vertebræ corresponds with the elicitation of definite reflexes but, if the vertebræ are promiscuously handled, counter-reflexes are evoked, which may often accentuate the reflexes in action and thus intensify the co-existing symptoms.

The foregoing sentence has been quoted several times throughout this book, but it is deserving of repetition.

In the therapeutic elicitation of the vertebral reflexes, the only kind of vibratory apparatus which is effective is one giving the PERCUSSION STROKE. All other motions, such as oscillations, shaking and friction, interfere with the results. In other words, it is *concussion* and not vibration which is effective.

Vibration is milder and of higher frequency than percussion.

The author has tested very many devices for vibra-massage and has been disappointed with the results. Thus there are many instruments which concuss, but in so doing, they also produce considerable friction, which is undesirable in prolonged séances with the apparatus.

When the author first employed vibra-massage with inadequate apparatus, the friction provoked in association with concussion, resulted in severe wounds over the spinous processes. Such accidents no longer occur in the author's experience, although the spinous processes may become tender owing to a mechanic periostitis which is of little or no consequence.

With an apparatus which does not cause friction, the concussors (Fig. 50) may be applied directly to the spinous process or processes and the application can be prolonged

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for several minutes at a time. In the event friction attends the use of the apparatus, one must interpose some medium between the concussor and the spinous process. Here a strip of linoleum is efficient and the treatment must be interrupted at once if the patient complains of a burning sensation.* The author's apparatus (Fig. 50) is essentially a

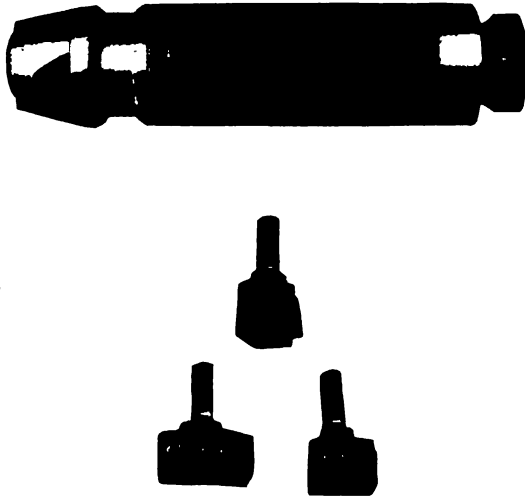


FIG. 50.—The author's pneumatic hammer with concussors.

pneumatic hammer giving a stroke of $1\frac{1}{4}$ inches and operated by compressed air. The force of the concussion-blow may be regulated by a stop-cock or by the pressure of the concussor on the spinous process. To start the action of the hammer it is often necessary to place the finger on the suction opening and then suddenly release it or strike the concussor forcibly with the hand. The absence of latch pins, springs or plugs avoids any waste of air and insures a steady working

*If a layer of rubber (1 cm. in thickness) covers the surface of the concussor, no heat is generated and there is no necessity for interposing a medium between the skin and the concussor.

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hammer. No vibration is transmitted to the operator's hand. Although quite heavy, it is easily manipulated, being suspended from the ceiling by means of a counter-weight. The concussors are of different sizes to include one, two, three or more spinous processes. The apparatus in question is only available when compressed air of considerable pressure can be obtained, but this is rarely objectionable inasmuch as all modern office buildings are equipped with air compressors.

Smaller pneumatic hammers are procurable, but they can only be regarded as mere toys for the elicitation of the vertebral reflexes.

An efficient percussion-stroke may be obtained from an electric apparatus (Fig. 51). It strikes from 3,500 to 5,000 blows per minute, and the force of the blow varies according to the pressure on the spine by the concussor in the vibrator from an imperceptible to the maximum blow. It is run with a $\frac{1}{2}$ H. P. and may be arranged for any kind of an electric current. The only objectionable feature is its price (about \$160).

If the physician cannot obtain an efficient apparatus, then a hammer and pleximeter (Fig. 2) may be used with fairly good results. In the excellent book⁴⁴ of Doctor M. L. H. Arnold Snow, the author specially cautions the reader to avoid the spinous processes in the application of vibration. In my opinion, this caution is absolutely unnecessary. Many times a day, for years, the author has concussed the spinous processes most unmercifully, yet he has never noted any untoward results. His experience in this regard, prompts him to side with those who hold that spinal concussion and cerebral commotion cannot give rise to the symptoms of a traumatic neurosis, for otherwise, many of his patients would have been the victims of "railway spine," inasmuch as they have been subjected to as much concussion as they would



FIG. 51.—Electric concussion-hammer.

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have experienced in several railroad accidents without suffering from any untoward results.*

It will be noted in the special chapters that vibra-massage is, in some instances, more efficient than the sinusoidal current for the elicitation of the vertebral reflexes. It may also be noted, that if treatment with either method is too prolonged, the spinal visceral reflexes become exhausted and a condition other than that sought for will result. Experience only will determine the time necessary for each treatment, although the relief of symptoms is a fair gauge for the duration of a séance.

Reference has been made on page 169 to the increase of temperature following massage of the spine, but in the opinion of the author, concussion with the pneumatic hammer is decidedly more efficient. Concussion of any of the spinous processes will elevate the temperature, but the best results are achieved when the spinous process of the 7th cervical vertebra is concussed. The two following cases of *myocarditis* are cited to show the effects of concussion on the spinous process of the 7th cervical vertebra:

CASE I.

Temperature before concussion.	97.2° F.
“ after “ for 4 minutes	98° F.
“ “ “ “ 8 “	98.8° F.

CASE II.

Temperature before concussion.	96.4° F.
“ after “ for 4 minutes.	98° F.

No such effects could be produced with the sinusoidal current.

*The fear of employing forcible concussion on the spinous processes and the use of inefficient apparatus are responsible for the inefficient results achieved by vibra-massage.

V i b r a t o r y M a s s a g e

The author does not believe that elevation of temperature following concussion of the 7th cervical vertebra is dependent on stimulation of a problematic thermogenic center, but to a stimulation of the heart (heart reflex).

In *fever*, the author has never succeeded in reducing the temperature by aid of concussion of any of the spinous processes, although his efforts have been many. The employment of concussion to induce analgesia is discussed on page 367.

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CHAPTER VI.

PSEUDO-VISCERAL DISEASES.

NEURALGIA—INTERCOSTAL NEURALGIA—DIFFERENTIAL DIAGNOSIS—
PSEUDO-APPENDICITIS—PSEUDO-CEREBRAL DISEASE—PSEUDO-AN-
GINA PECTORIS—PSEUDO-ARRHYTHMIA — PSEUDO-ESOPHAGISMUS
—PSEUDO-NEPHROLITHIASIS — PSEUDO-DYSPEPSIA — PSEUDO-
CHOLELITHIASIS—PSEUDO-MAMMARY NEOPLASMS.

EVERY physician owes a modicum of his success to the recognition and successful treatment of some special disease. In this respect, the author's talismanic affection is neuralgia of the spinal nerves with their bizarre and protean manifestations. The author may be pardoned for his apparent presumption when he asseverates that he feels justified in having written this book, if for no other reason than to direct the attention of the profession to recognize the greatest simulator of visceral diseases, viz., NEURALGIA OF THE SPINAL NERVES.

It very frequently happens that neuralgia of the spinal nerves may be accompanied by visceral symptoms of such prominence that the neuralgia is overlooked and unsuccessful treatment is directed toward the supposititious visceral disease. Such cases, while presenting varied clinical pictures, are frequently analogous, if only atypically so, to gastric, cardiac, renal, vesical and intestinal affections. The neuralgic paroxysms occurring in spinal diseases like tabes are manifested by symptoms occurring in organs like the stomach, intestine, bladder, etc. Here, like in neuralgias of the spinal nerves, we are dealing with lesions represented by nerve-root symptoms. Many pseudo-visceral diseases may be partially explained by the anastomosis existing between

Pseudo-Visceral Diseases

the spinal and sympathetic nerves (*vide* sympathetic sensations, page 57). *Neuralgia of the intercostal nerves* most frequently simulates visceral disease.

The upper group of the thoracic nerves is distributed entirely to the thoracic wall and the lower group (7th to 11th) is distributed partly to the thoracic and partly to the abdominal wall. It is the latter fact which often makes the recog-

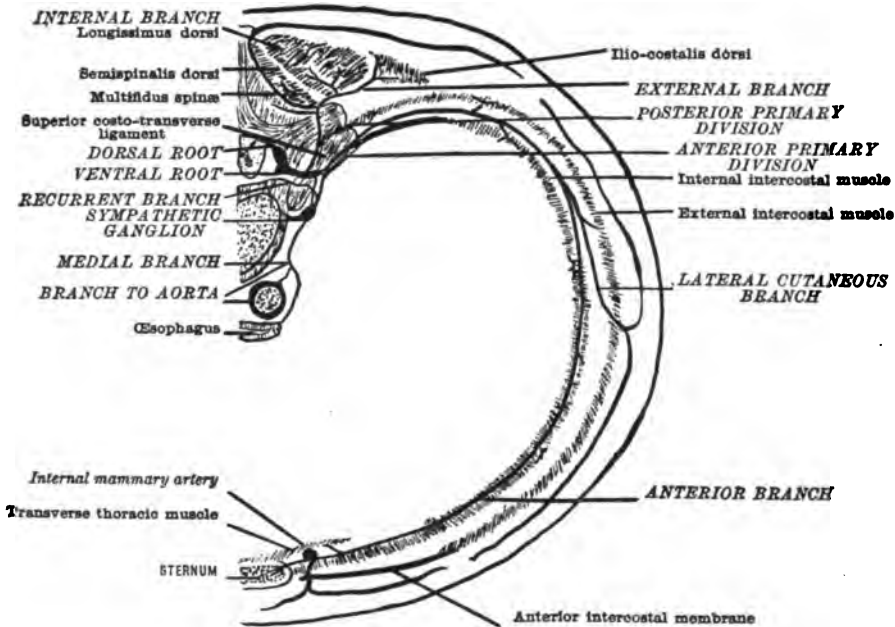


FIG. 52.—Diagram of the distribution of a typical thoracic nerve (Morris).

nition of intercostal neuralgia difficult, insomuch as the word intercostal (between the ribs), connotes an erroneous topography in the localization of pain. It is evident that in diseases affecting the nerve-trunks at or near their origin, the pain is referred to their peripheral terminations. Thus, in Pott's disease of the spine, the pain is referred to the belly, owing to the irritation of the nerve-trunks at their origin. In

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pneumonia or in pleural affections, the pain may be referred to the abdomen or the right iliac fossa and may suggest appendicitis. Here the lower thoraco-abdominal nerves are irritated owing to their juxtaposition to the pleura.

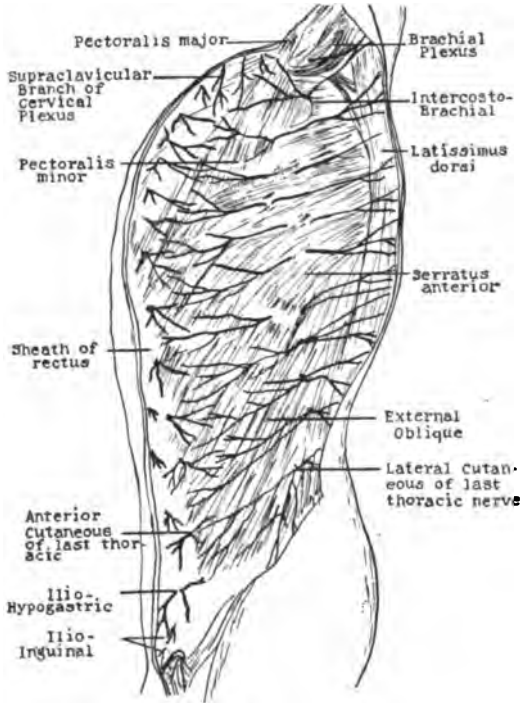


FIG. 53.—Cutaneous nerves of the thorax and abdomen viewed from the side (Morris, after Henle).

A typical thoracic nerve is shown in Fig. 52. In the posterior parts of the intercostal spaces, muscular branches are distributed to the levatores costarum and the nerves pass forward between the external and internal intercostals and divide into: 1. Lateral branches, which after penetrating the external intercostals near the mid-axillary line, divide into anterior and posterior branches. 2. Anterior branches, which at a short distance from the sternum give off terminal

N e u r a l g i a

branches. Fig. 53 shows the cutaneous nerves of the thorax and abdomen.

To properly appreciate this subject it will be necessary first to describe neuralgias in general and later intercostal neuralgia in particular.

NEURALGIA.

Neuralgia is usually a unilateral affection associated with paroxysmal pains and painful areas (*points douloureux*) on pressure at certain points in the course of the nerve where the latter passes through bones, muscles, or lies superficially. The painful areas are also present in the interparoxysmal periods.

Associated symptoms of neuralgia are: disturbances of sensation (hyperesthesia or anesthesia), vaso-motor symptoms, anemia or hyperemia of the skin and increase of the secretions, trophic disturbances and localized clonic spasm of the muscles.

The pains in neuralgia are usually localized to a single nerve, but at the height of the paroxysm the pains may radiate to other nerves.

MUSCULAR PAINS show diffused areas of tenderness in the muscles, are dependent on movement and are not paroxysmal.

Malaria has often been accused as an etiological factor in neuralgia because the pains are paroxysmal, but this is an erroneous supposition inasmuch as the pains of neuralgia, irrespective of cause, are paroxysmal.

Again, syphilis is accepted as a cause because the paroxysmal onset occurs at night. But this feature is common to many neuralgias. On the other hand, the absence of nocturnal exacerbations speaks against syphilis.

Among the more frequent etiologic factors of neuralgia are:

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1. Mechanic (pressure on nerve from growths, exudations, etc).
2. Thermic (chilling draughts, etc).
3. Toxic (drugs, infectious diseases and nutritive disturbances).

One must not forget that, whereas in the majority of instances intercostal neuralgia is primarily due to cold (with the lesion at the vertebral exit of the nerve), it may be secondary to vertebral disease, spinal meningitis and pressure from an aneurysm, tumor, etc.*

INTERCOSTAL NEURALGIA.

As before remarked, the diagnosis of this affection is not difficult when the middle intercostal nerves are involved; the difficulty arises when the lower group is involved, owing to the distribution of the nerves to the skin of the lateral and anterior abdominal wall.

In intercostal neuralgia three painful points are invariably found on pressure, viz., at the vertebral exit of the nerve, in the mid-axillary line and in the median line of the thoracic and abdominal walls. The point at the vertebral exit is most constant and the method for the elicitation of the pain or tenderness has already been described on page 66. Here a word of caution is necessary. Unless the muscles are relaxed the contracted muscular fibers over the areas of tenderness will prevent elicitation of pain upon pressure.

Presuming the patient suffers from pain dependent on a lesion of the spinal nerve, our primary endeavor is to locate the vertebral point of tenderness. Insomuch as several points of tenderness may be elicited, we proceed to locate

*In neuralgia and neuritis of the intercostal nerves, pain is frequently accentuated when the patients lean far forward. The stooping attitude in corpulent persons may cause intercostal pains (pressure of the ribs on the nerves or traction), and in such instances cure may be achieved by instructing the patients to assume the erect posture.

Intercostal Neuralgia

the point first from above and, when the sensitive area is reached, it is marked with a dermatograph (skin-pencil). Next we locate the sensitive area from below and, when the latter is reached, it is also marked. It is wise to compare the sensitiveness on both sides of the spine although, as a rule, the neuralgia is unilateral.

The author makes exclusive use of freezing (page 172) for diagnostic and therapeutic purposes. The area to be frozen in neuralgia of a spinal nerve or nerves is that included between the two pencil marks just referred to.

It will be noted that if the mid-axillary and sternal points of tenderness are marked with a pencil and freezing is executed at the vertebral point, the other points of tenderness disappear, or will be, at least, less sensitive after a single freezing.

This latter test is diagnostic of neuralgia of any of the spinal nerves. Several freezings, however, may be necessary before the neuralgia is cured.

In practically every case the author ever saw, when a diagnosis of neuralgia of a spinal nerve was made, the attending physician had applied his counterirritant at the site of the pain, *i. e.*, at the peripheral distribution of the nerve and not as he should have done near the site of the lesion, *viz.*, the vertebral exit of the affected nerve.

If the negative pole of a Galvanic current is fixed at an indifferent spot, and the positive pole is placed successively over the other sensitive points, neuralgic pain is likewise inhibited, but this method cannot compare in accuracy nor in rapidity with the freezing method.

The author has often utilized the following method in the absence of a freezing apparatus; firm pressure is made with the thumb and maintained for several minutes at the vertebral area of tenderness. At first, the pains are accen-

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tuated, but later they are mitigated or disappear. The method cited is used in an emergency and is decidedly less radical than freezing. Reference has been made to it on page 171.

It may happen, and indeed it often does, inasmuch as cold is the common etiologic factor of neuralgia and muscular rheumatism, that both affections coexist. Here Faradism temporarily inhibits the pain of rheumatism, leaving the pain from other causes uninfluenced. Again, Faradism will accentuate the painful areas of muscular rheumatism.

Congelation (freezing) may be employed as a means of diagnosis for the following purposes:

- A. To diagnose neuralgia of central from one of peripheral origin.
- B. To differentiate neuralgia from neuritis.
- C. To localize the lesion in neuralgia.

A. If a nerve the seat of neuralgia is frozen nearest its point of origin, the pain will disappear if the neuralgia is of peripheral origin and it will persist if of central origin. In the absence of spontaneous pain the painful points in the course of the nerve-distribution may serve as guides.

B. Freezing is a specific for all forms of uncomplicated neuralgia, provided it can be executed near the point of origin of the involved nerve, *i. e.*, close to the site of the lesion. If, however, the pain is central in origin or due to a neuritis, the pain, as a rule, will not be inhibited. Many years ago I suggested freezing for the pains associated with herpes zoster. In some instances it was marvelously efficient, but in the majority of cases, no relief followed. Here the pain was of central origin, due presumably to disease of the intervertebral ganglion.

C. The following cases illustrate the employment of freezing for localizing pain:

I n t e r c o s t a l N e u r a l g i a

Case I. Male. In a row received many cuts on the scalp. Various cicatrices resulted. He suffered from ill-defined neuralgia located in the scalp. All cicatrices were equally sensitive to pressure. Freezing was conducted at the exit of the occipital nerves in the neck without effect. Then the individual scars were successively frozen during a paroxysm. Pain continued until one cicatrix in the occipital region was frozen, when the pain ceased at once. Excision of the latter cicatrix resulted in cure.

Case II. Case of occipital neuralgia. Usual painful points. Freezing conducted during a painful paroxysm. When freezing was made over a particular sensitive point the pain ceased. Palpation at this point demonstrated the presence of a little growth. Cure after removal of a small neuroma.

Case III. Neuralgia of the trigeminus (prosopalgia). Freezing during a painful paroxysm at the supra-orbital foramen, infra-orbital foramen and mental foramen respectively. Relief from the pain when congelation was conducted at the latter point. Examination of the teeth of the lower jaw showed the presence of a carious tooth, which, when extracted, was followed by a cure.

DIFFERENTIAL DIAGNOSIS.

Visceral diseases are frequently confounded with intercostal neuralgia. Here, as a rule, we find only a vertebral area of tenderness, whereas the mid-axillary and sternal points of tenderness are absent. Again, freezing at the vertebral area of tenderness is not followed by any relief of the pain. In visceral disease simulating intercostal neuralgia, one may demonstrate dermatomes (page 58) which, like the vertebral tenderness, become accentuated after palpation of special organs. Supposing, for example, one finds a

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sensitive area over the stomach. If pressure sufficiently great is made at this point to induce pain, the area of vertebral tenderness in my experience, becomes accentuated and the dermatomes are more easily demonstrated.

In localizing the latter, however, one must not forget that hyperesthetic zones may also be demonstrated in neuralgia.

As a rule, in visceral disease, vertebral tenderness may be demonstrated on both sides of the spinal column, whereas, in intercostal neuralgia, the sensitiveness is unilateral. Bilateral sensitiveness in the latter affection suggests an *intravertebral lesion*.

Whereas, in intercostal neuralgia, pressure on the area of vertebral tenderness may reproduce the pains from which the patient suffers, in vertebral tenderness of visceral origin, like pressure may reproduce other symptoms. Thus arrhythmia may be reproduced or accentuated when the area of vertebral tenderness is firmly compressed. Similarly, in gastric disease, pressure on the sensitive vertebral area may cause eructations of gas and other symptoms suggestive of a gastric anomaly.

The aphonia and dysphonia of LARYNGITIS (acute) may be differentiated from like symptoms due to other laryngeal affections by the following simple method: First, mark with a pencil on either side of the neck the approximate point in the thyro-hyoid membrane where the internal laryngeal branch of the superior laryngeal, the nerve of sensation to the larynx, passes into the latter organ. Next, thoroughly freeze the points marked with the pencil. Relief is, as a rule, almost instantaneous and is of signal advantage to many professionals. In some instances, the restoration of the voice is of only short duration and freezing may have to be repeated several times.

The author desires to illustrate by the citation of a few

P s e u d o - A p p e n d i c i t i s

cases what he intends to convey by the phrase, pseudovisceral disease. In this respect he will be brief, for in this epoch of therapeutic skepticism, one dare not report phenomenal cures without being accused of extravagant representation, misinterpretation or, if the calumniator is charitable, of auto-suggestion.

PSEUDO-APPENDICITIS.

LUMBO-ABDOMINAL NEURALGIA which involves the six branches of the lumbar plexus is frequently mistaken for appendicitis. The author has observed many patients who had even contemplated an operation for the relief of their pain, but who were cured after one or several freezings at the vertebral exits of the sensitive nerves. One patient in particular is recalled who was seen in consultation, and who, despite the protests of the author, had his appendix removed. After the operation the persistent pains of a lumbo-abdominal neuralgia were cured by several freezings.

These cases are not difficult to diagnose. Painful areas are located near the lumbar portion of the vertebral column, in the center of the iliac crests, over the symphysis in the hypogastric region, at the scrotum in the male and at the labium majus in the female.

Pain in these patients is also felt on the anterior surface of the thigh corresponding to the area of distribution of the lumbo-inguinal nerve.

Difficulty in diagnosis in these cases is often hampered by the fact that there is a circumscribed tonic spasm of the abdominal muscles in the ileocecal region which may be mistaken for a deep-seated intumescence.

We have long recognized the almost intelligent function of muscles whether displayed in fixing a diseased joint or spine, or in protecting an inflamed serous membrane. The fact is, that in spinal neuralgias, *spasm of the muscles* can almost

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invariably be demonstrated and it is a nerve-root symptom. When the lesion, as in neuritis, is destructive rather than irritative, muscular atrophy and not spasm is the concomitant sign.

One would naturally conclude that a skilled diagnostician could not possibly err in mistaking a lumbo-abdominal neuralgia for appendicitis. In Paris, the author recently saw an American lady who was suffering from atrocious pains in the ileocecal region. She consulted some of the leading surgical and medical clinicians of Europe. All were unanimous in their conviction that she had appendicitis, and that an immediate operation was imperative and the only means of arresting the pains. An examination demonstrated the spasm of the abdominal muscles in the neighborhood of the appendix, which, at one point, was so circumscribed as to awaken the suspicion of a tumor. A point over the appendix was exquisitely tender. There were the usual tender points elsewhere in the gluteal region, on the outside of the thigh, symphysis pubis and at the vertebral exits of the involved nerves. A single freezing gave immediate relief, although about ten freezings were necessary to effect a permanent cure. These patients often suffer a relapse, especially in inclement weather, but a single freezing suffices to cure. My only excuse for citing the latter case is to illustrate the frequency of pseudovisceral affections which are often erroneously interpreted by some of the best men in the profession. Verily, if the surgeon were a better diagnostician there would be less surgery.

PSEUDO-CEREBRAL DISEASE.

When a neuralgia implicates respectively the four superior cervical nerves, it is referred to as cervico-occipital neuralgia and the four inferior cervical nerves, as a cervico-brachial

P s e u d o - M a s t o i d i t i s

neuralgia. In the former neuralgia, the major occipital nerve is most frequently involved and the pain is located in the neck and radiates along the occipital region as far forward as the eyes. There is practically always a spasm of the cervical muscles which interferes with the elicitation of pain upon deep pressure at the vertebral exits of the implicated nerve or nerves. Not infrequently, branches of the brachial plexus are similarly involved and the pains radiate down the arms. In cervico-occipital neuralgia, localized areas of sensitiveness may be detected notably at the external occipital protuberance and at the tip of the mastoid process. The latter point of sensitiveness has, in my experience, often been mistaken for a *mastoiditis* by enthusiastic aurists, yet a single freezing at the vertebral exits of the involved nerves will determine the nature of such forms of PSEUDO-MASTOIDITIS. Pseudo-mastoiditis is frequently mistaken for the true form of the disease if a discharge from the ear (otorrhea) is present.

When the pathologist makes an autopsy he records the many pathological conditions as anatomic diagnoses. The clinician should be similarly guided, but, unfortunately, he too often errs in tracing a connection between varying symptoms in his effort to include them all in a single diagnosis. Co-existing symptoms may be the expression of not only one but of several distinct diseases. The following case will amply illustrate the author's meaning: A gentleman having fallen from a ladder sustained an injury of the spinal column which resulted in a kyphotic deformity. Several weeks later he developed atrocious pains in his right leg which several orthopedists attributed to the original injury. Examination of the patient in question demonstrated a *sciatica* which had absolutely no connection with the primary traumatism and after several freezings over the region of

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the nerve, the pains subsided completely and have ceased to reappear after several years, notwithstanding the persistence of the spinal deformity.

About four years ago one of my tabetics returned from Europe suffering from severe pains in the head which several specialists had told him were dependent on a cerebral lesion. The pains resisted conventional treatment. Examination of the patient, who returned to San Francisco in despair and without relief, demonstrated the presence of a cervico-occipital neuralgia. The localized areas of sensitiveness on his scalp disappeared after a single freezing at the vertebral exits of the involved cervical nerves and cure resulted after a thorough repetition of the procedure.

A lady with pains in the left half of the abdomen consulted several gynecologists, all of whom discovered a prolapsed ovary and suggested its removal. The pains due to a lumbo-abdominal neuralgia continued after the operation and were cured after several freezings at the exits of the involved nerves.

PSEUDO-ANGINA PECTORIS

An intercostal neuralgia is frequently misinterpreted for angina pectoris. In the latter affection pains radiate to the neck and arm. The investigations of Head and Mackenzie show the following:

1. In cardiac and aortic disease, the pain is referred along the 1st, 2nd and 3rd dorsal nerves.
2. In angina pectoris, the pain in addition may be referred from the 5th to the 9th dorsal nerves.

The forms of anginal pains referred to in this connection are not concerned with functional angina pectoris observed in neuroses, but are distinctly traceable to a neuralgia of the intercostal nerves.

P s e u d o - A r r h y t h m i a

About fifteen years ago an elderly individual was referred to me by an Eastern physician with a diagnosis of angina pectoris. Several prominent clinicians had made a similar diagnosis. Like in true angina, the common exciting factor in provoking a paroxysm of pain in this patient was exposure to cold. Despite the concomitant symptoms which suggested the correctness of the diagnosis, the patient was examined for the signs of intercostal neuralgia which could easily be demonstrated. A few freezings at the vertebral exits of the involved nerves sufficed to rid the patient of his pains which, up to the time of writing, have not recurred.

PSEUDO-ARRHYTHMIA.

An irregular heart may be clinically manifested as an intermission when one or more beats of the heart are dropped, or, as an irregularity, when the beats show inequality in volume and force. The causal classification of Baumgarten is as follows :

1. Organic cerebral affections.
2. Reflex from visceral diseases.
3. Toxic, from tobacco, coffee, tea and from drugs like digitalis, belladonna and aconite.
4. Changes in the heart.

Arrhythmia may exist for a long period without symptoms. It is usually in connection with other cardiac signs that its presence is noted. Associated with myocardial or valvular lesions it is ominous, but as a permanent condition, secondary to mental influences, it is usually without significance. Irregularity of the heart-rhythm may give no expression in the pulse. The purely neurogenic type of irregularity observed in healthy children and young adults is due to overaction of the vagus. When the latter is paralyzed by atropin (grain 1-120 to 1-60), the pulse becomes

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regular. Heart intermittency is differentiated from simple irregularity, by the fact, that, in resumption of the cardiac contractions they are regular from the beginning.

The author has demonstrated that, in the norm during the time the pulse is palpated, firm pressure made at the exit of the spinal nerves (preferably at the sides of the upper dorsal vertebræ), will result in decided alteration in the character of the pulse which often amounts to inhibition of the latter. In a few instances a decided arrhythmia may be observed.

The observations of the author have taught him that a neuralgia of the upper intercostal nerves is not an infrequent etiologic factor in arrhythmia notwithstanding the fact that, this cause is unrecognized in the text-books.

In intercostal neuralgia associated with arrhythmia, pressure on the sensitive areas corresponding to the exits of the involved nerves will accentuate the condition, and, if absent, will provoke it.

In such instances of arrhythmia, a single freezing at the vertebral exits of the involved nerves will often arrest the trouble at once. Arrhythmia may also exist as a result of a nerve-root lesion of the upper group of dorsal nerves without any symptoms of intercostal pains.

PSEUDO-ESOPHAGISMUS.

The following case, selected from many cases of a similar nature, is interesting as a paradigm of this condition. The patient, a female, has suffered for months in consequence of painful deglutition and is very much emaciated in consequence of her difficulty in swallowing not only solid foods, but liquids. An examination was negative beyond pain on pressure in the cervical region with sensitive cervical vertebræ on percussion. There were no symptoms of hysteria. The

Pseudo-Visceral Diseases

dysphagia disappeared completely after three applications of the freezing-spray to the region of the sensitive cervical nerves.

PSEUDO-NEPHROLITHIASIS.

The patient, a physician, had suffered for many years from pains in the lumbar region on the right side occurring in paroxysms and simulating the pain of renal colic. An exploratory incision down to the kidney was made by an eminent surgeon of Philadelphia, and nothing was found. When the patient came to me his pain still persisted. The first and second lumbar vertebræ were sensitive to percussion and areas of vertebral sensitiveness were located to the right of the spinal column. Successive freezings of the paravertebral area of sensitiveness checked the painful paroxysms completely.

PSEUDO-DYSPEPSIA.

There are many cases which I have denominated *fictitious dyspepsia*, which are comparatively frequent and are associated with involvement of the spinal nerves. The patients may exhibit all the symptoms of dyspepsia, yet the presence of the painful areas of sensitiveness of an intercostal neuralgia are demonstrable. These cases, like the others, yield to freezing.

PSEUDO-CHOLELITHIASIS.

About several months ago several surgeons had made the diagnosis of gall-stones in an adult male, who for several years had suffered from paroxysmal pains in the region of the gall-bladder. Before submitting to an operation he decided to consult three medical clinicians. We also concurred in the diagnosis. The author was reluctant to question the diagnosis for the reason that the severe paroxysms of pain necessitated the use of morphine. When pain is severe

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enough to necessitate an analgesic so powerful as morphine (in the author's experience) intercostal neuralgia can be excluded. On the following day, the patient in question was re-examined and the areas of sensitiveness peculiar to intercostal neuralgia could be demonstrated. About ten freezings over the vertebral exits of the implicated nerves sufficed to completely rid the patient of his paroxysms of pain. In fact, after the first freezing, the painful area located near the gall-bladder was no longer sensitive to pressure.

The author has seen a number of such cases and one case in particular is recalled, where jaundice accompanied the painful paroxysms. The jaundice in the latter case could be explained by the fact that respirations on the affected side were limited. It is well-known that the bile is secreted under very low pressure and that the diaphragm in contracting, subjects the liver to pressure which is an active factor in forcing the bile from the smaller to the larger biliary ducts. Interference with the movements of the diaphragm is likely to cause icterus of resorption.

PSEUDO-MAMMARY NEOPLASMS.

As before remarked, neuralgia of the intercostal nerves is associated with a circumscribed tonic spasm of muscle and, if the neuralgia involves the nerves in juxtaposition to the mamma, the pain and intumescence suggest a neoplasm. In such instances, an error is unavoidable, unless the physician recalls the fact, that *mastodynia* may be a variety of intercostal neuralgia.

T h e H e a r t R e f l e x

CHAPTER VII.

THE CIRCULATORY SYSTEM.

THE HEART REFLEX—CARDIAC SUFFICIENCY—DIFFERENTIAL TABLE OF ASTHMA—TESTS FOR HEART-SUFFICIENCY—ANGINA PECTORIS—THE HEART REFLEX OF DILATATION—DIFFERENTIAL TABLE OF TRUE AND FALSE ANGINA—FUNCTIONAL AFFECTIONS OF THE HEART—INHIBITION OF THE HEART—PHYSIOLOGY AND PATHOLOGY OF THE BLOOD-VESSELS—BLOOD-PRESSURE—VASO-MOTOR FACTOR IN BLOOD-PRESSURE—SPHYGMOMANOMETRY—HYPERTENSION AND HYPOTENSION—THE AORTIC REFLEXES—ANEURYSM OF THE THORACIC AORTA—THE VASO-MOTOR APPARATUS—VASO-MOTOR NEUROSES.

THE HEART REFLEX.

ATTENTION was first directed in 1898 to the phenomenon⁵² now known as the heart reflex of Abrams. The reflex in question is a contraction of the myocardium of varying duration, which results when the skin of the precordial region is irritated. The cutaneous irritant may be a spray of ether directed over the region of the heart, or the skin may be rubbed with a blunt instrument, or by means of an ordinary pencil eraser, or by a series of percussion blows. The nearer the irritant is applied to the precordial region and the more vigorous the cutaneous friction, other things being equal, the more pronounced is the heart reflex. The reflex is best observed with the Roentgen rays with the fluorescent screen approximating the anterior chest-wall. The reflex is, as a rule, more manifest in the left than in the right ventricle, and the contraction of the myocardium is not always sudden and of momentary duration; on the contrary, its duration in children, on whom most of the original observations were made, is not less, as a rule, than

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two minutes, and, furthermore, the myocardial recession continues even after the source of cutaneous irritation is removed. The degree of myocardial recession (heart reflex) varies greatly. In some persons it is scarcely perceptible, while in other individuals the heart may recede more than 2 cm. on either side upon the first application of the cutaneous irritant (Fig. 54).

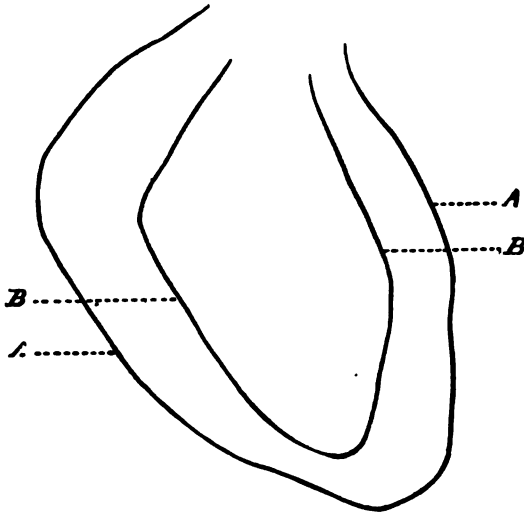


FIG. 54.—Heart reflex in a boy, aged eight years. Duration of reflex two and a half minutes. The normal outline of the heart drawn on the fluoroscope is represented by A, whereas B represents the outline of the heart after cutaneous irritation and shows the degree of myocardial recession of the heart reflex.

In other instances, although the reflex is practically never absent in the norm, it is strictly confined to the left ventricle, as shown in Fig. 55.

In individuals with dilated hearts the reflex is very evident and is of much longer duration than in healthy hearts. This latter observation, as we shall learn presently, has been confirmed by the careful observations of Merklen and Heitz.

In the original communications concerning the heart

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reflex, the latter was only observed in the transverse cardiac diameter, but with the x-rays it can also be seen in the sagittal diameter. Subsequent observations demonstrated that the heart reflex could be elicited by irritation of more remote regions, viz.:

1. Irritation of the nasal mucosa.
2. Irritation of the gastric mucous membrane.
3. Irritation of the rectal mucosa.
4. By irritation of the esophageal mucosa in the act of swallowing.
5. By percussion of the muscles.
6. By psychic influences.
7. By vertebral concussion.



FIG. 55.—Heart reflex in a boy, aged fourteen years. Duration of reflex, fifteen seconds. A represents the cardiac outline before, and B after, cutaneous irritation, while C represents the upper border of the liver.

IRRITATION OF MUCOUS MEMBRANES.—Here investigations were conducted during the time the x-rays were traversing the chest, and by means of the fluoroscope the heart was directly observed. It was noted that, when irritating vapors were inhaled there was a decided recession of the cardiac ventricles (heart reflex), especially the left, and that this heart reflex was more pronounced than when

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excited through the skin of the precordium. Ether and chloroform inhalations also excite the reflex and in a few instances, these vapors produced a veritable cardiac inhibition. It was noted that, the reflex in question was excited by irritation in succession of the nasal, pharyngeal and laryngeal mucous membranes, and when the latter were made anesthetic by cocain, no heart reflex could be elicited.

The accompanying sphygmogram (Fig. 56) shows a decided difference in the output into the general circulation before and after the inhalation of ammonia.

The heart reflex may also be elicited by irritation of the gastric mucosa when the sponge of the gyromele is made to



FIG. 56.—Sphygmogram of the radial artery; A before, and B after, the inhalation of ammonia.

revolve against the membrane in question. One may also excite the reflex by irritation of the rectal mucosa by means of the finger in the rectum.

PERCUSSION OF THE MUSCLES.—If one percusses the muscles (*tapotement*) of the extremities, one can elicit the cardiac reflex. The latter is essentially a reflex of muscular origin exclusively, as such a reaction does not follow irritation of the skin of the extremities or percussion of the bones. Percussion of the muscles of one arm usually suffices to elicit this reflex. Another curious feature of this *myopathic heart reflex* is, that it causes contraction of the right ventricle of the heart only, the left being uninfluenced. Placing the subject before the x-rays, this reflex is at once evident. After the borders of the heart are defined, request an assistant

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to percuss the muscles of one arm by means of a percussion-hammer. Following the manœuvre the right ventricle shows considerable retraction. The effect on the systemic blood-pressure by percussion of the muscles is very slight, and this is obvious, considering that the left heart-ventricle is uninfluenced by the manœuvre.

PSYCHIC INFLUENCES.—We have always recognized the influence of emotions on the heart, but no tangible evidence of such effects has been demonstrated. The epigram of Peter is worth repetition: "The physical heart is the counterpart of a moral heart." The conventional expression of the frightened individual, "My heart was in my mouth," finds justification by an x-ray study of the organ. Inform the patient standing before the x-rays, that you are going to burn him with a hot iron or frighten him in some other way, and the effect on the heart is at once manifested. It is a veritable *psychic heart reflex* implicating the entire organ. The heart becomes very much reduced in size, and appears as if it were retreating towards the neck. I know of no irritation, cutaneous or otherwise, that is so pronounced as this psychic factor of fright in inducing the heart reflex. The foregoing fact is of the utmost importance in eliminating emotional influences in the treatment of cardiac diseases. Even in an ordinary x-ray examination of the heart, one may observe in nervous patients a reduction of the heart-mass. Mr. Bezley Thorne⁶³ observed that the heart shrank after exposure to the Roentgen rays. It is evident that the shrinkage thus observed, was naught else but a cardiac reaction (heart reflex) to emotional influences, for an x-ray examination to the average patient is a momentous procedure.

The author has frequently witnessed the pulmonary reaction of fright; the lungs became hyperresonant on percussion and the superficial areas of cardiac, hepatic and

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splenic dullness became diminished, a condition which the author has called the *psychic lung reflex of dilatation*. The latter psychic reflex may be easily demonstrated, if the areas of the organs in question are first outlined, and later, if the patient is frightened, percussion will demonstrate that the areas of the organ are reduced in proportion to the psychic reaction which provokes a dilatation of the lungs.

VERTEBRAL CONCUSSION.—Perhaps the most effective method of provoking the heart reflex is by means of concussion of the spinous process of the 7th cervical vertebra. It will be noted that this refers to the heart reflex of contraction, for there is still another heart reflex which is to be described presently, known as the heart reflex of dilatation.

PRACTICAL VALUE OF THE HEART REFLEX.—Percussion of heart, or, for that matter, any other organ adjacent to the lung, is associated with many errors unless one takes into consideration the *lung reflex*.

Percussion of the heart, as executed ordinarily, yields an absolute or superficial, and a deep or relative dullness. Practically little or no value can be attached to the superficial dullness in estimating the size of the heart, as it varies with the position of the overlapping lung-borders. Even the lightest percussion blow will provoke sufficient cutaneous irritation to induce the lung reflex of dilatation, *i.e.*, an acute dilatation of the lungs which may diminish the area of superficial cardiac dullness, even to obliteration. Cabot,⁵⁴ in his classical book, makes the following observation: "Anyone who has demonstrated an area of percussion dullness to many students in succession must have noticed occasionally that the more we percuss the dull area the more resonant it becomes, so that those who last listen to the demonstration, the difference which we wish to bring out is much less obvious than to those who heard the earliest percussion

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strokes. Abrams has referred to this fact under the name of the '*lung reflex.*'" Sahli, in his "Diagnostic Methods," refers to the same fact. The mere influence of room temperature materially changes the results of percussion. Let any one, after percussing the areas of superficial dullness, direct a current of cold air, *e.g.*, from an atomizer, over the regions percussed, and the result will be diminution or obliteration of the areas in question. It is evident from what has preceded that, while the heart reflex can always be determined by the x-rays, after cutaneous irritation of the precordium, mere percussion of the superficial area of cardiac dullness cannot determine its existence because the irritation necessary to evoke the heart reflex will also induce the lung reflex, which must necessarily mask the heart reflex.

Thus the observations of Schott and others, who seek to demonstrate the effects of carbonated baths on the heart by percussion of the latter organ are evidently erroneous unless such percussion takes into consideration only the deep or relative cardiac dullness. Heitler⁵⁶ perpetrates the same error by failing to take into consideration the coincident lung reflex when making cutaneous irritation. Heitler seeks to determine the sufficiency of the heart muscle by a series of percussion blows over the heart region. If, thereafter, the cardiac dullness is much diminished, it is an evidence, he argues, that the cardiac musculature is sufficient, for the tendency of the normal muscle tonus of the heart is to maintain a limited patch of dullness. As before remarked, the heart reflex can be observed directly with the rays, but if strong percussion is employed so that reliance is alone placed on the deep or relative cardiac dullness, the reflex in question may be determined by percussion. Heitz,⁵⁷ in discussing "*Le Reflexe Cardiaque d'Abrams,*" observes that, while in the normal subject the heart reflex is of short dura-

tion, in cardiectasis it may persist for several hours. In the third edition of their valuable book ("Examen et Séméiotique du Cœur"), Merklen and Heitz show graphically the effects

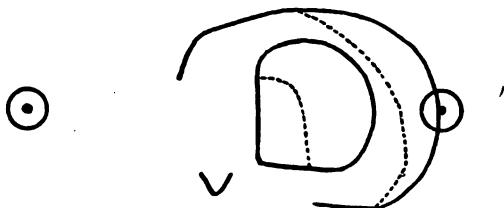


FIG. 57.—Cardiac reflex in a neurasthenic with functional troubles of the heart; reduction of the absolute and relative dullness. (After Merklen and Heitz).

of friction of the skin in the region of the heart of a cardiac neurasthenic (Fig. 57), and in a cardiopath with hyposystolie (Fig. 58).

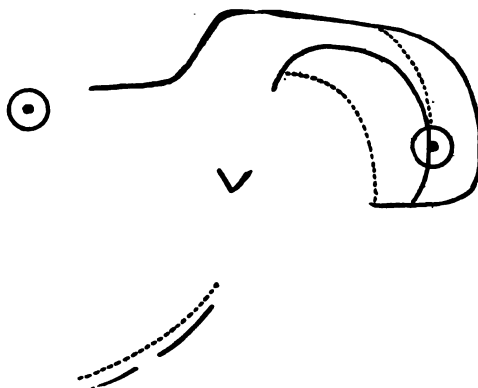


FIG. 58.—Hyposystolie in an arteriosclerotic; reduction of the absolute and relative cardiac dullness and ascension of the inferior border of the liver under the influence of precordial massage. (After Merklen and Heitz).

In Fig. 58 the reduction of the hepatic dullness is shown following the friction of the skin; the continuous lines show the superficial and the deep dullness of the heart before, and the interrupted lines the reduction of the areas after friction of the skin.

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All physicians do not possess equal skill in determining the relative cardiac dullness, and I have devised a simple apparatus called the "Vibrosuppressor," which serves to simplify topographical percussion (page 80).

The Heart Reflex of Nasal Genesis.—Reference has already been made to the fact that the heart reflex can be provoked by irritation of the nasal, pharyngeal, and laryngeal mucous membranes, and that if the irritation is sufficiently prolonged and violent the movements of the heart may be inhibited. If the membranes in question have been previously cocainized the heart reflex cannot be elicited. It is evident, then, that previous cocainization of the nasal and pharyngeal mucous membranes should precede the employment of an anesthetic. On theoretical grounds, the laryngeal mucosa should not be cocainized, as it is necessary to preserve the laryngeal reflex to prevent the entrance of foreign substances into the larynx.

The Heart Reflex of Gastric Genesis.—Knowing that irritation of the gastric mucosa will provoke the heart reflex, it is not improbable that sudden death of gastric origin may be caused by reflex inhibition of the heart. In instances of this kind the fact of a dilated stomach directly compressing the heart cannot be ignored. I have studied, by aid of the x-rays and the fluoroscope, the action of a dilated stomach on the heart by artificial distension of the stomach. The healthy heart can tolerate considerable compression and dislocation without modifying the intensity of the heart tones, but when the organ is diseased, the slightest compression and dislocation is followed by evil consequences. Artificial insufflation of the colon will also compress and dislocate the heart, but never in the same degree as will insufflation of the stomach (Fig. 33).

The Heart Reflex of Rectal Origin.—Irritation of the

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rectal mucosa will also induce the heart reflex. Straining at stool in elderly people by increasing intraabdominal pressure, and thus putting a strain on the cerebral vessels, predisposes to rupture of the latter. Straining, however, is not wholly a question of pressure. Some patients, particularly those with weak hearts, suffer from collapse symptoms while straining at stool. In investigating the cause of such symptoms, I found that contraction of the abdominal musculature will cause even in the norm a veritable weak heart reflex with diminished output of blood from the left ventricle. For the latter reason the amount of blood is decreased in the arterial system and

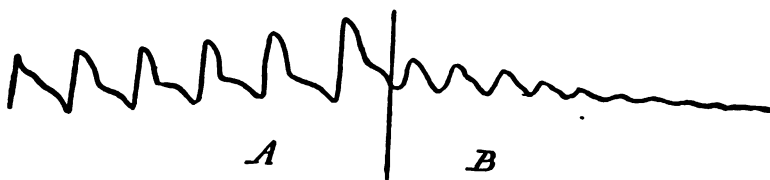


FIG. 59.—Sphygmogram (A) before and (B) while straining at stool.

increased in the veins. The accompanying sphygmogram (Fig. 59) illustrates the effects of contraction of the abdominal musculature on the heart.

It is evident that if the heart is enfeebled the effects of such cardiac inhibition may be attended with serious results. It is well known that different nerves from the abdomen and intestine are in close communication with the cardioinhibitory center in the medulla and that reflex inhibition of the heart can be easily produced in the frog by tapping a loop of the intestine with the handle of a scalpel. Severe abdominal affections, like peritonitis and appendicitis, are frequently attended with symptoms of heart collapse, owing, no doubt, to reflex inhibition of the heart.

Anyone can appreciate the inhibitory influence on the

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heart if the radial pulse is palpated during contraction of the abdominal muscles while straining at stool.

Relative Valvular Insufficiency.—The normal heart can easily adapt itself to the average grades of dilatation such as occur during exertion; in fact, the size of the cavities of the heart varies even in health, and a dilatation is physiologic as long as the heart cavity is capable of emptying its content during systole. What is called “getting wind” in climbing a mountain or in athletic training is practically a moderate dilatation of the cavities of the right heart. In relative valvular insufficiency the valves are normal, but they are no longer capable of completely closing the orifices of the heart. This condition is frequent after heart strain and involves particularly the tricuspid valves. A murmur which is heard in such instances may be made to disappear temporarily by inducing the heart reflex, which, by causing myocardial contraction, reduces the size of the cardiac orifices, thus enabling the valves to close the openings. Here the excitant of the heart reflex must be vigorous and for this purpose the sinusoidal current, with both electrodes to the precordial region, is most efficacious. Percussion of the precordial region with a percussion hammer will often suffice.

Pericardial Effusion.—The differential diagnosis between a dilated heart and a pericardial effusion is often conceded to be a difficult clinical problem. From what has preceded the heart reflex can be employed in diagnosis. The reflex in question is absent in pericardial effusions and present in cardiectasis. In other words, after the heart reflex is provoked the area of deep cardiac dullness will be uninfluenced in effusions but modified in cardiectasis.

It may be difficult to say whether a *pulsating intrathoracic mass* examined with the x-rays is the heart or an aneurysm. A retraction of the mass after provoking the

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heart reflex would indicate that it is the heart and not an aneurysm. Cooper utilized the foregoing fact in differential diagnosis. I will not now attempt to discuss the therapeutic value of the heart reflex, but it is my personal opinion that the carbonated baths in the Schott treatment possess no special effect beyond their action in provoking the heart reflex by cutaneous irritation and that cutaneous friction by any other method is equally efficacious. The foregoing conclusion is formulated only as a result of many years of observation. Massage of the precordial region or the employment of the sinusoidal current, especially in cardiopaths, will reduce the area of the heart and the pulse-rate and augment blood-pressure. The now prevailing fetish in cardiotherapeutics is Nauheim. I subscribe equally to the efficiency and deficiency of this famous resort, but it is puerile to endow its waters with marvelous attributes.

CARDIAC INSUFFICIENCY.

One frequently observes in a large number of individuals at about the period of middle-age, definite signs of cardiovascular disturbances even though no valvular lesions are present. Here the condition is due to some change in the heart-muscle which has not been definitely established even by the microscopist. This condition has been popularly designated as heart-failure or heart-weakness, and others speak of the condition as chronic cardiac insufficiency or incompetency.

The signs of *incompensation* vary according to whether they are caused by a lesion of the valves or occur independently of the latter and are dependent on changes in the myocardium. All diseases of the heart, whether of the valves or myocardium, lead eventually to disturbances of circulation. The phenomena associated with the latter are easier of interpretation if we study the effects of valvular lesions.

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The compensatory mechanism of the heart illustrates why cardio-vascular disease is not at once followed by disturbances in the circulation. The normal heart can easily adapt itself to the average grades of dilatation such as occur during exercise. In fact, the size of the cavities of the heart varies even in health, and a dilatation is physiologic as long as the heart-chamber is capable of emptying its contents during systole. Any increased work on the part of the heart, if continued, leads to an increase in the size and number of the muscle-fibers, a condition known as *hypertrophy*, which enables the organ to contend with additional burdens.

Although a valve-lesion may be of some significance in prognosis, yet the essential factor always is the question of compensation.

Valvular lesions are of two kinds, narrowing of the valve-openings (stenosis), and incomplete closure of the orifices (incompetency or regurgitation) due to retraction of the valves. In either condition dilatation of one of the chambers of the heart occurs because it is always distended with blood, and incompletely discharges its contents at systole. When the heart hypertrophies, to overcome the latter defect, and thus prevent stasis in any part of the blood-current, the lesion is compensated. Thus compensation is practically dependent on the condition of the heart-muscle. If the heart fails to hypertrophy, or if the latter has occurred and it is subjected to burdens beyond its capacity, or in consequence of degenerative changes, the heart fails as a motor and it becomes insufficient, or, as is often said, compensation is broken or ruptured. In consequence of incompetence, a diminished quantity of blood is pumped into the arterial system, hence the arterial pressure is decreased, venous pressure is increased and the current of the blood in the capillaries is retarded.

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The cavities of the ventricles dilate because they cannot discharge their contents (increased area of cardiac dullness). Overloading of the veins conduces to the collection of fluid in the tissues which begins primarily in the feet and gradually invades the other parts of the body.

Cyanosis of the skin is an early symptom and appears as soon as there is a disturbance in the pulmonic circulation.

In children, a lesion of a valve retards development and nutrition and produces a condition known as *cardiac cachexia*.

The pulse is often characterized by intermittency and is caused by feeble contractions of the heart which are not strong enough to drive the blood to the radial artery. In such instances, if the heart is auscultated synchronously with palpation of the pulse, there are more heart-tones than pulse-beats.

DYSPNEA in disease of the heart is out of all proportion to the physical changes in the lungs and is caused by pressure of the enlarged heart on the lungs, disturbed pulmonic circulation, hydrothorax, ascites, or bronchial catarrh.

CARDIAC ASTHMA may be confounded with asthma of bronchial origin and the following table will assist in differential diagnosis:

DIFFERENTIAL TABLE OF ASTHMA.

CARDIAC ASTHMA.	BRONCHIAL ASTHMA.
Signs of cardiac disease.	Usually absent.
Dyspnea is equally inspiratory and expiratory.	Dyspnea is expiratory.
Pulse in the early stage of paroxysm may be strong, but it soon becomes soft and small.	Pulse-tension usually increased throughout the paroxysm.
Percussion shows an extension of the borders of the lungs and obliteration of the area of superficial cardiac dullness.	Extension of lung-borders more pronounced.

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CARDIAC ASTHMA.

Auscultation shows an absence of *râles* unless complicated by lung-
edema.

Tracheal traction-test is positive.*
Cardiac stimulation will inhibit
attacks and cardiotonic medica-
tion will prevent them.

Tests show cardiac insufficiency
(page 215).

Concussion of the 7th cervical ver-
tebra may arrest an attack at
once by provoking the heart re-
flex (page 199).

BRONCHIAL ASTHMA.

Sonorous and sibilant *râles* are
always heard and are loudest
during expiration.

Tracheal traction-test, negative.
No special results from cardiac
stimulation.

No cardiac insufficiency unless
heart-weakness exists as a com-
plication, and then the right
heart is usually compromised.

Very frequently the attack can be
subdued by concussion of the
4th and 5th cervical vertebræ
(page 313).

Cardiac insufficiency due to *myocardial disease* may be
divided into three main groups, which are as follows:

1. An arrhythmic form, in which the pulse is irregular
and intermittent and lacks force and volume.
2. A group characterized by acceleration of the pulse
(*tachycardia*) and paroxysms of palpitation.
3. An asthmatic group, which is characterized by
attacks of acute pulmonary edema and cardiac
asthma.

Usually the patients are middle-aged men of strong
physique who have eaten to excess and have taken very little
exercise.

The frontier symptoms of cardiac incompetency in such

*The author has described this test as an aid in the diagnosis of idiopathic asthma.⁵⁰

When the head of a patient is thrown forcibly backward, the normal resonance
obtained by percussion over the manubrium sterni and lungs contiguous
thereto becomes converted into a dull or flat sound. This manoeuvre is the
tracheal traction-test. It is positive in health and in all cardiopulmonary
affections, excepting in idiopathic asthma. In other words, in the latter
affection, the pulmonary resonance over the manubrium is unchanged when
the head is thrown backward. The explanation of this phenomenon is dis-
cussed on page 311.

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individuals are slight difficulty in breathing on exertion in ascending stairs and in walking up a slight hill. The individual may observe that, after a hearty meal there is a feeling of uneasiness or a dull pain in the region of the heart. These symptoms continue to become more pronounced and are not infrequently associated with attacks of fluttering or palpitation of the heart.

One may also observe in these cases signs of arteriosclerosis.

Percussion shows as a rule an increase in the area of cardiac dullness which may involve either ventricle or both.

Respecting the prognosis in cases of cardiac insufficiency, it is usual to regard the cases as hopeless and that little can be done to patch up the crippled heart.

The author, however, finds that provided a good heart reflex can be obtained, the prognosis is, as a rule, favorable. In this regard one may cite the observations of Heitz who shows that, the heart reflex of Abrams is a good guide by which to determine the probable effect of contemplated balneologic treatment. If the size of the heart does not change under the excitation of the reflex, by sharp blows over the precordial region, the treatment will be ineffectual or may even be contra-indicated on account of the probable development of cyanosis. In very large dilatations and in advanced myocardial degeneration, the heart does not respond to precordial excitation and is not favorably influenced by baths. If the reaction is feeble, good results may be achieved, but the treatments must be used cautiously. Since the author has employed concussion of the spine of the 7th cervical vertebra for provoking the heart reflex, decidedly better results can be achieved from treatment than by mere precordial excitation which has heretofore been practiced.

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It may be remarked, that while the x-rays furnish the best proof of the amplitude of the heart reflex, yet results may be achieved by percussion, if the vibrosuppressor is employed as an aid (page 80). Here one percusses the heart to obtain the deep or relative cardiac dullness and the limitations of the organ are carefully marked with a pencil. Next, one rubs vigorously the skin over the region of the heart, or, better still, one strikes a series of concussion-blows upon the spinous process of the 7th cervical vertebra and percussion of the heart is again executed; any diminution in the area of cardiac dullness indicates the amplitude of the heart reflex.

TESTS FOR HEART-SUFFICIENCY.

In disease of an organ, the severity of a lesion is generally gauged by the incapacity of the organ to execute its functions. Thus it is, that in affections of the kidney, the percentage of albumin in the urine is of minor prognostic importance, provided the nitrogenous excretion is relatively normal.

Similarly, in affections of the heart, a *murmur* is of no value in determining the prognosis of any given case, inasmuch as some of the most serious affections of the heart are unaccompanied by murmurs.

In the presence of a cardiac disease, whether of the valves or of the muscle of the heart (myocardium), it should be the primary endeavor of the physician to determine the functional capacity of the organ. Many functional diseases of the heart, described as *cardiac neuroses* are mere instances of heart-fatigue, for the heart like the skeletal muscles will tire when an additional burden is cast upon it; in fact, the heart may be the most vulnerable muscle in exhaustion.

We have already noted (page 203) the effects of emotions on the heart and among neurasthenics, emotional influences

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must be regarded as additional etiologic factors in super-inducing heart-fatigue.

There are many individuals, notably women, labeled as neurasthenics, who are really sufferers from cardiac incom-pensation.

To determine the vigor of the myocardium, the conven-tional physical methods of examination furnish little practical aid, hence recourse is had to any of the following manœuvres :

1. THE PULSE METHOD.—The pulse of the cardiopath is altered in character after body-movements and physical exertion in a more pronounced manner than in health, and such alteration is in proportion to the insufficiency of the heart-muscle. When the heart is healthy and one counts the pulse first in the erect and again in the recumbent posture, a retardation of the pulse in the latter position from 10 to 12 beats per minute is observed. In disease of the heart-muscle, however, retardation of the pulse in the recumbent posture becomes less and less conspicuous, the greater the degree of cardiac insufficiency, until in pro-nounced grades of the latter, the frequency of the pulse may even be greater in the recumbent than in the erect posture.

2. BLOOD-PRESSURE METHOD.—This method (like the two following methods) requires the use of a blood-pressure instrument (*sphygmomanometer*, page 244). It is known that muscular work is associated with alterations in the arterial blood-pressure. In health muscular exertion in-creases the blood-pressure, but, if the heart is insufficient, this rule is reversed, *viz.*, muscular exertion will reduce the blood-pressure. The less evident the rise in pressure after exercising the muscles, and the deeper the remissions of the blood-pressure curve and the less muscular exercise it takes to produce such remissions of pressure, and the longer it

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takes for the blood-pressure curve to attain the normal, the greater is the functional incapacity of the heart.

3. **METHOD OF KATZENSTEIN.**—After determining the blood-pressure and the pulse on the reclining patient, both of the femoral arteries are compressed with the middle finger of each hand at Poupart's ligament, the other fingers testing whether the compression is absolute. With normal heart-energy the blood-pressure then rises by from 5 to 15 mm. mercury, while the pulse remains unaffected or drops. When the compression is relinquished, the blood-pressure gradually returns to normal. A slightly enfeebled heart is not able to raise the blood-pressure when the obstruction to the circulation is interposed, and with a much enfeebled heart the blood-pressure actually sinks under the compression, while in both events the pulse becomes more or less accelerated. The respiration is kept superficial during compression.

4. **HEART REFLEX METHOD.**—After taking the blood-pressure, fix over the heart-region a pleximeter and strike the latter a series of vigorous blows with a hammer (Fig. 2), after which immediately take the pressure again. If the myocardium is sufficient, the blood-pressure remains the same or rises; otherwise, it falls, and the rise and fall are in proportion respectively to the vigor and insufficiency of the heart-muscle, *e.g.*:

BLOOD-PRESSURE BEFORE AND AFTER EXCITATION OF THE HEART-REGION.

BEFORE.	AFTER.	CONCLUSION.
120 mm.	140 mm.	Myocardium very strong.
135 mm.	138 mm.	Myocardial sufficiency.
190 mm.	155 mm.	Myocardial insufficiency.

Concussion of the heart region elicits a maximum heart reflex with a temporary augmentation of vigor if the myocar-

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dium is normal, otherwise, the stimulation is in the nature of a shock.

TREATMENT OF CARDIAC INSUFFICIENCY.

One must concede the phenomenal results achieved in cardiotherapeutics since the inauguration of the Schott methods by saline baths and resisted movements in failing heart-power. If the Schott methods of treatment are effective, their efficiency is recognized by the following results:

1. A sensation of warmth.
2. Augmented pulse-volume with diminished frequency.
3. Stronger cardiac systole.
4. Diminished area of cardiac dullness.
5. Amelioration of precordial distress.
6. A feeling of well-being.

There are many theories concerning the action of the saline baths and resisted movements, but in the opinion of the author, the theory that best responds to reason is that which supposes their action to be due to the elicitation of the heart reflex. From what has been said concerning the latter reflex (page 199), it is known that cutaneous stimulation of any kind will result in a vigorous contraction of the heart-muscle. Hence, mere friction of the skin with a coarse towel is equally as efficient as the waters of Bad Nauheim, in Germany, which owe their action to various chlorid salts and to the presence of carbonic acid.*

In studying the amplitude of the heart reflex (Fig. 54), when elicited from various regions of the organism, the

*"Dr. Bloch, of Franzensbad, uses carbonic acid douches for producing contraction of the heart, based on the fact discovered by Dr. Abrams, of San Francisco, that friction of the precordial region will produce contraction of the heart (Satterthwaite)."

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author is justified in concluding that the most effective site is the *spinous process of the 7th cervical vertebra*, and that the most satisfactory method for its elicitation, is by means of the pneumatic hammer (Fig. 50) or any similar apparatus giving a percussion stroke. In the absence of an apparatus, mere concussion by means of a pleximeter and hammer (page 8) may be employed.

The duration of each séance is governed by the results and one must not forget that a reflex may be exhausted as well as excited. My usual custom is to limit each séance to about five minutes with frequent periods of rest during the application of the percussion stroke. In the opinion of the author, the results achieved are more satisfactory and more rapid than by any other method of treatment.

Very frequently he has observed cardiopaths with severe dyspnea and other signs of heart failure, who obtained immediate relief after a single séance of concussion-treatment.

It is evident, however, that many séances are necessary before one may expect permanent results.

It is equally evident that concussion must not be employed to the exclusion of other methods of treatment in failing compensation, although the author has employed concussion exclusively in his cases to enable him to formulate conclusions respecting the efficacy of the method.

Reference to Figs. 60 and 61 shows the effects of concussion of the 7th cervical spinous process in two patients with dilated hearts superinduced by myocarditis. The relief following concussion is dependent on the duration of the heart reflex which, in turn, is dependent on the condition of the heart-muscle. In several instances of myocarditis no results were achieved by concussion, but in these cases the myocardium was past restitution.

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When attacks of *cardiac asthma* (page 212) or other paroxysmal symptoms of heart-failure occur at the home of the patient, some competent member of the family is instructed to concuss the spinous process of the 7th cervical vertebra by means of the pleximeter and hammer.



FIG. 60.—The effects of concussion of the spine of the 7th cervical vertebra on the area of the heart in a patient with myocarditis. The continuous line represents the area of the heart before, and the broken line after, concussion.



FIG. 61.—The effects of concussion of the spine of the 7th cervical vertebra on the area of the heart and liver in a patient with advanced myocarditis. The continuous line represents the area of the heart and liver before, and the broken line after, concussion.

As a rule, the latter manœuvre is followed by immediate relief of the symptoms.

As observed on a previous page (215), some patients owe their infirmity to heart-failure and many anemic women who respond unceasingly to the demands of an active social life, who say they are "worn out," often suffer from an overstrained heart. The subjective symptoms are lassitude, slight dyspnea on exertion and digestive disturbances.

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Objectively, one may recognize dilatation of the ventricles by percussion, feeble heart-tones, and a pulse which is rapid and feeble and may be irregular or intermittent. These cases, as well as those hearts which fail to respond to the tests of cardiac sufficiency (page 215) are benefited by concussion-treatment.

ANGINA PECTORIS.

THE HEART REFLEX OF DILATATION.

Heretofore only one heart reflex was recognized, *viz.*, the heart reflex of contraction (page 199), but when the spinal processes of the 9th, 10th, 11th and 12th dorsal vertebræ are rapidly concussed in succession there is a decided increase in the area of cardiac dullness as obtained by percussion. This increase in the area of cardiac dullness is not associated, as the x-rays show, with any increase in the diameters of the heart. The latter fact corresponds with the investigations of Kornfeld, who demonstrated that the heart-muscle possesses the property of increasing the size of its cavities without any corresponding augmentation of tension of its walls, a condition which he calls *Ausweitungs-fähigkeit*.

Among the theories of ANGINA PECTORIS, that of Allan Burns appeals most cogently to reason.

The latter assumes that, in consequence of a transient ischemia of the heart-muscle caused by disease or spasm of the coronary arteries, a condition analogous to intermittent claudication ensues. It is known that the coronary arteries are practically always diseased in fatal cases of angina, but if we accept the observation of Schäfer that the coronary vessels are unprovided with vasomotor nerves, the theory of intermittent claudication of the coronaries must necessarily suffer a serious setback unless supported by other evidence.

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The coronary arteries supply the heart with blood only during diastole, for during systole the ventricular wall is so strongly contracted that the muscular tension becomes greater than the coronary pressure and so the coronary artery and branches are compressed and the blood is driven back into the aorta. It is our contention that the theory of Burns is correct, but that the ischemia is quite independent of the coronary arteries, which are merely passive structures. We assume that any factor operating to augment the tonicity of the cardiac musculature compresses the arteries in question and thus induces ischemia. The heart reflex is essentially a myocardial contraction and when the reflex is in evidence the coronary arteries are subjected to varying degrees of pressure. If in an attack of angina, the pulse shows augmented tension and is small and perhaps diminished in rate, or if syncope is observed, such symptoms are explainable by the heart reflex.

We know that when the reflex is in evidence, the heart is practically inhibited; there is a diminished output of blood into the general circulation and, if the pulse shows increased tension, it is only an expression of vaso-motor activity which assumes the burden of maintaining the circulation.

If one studies the etiology of angina, one notes that the factors which precipitate a paroxysm are also equally operative in inducing the heart reflex. Muscular effort is a potent factor which also provokes the *myopathic heart reflex*. Emotion is another prominent factor and led John Hunter to observe that "his life was in the hands of any rascal who chose to annoy and tease him." Emotion as a cause corresponds with the *psychic heart reflex*. A gust of wind striking the chest is equally involved in inducing either an attack of angina or the heart reflex.

Oliver demonstrated that patients who have suffered from

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precordial pain obtain permanent relief on the supervention of cardiac dilatation and failure, and Broadbent has shown that the supervention of mitral insufficiency may diminish the tendency to anginoid attacks.

Now, in cardiectasis, while the heart reflex can be provoked, the cardiac musculature is enfeebled and the resulting pressure on the coronary arteries is correspondingly diminished. Reference has been made to the heart reflex of dilatation and in several instances, during my office hours, I have inhibited anginoid pains by concussion of the vertebrae which induces cardiac dilatation, and I have employed the same method with fairly good results in the treatment of angina pectoris. In other instances, I have unintentionally provoked attacks of angina in studying the heart reflex and the methods for its elicitation.

Here concussion of the spinous process of the 7th cervical vertebra is often effective in developing some of the symptoms of angina pectoris when absent and the same may be said of concussion of the precordial region. Thus, concussion from either region is a diagnostic sign of some importance and serves as corroborative evidence of the author's heart reflex theory of angina pectoris. Not infrequently eructations of gas attend the concussion and here it is assumed, that concussion not only provokes the heart reflex by reflex stimulation of the vagus, but also the stomach reflex of contraction (page 316).

By means of the heart reflex, one can easily comprehend the attacks of false angina. In functional angina, the heart reflex is always accentuated, as I have assured myself by repeated x-ray examinations. In cardiodynia (*Herzangst*) observed in neurotics, one is dealing essentially with a *psychic heart reflex*.

The following table will aid in the differentiation of true and false angina pectoris :

S p o n d y l o t h e r a p y

DIFFERENTIAL TABLE OF TRUE AND FALSE ANGINA PECTORIS.

TRUE ANGINA.	FALSE ANGINA.* (Neurotic Form.)
Most frequent between the ages of 40 and 50 years.	May occur at any age and even in children.
More frequent in males and the paroxysms are evoked by exertion. The attacks are rarely periodic and nocturnal.	More frequent in women and the attacks are spontaneous, periodic and nocturnal.
No other symptoms.	Associated with nervous symptoms.
Pain is agonizing with the sensation of compression by a vice.	Pain is less severe and the sensation is one of distention.
The pain is of short duration and the patient is silent and immobile.	Pain may continue for one or two hours and the patient is restless and talkative.
The lesion is a sclerosis of the coronary artery.	Neuralgia of nerves and cardio-plexus.
Prognosis grave.	Never fatal.
Arterial medication is effective. Antipyrin (large dose) may accentuate the pain, at any rate it gives no relief.	Antineuralgic medication. Antipyrin (large dose) is effective in subduing the pain (Huchard).

There are etiological factors concerned in angina which on first view could find no explanation by my *heart reflex ischemic theory*, yet, on reflection, the theory is applicable. Thus, one of my friends, a physician in Paris, suffers like several other members of his family from pronounced attacks of angina pectoris several hours after the use of coffee, tea or tobacco. One knows, for instance, that the effect of caffeine in small doses on the cardiac muscle is to increase its activity; in larger doses, it produces phenomena analogous to fatigue, and in very large doses, the muscle is thrown into

*Reference on page 194 has already been made to false angina caused by *intercostal neuralgia*.

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rigor. In the latter instance, the strong contraction of the myocardium (which is essentially a heart reflex) mechanically compresses the coronary vessels.

The toxic factor here involved in eliciting the heart reflex is necessarily delayed and cannot be immediate like the other factors concerned in the elicitation of the reflex in question. Digitalis and other circulatory stimulants may provoke an attack of angina for the reason that they augment the tonicity

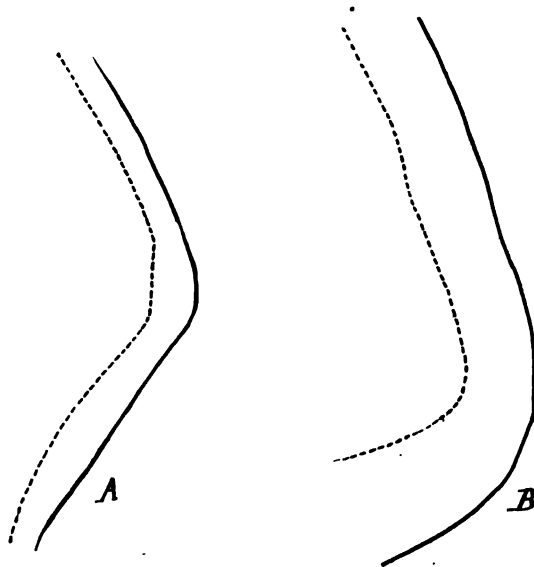


FIG. 62.—The heart reflex; A before, and B, after, the use of digitalis.

of the cardiac musculature. Digitalis increases the amplitude of the heart reflex as shown in Fig. 62.

Recently I have observed the following singular phenomenon: After placing the ankle of one lower extremity on the knee of the other extremity, the pulse of the anterior tibial artery is easily palpated (Fig. 63).

Next, direct the patient forcibly to extend and flex his foot (the leg occupying the same position) a number of

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times in succession. If the tibial pulse is again sought, it will be either very feeble or absent. In the norm fully thirty seconds may elapse before the pulse has attained its former volume. The blood-pressure also falls. In a patient with claudication, five minutes elapsed before the tibial pulse resumed its former volume. This test may prove of value in the diagnosis of the latter affection. I assume that the tibial artery, immersed as it is in a muscular atmosphere, responds reflexly to the muscular contractions, and in arte-



FIG. 63.—Position of the leg to facilitate palpation of the anterior tibial artery.

riosclerosis the longer duration of the arterial contraction accounts for the phenomena of claudication. Here, as in my heart reflex theory of angina, the ischemia is dissociated with vaso-motor action, insomuch as when amyl nitrite is inhaled, obliteration of the tibial artery is effected by the muscular manœuver suggested.

The treatment of angina pectoris includes the elimination of all factors concerned in the elicitation of the heart reflex. The value of amyl nitrite inhalation in the treatment of a

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paroxysm is universally conceded. When the latter drug fails, and it often does, the failure may be attributed to irritation of the nasal mucosa which induces the heart reflex, which would still further accentuate the paroxysm. In such instances and, in fact, in nearly all instances, the action of the drug in question is aided by previous cocainization of the nasal mucosa, which eliminates the irritant factor in amyl nitrite inhalations. Concussion of the lower dorsal

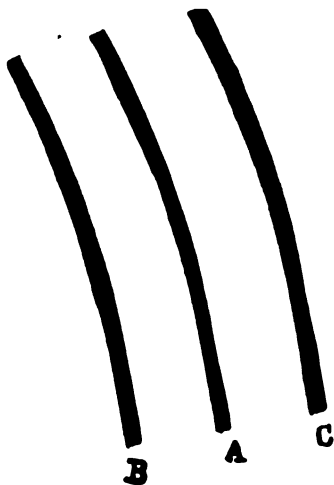


FIG. 64.—Demonstrating the amplitude of the heart reflex: C, left border of the deep cardiac dullness; A, recession of the same border when the heart reflex is elicited after excitation of the precordial region; B, still further recession of the same border when the heart reflex is elicited after concussion of the spinous process of the 7th cervical vertebra. Note in this figure that after concussion of the four lower dorsal vertebræ to excite the heart reflex of dilatation, the amplitude of the heart reflex of contraction after concussing the spinous process of the 7th cervical vertebra is from C to A only.

vertebræ (daily treatment) should be given a trial in the treatment of angina pectoris to induce the counter-reflex of dilatation.

It will be noted in Fig. 64, that after the heart reflex of dilatation is elicited, the amplitude of the heart reflex of contraction is diminished. In some instances, the treatment suggested for angina pectoris (true and false) and

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cardiodynia is very effective, whereas in other instances, no results are achieved.

FUNCTIONAL AFFECTIONS OF THE HEART.

INHIBITION OF THE HEART.

The rapidity and force of cardiac action are regulated by the pneumogastric or vagus nerve, which inhibits it, and the



FIG. 65.—Position of head to inhibit the heart. This position is the one adopted for obtaining the vago-visceral reflexes (*q. v.*).

sympathetic, which accelerates it. Many persons can voluntarily stop the action of the heart, and among Indian sorcerers, the phenomenon is regarded as a marvelous feat. The explanation, however, is very simple: by voluntary contraction of the muscles of the neck innervated by the

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nervus accessorius, the branches of the latter running in the path of the vagus nerve are irritated, resulting in temporary stoppage of the heart action. Czermak was able to press his vagus nerve against a little bony tumor in the neck, and by thus subjecting the nerve to mechanic stimulation was able to slow or even stop the beating of his own heart.

If, in almost any healthy person, the carotid artery, or a point immediately adjacent to it in the neck, is compressed, slowing or complete inhibition of the heart and pulse ensues. This phenomenon is explained by compression of the vagus lying alongside the carotid artery.

The author has shown, that forcible compression of the abdominal muscles (Fig. 59), inhalation of irritating vapors, firm pressure in any of the intercostal spaces and pressure at the vertebral exits of the spinal nerves (preferably at the side of the upper dorsal vertebræ, Fig. 48), will result in a reflex inhibition of the heart. A method which the author employs for this purpose is to have the patient firmly contract the muscles of the neck as shown in Fig. 65.

There are many functional NEUROSES OF THE HEART, such as *palpitation*, *arrhythmia* and *tachycardia*, which owe their origin to insufficiency of the vagus nerve, and in consequence of such incompetency, the mastery of the organ is assumed by the sympathetic.

Now we know that the action of the vagus can be reflexly controlled by the manœuvres already cited, and in this action, acceleration and irregularity of the heart can be mastered. By executing such a manœuver, we are merely subduing one reflex by its counter-reflex.

In a case of *tachycardia* (heart-hurry) reported by Nothnagel, the attacks were jugulated by deep inspirations, and Rosenfeld's patient controlled her attack by going to bed, raising her head with her feet planted firmly against

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the foot of the couch, and then taking a forced inspiration she pressed down with all her might, with the object of closing her glottis.

A patient of mine, a neurasthenic, controlled his attacks of palpitation by firm compression of an intercostal space with his finger.

An analysis of the foregoing manœuvres, acquired instinctively, shows that what the patients did was to call into action the functions of the vagus nerve.

The spinal region in juxtaposition to the vertebral exits of the upper spinal nerves (at about the spinous process of the 4th dorsal vertebra), is the most favorable site for calling into activity the functions of the inhibitory nerve of the heart. Here the most suitable method is to make firm compression (and maintain the compression for several minutes) with the thumbs on either side of the spine.

The application of an ice-bag in the region shown in Fig. 48 (corresponding to 7th cervical spine) is often of service and the same may be said of the sinusoidal current; one electrode in the sacral region and the other electrode in the region indicated in Fig. 48. In arrhythmia, the action of this current is often surprisingly efficient.

The latter manœuver is equally available in *diagnosis*. Thus, in irregular action of the heart or in delirium cordis, the inhibition manœuver, by temporarily inhibiting the rapidity of the heart, enables us to determine the time of a murmur; the manœuver thus simulating the physiologic action of digitalis.*

*Concerning the further employment of this manœuver in diagnosis, *vide* "Diseases of the Heart," by the author, page 59.

T h e B l o o d - V e s s e l s

THE BLOOD-VESSELS.

PHYSIOLOGY.

The blood-pressure is most evident in the arteries and least pronounced in the veins, whereas in the capillaries, it is intermediate between the arteries and veins. Thus the blood circulates continuously in the direction of the lowest pressure (arteries to veins).

Arterial pressure or tension is made up of four factors :

1. Ventricular pressure.
2. Peripheral resistance.
3. Elasticity of the arterial walls.
4. The volume of the circulating blood.

INNERVATION of the blood-vessels is effected through the vaso-motor nervous system, which consists of the center in the bulb, subsidiary centers in the spinal cord and vaso-motor nerves.

The latter are of two kinds : Vasoconstrictor nerves, which when stimulated cause contraction of the vessels, and vasodilator nerves, which dilate the vessels. The latter supply the musculature of the vessels and regulate their caliber, and their most pronounced action is on the arterioles, which contain relatively the largest amount of muscular tissue. In the norm, the arterioles are in a state of tonic contraction, and this is what constitutes the peripheral resistance which helps to maintain the blood-pressure and thus promotes the circulation of the blood. By means of the vaso-motor apparatus the amount of blood supplied to an organ is regulated. Thus, during digestion more blood must be supplied to the digestive organs, hence the arterioles of the splanchnic area are relaxed and there is a constriction of the vessels in other areas, as, for example, the skin ; the chilly sensations after a meal are attributable to the latter fact. In certain

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organs, like the lung and brain, there are no vaso-motor nerves, because there are no variations in the blood-supply. There are afferent impulses which may reflexly excite the vaso-motor center in the medulla, and such impulses are divided into *pressor* and *depressor*. Most sensory nerves contain pressor fibers which, when stimulated, cause a rise of blood-pressure, whereas the depressor fibers also present in many sensory nerves will, when stimulated, cause a fall of blood-pressure. A distinct nerve known as the depressor nerve exists in animals in the trunk of the vagus, or as a separate branch running from the heart or the commencement of the aorta, and reaches the vaso-motor center by joining the vagus.

PATHOLOGIC PHYSIOLOGY.

The primary factor in blood-pressure is the force of ventricular systole, and any increase in the volume-output causes a rise, and conversely a fall, in pressure, provided the peripheral resistance is the same. In animals the pulse-rate is slowed when the arterial pressure is raised and accelerated when lowered. A continued high blood-pressure entails increased work on the part of the heart, but the abnormal tension of the ventricular wall stimulates the filaments of the depressor nerve and thus automatically causes a fall of pressure. Another protective mechanism exists to prevent excessive blood-pressure, and that is, when the peripheral resistance is very much augmented, the volume-output of the ventricle diminishes. *Peripheral resistance*, as has been noted, is made up of the tonus of the arterioles, but there are minor factors also concerned, notably, friction due to the viscosity of the blood and the subdivisions of the arterial tree. It has been shown that the veins also possess tonus. Thus, stimulation of a splanchnic nerve will produce a contraction of the portal vein. The vasodilator have not

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the same physiologic value as the constrictor nerves, for their division causes no narrowing of the vessel, hence they possess no tonus. It has been shown that stimulation of the muscles and the mucosa of the rectum and vagina will cause a fall of blood-pressure, and this fact is more evident during anesthesia. In the latter instance depressor in lieu of pressor reflexes occur. The abdominal vessels supplied by the splanchnic nerves have the most pronounced influence on the general blood-pressure, for the evident reason that they are sufficiently capacious to hold practically all the blood-volume of the body. *Arterial elasticity* diminishes the work of the heart. Hasebroek contends that there is a propulsive energy at the periphery independent of that in the heart, and that the periphery represents another second independent pumping apparatus, coupled with that of the heart. The periphery has not only its elastic contraction and expansion, but also its active diastole and systole in the arteries. This diastolic-systolic activity is manifested in the capillaries as a sucking-in, an inspiration, as it were, while in the arteries it is more of a propulsive energy. Both these forces combine to create an independent and forcible stream into the veins, which are passive, and merely serve as a passive reservoir for the blood-stream.

The *blood-volume* has only a subordinate influence on blood-pressure, as many experiments show. When the blood-volume is diminished, pressure is maintained by peripheral contraction of the arterioles, and when the volume is increased, certain compensatory mechanisms come into play, *viz.*, dilatation of the vessels, transudation into serous cavities and lymph-spaces, and increased activity of the secreting organs. Another important factor in compensation is dilatation of the arterioles of the abdominal viscera caused by stimulation of the depressor nerve.

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NORMAL BLOOD-PRESSURE.—Pressure, like temperature and the rate of respiration, is subject to fluctuations. Most of the recorded results have been obtained with the *Riva-Rocci apparatus* and the figures quoted represent the systolic pressure. Cook and Briggs present the following as representing the average pressure:

Children up to two years.....	75 to 90 mm.
Children after two years.....	90 to 110 mm.
Young adult males, about.....	130 mm.
Women.....	10 to 15 mm. lower.

A pressure below 70 mm. signifies very low, and above 200 mm. very high tension.

Janeway has never seen a pressure above 180 mm. in a normal person, and seldom one above 160 mm. There are postural variations of pressure, hence all pressure estimations should be taken in the same position. Sleep lowers the pressure. Tobacco either increases or diminishes the pressure according to whether the subject experiences a stimulating or sedative effect; this, at least, has been my observation. Emotional influences and intellectual application increase the pressure. Muscular exertion increases the pressure, owing to augmented ventricular force; if, however, exertion is carried to exhaustion, the pressure falls.

BLOOD-PRESSURE IN DISEASE.

Among the dominant factors inducing high pressure (*hypertension*) are pains of all kinds which reflexly cause a stimulation of vaso-motor tone. Drugs like strychnin, digitalis, adrenalin, and other cardiotonics act by increasing either the peripheral resistance (vasoconstriction) or cardiac energy or both. Vasoconstriction is evoked by many toxic conditions (plumbism, nicotinism, gout, uremia). No doubt a toxic

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factor is also present in many *psychoses*. During *labor pains* two factors are present, the pain and the increased volume of blood sent to the heart by compression of the abdominal vessels. In *renal affections* the cause of high pressure is due to a number of conditions, notably, cardiac hypertrophy and increased peripheral resistance due to a vaso-motor spasm provoked by the irritating action of waste-products in the blood or degeneration of the peripheral vessels or both. Hypertension necessarily increases the work of the heart unless a compensatory factor is brought into play, and the primary effect is to cause cardiac hypertrophy. A hypertrophic heart is by no means as good as a normal one, as the old dictum runs, for, sooner or later, that heart will become insufficient. Hypertension diminishes the elastic distensibility of the arterial wall, and this in turn conduces to dilatation (aneurism) and rupture (cerebral hemorrhage) of the vessels. Diminished pressure (*hypotension*) is usually regarded as such when the systolic pressure in an adult is below 100 mm. Any or all of the factors concerned in blood-pressure may be involved; wasting diseases reduce pressure by compromising all these factors. The vasodilators reduce pressure by diminishing the peripheral resistance and chloroform acts by directly paralyzing the vaso-motor center or heart. In acute infectious diseases the fall in pressure is due in part to vaso-motor paralysis and in part to weakness of the heart-muscle. Hypotension causes blood to accumulate in the veins (notably the abdominal) and diminishes the rapidity of the circulation. The vigor of the heart becomes compromised because it receives less blood.

In affections of the *nervous system* Pal found that in *tabes*, during the occurrence of lightning pains, the pressure fell, and that during gastric and abdominal crises there was an enormous augmentation of pressure, hence he concludes

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that the latter are caused by a spasm of the splanchnic vessels. *Cerebral hemorrhage*, like all other conditions increasing intracranial tension, will cause an increase of pressure in proportion to the degree of such tension. A high and rising pressure points to more bleeding and a progressive failure of the circulation in the medulla. The observations of Bruce show that in *insomnia* there are cases with high and low pressure, and that the administration of *erythrol tetranitrate* to the former acted as a hypnotic (if it reduced tension).

In *arteriosclerosis* (which will be discussed later at great length), the pressure is usually high.

The arteries may be thickened and yet no rise of pressure exists; in fact, if the heart-muscle is weak, the pressure may even be lower than normal. Janeway concludes that high pressure in this disease indicates involvement of the small arteries, especially in the splanchnic circulation. Among the symptoms of arteriosclerosis are headache, vertigo, apoplectiform attacks, and irritability. Such symptoms are accentuated when the pressure is high, and are aggravated by raising the latter with subcutaneous injections of adrenalin and ameliorated by the use of vasodilators. Amyl nitrite inhalation may be tried to rapidly secure the latter action.

Sphygmomanometry has been utilized in tracing the etiology of *insomnia*. Thus, it is claimed that when the latter is caused by auto-intoxication, the blood-pressure is augmented, whereas it is very low in the insomnia of neurasthenia.

Marfan contends that arterial hypotension is the rule in *chronic pulmonary tuberculosis*, and that a normal or increased pressure indicates a favorable prognosis. When the tension at the commencement of the treatment is low, and is subse-

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quently raised, the prognosis is equally favorable. Inversely, a constant low pressure portends an unfavorable course.

In the differential diagnosis between gouty and tuberculous affections of the skin or elsewhere, a high pressure argues in favor of the former and a low pressure in favor of the latter affection. *Albuminuria* is probably of renal origin if the pressure is high. In *neurasthenia* due to intestinal auto-intoxication the pressure is usually high, and treatment addressed to the condition will lower the pressure, whereas in *neurasthenia* due to actual exhaustion, the pressure is low.

In high blood-pressure due to augmented tonus of the vaso-motor center (usually present in neurasthenic conditions) the bromids carried to their physiologic effects will cause such pressure to fall. When dependent on the absorption of enterotoxins, the abdominal application of the sinusoidal current for a week (daily séances of fifteen minutes) will cause a marked reduction in blood-pressure, otherwise the influence of the current is without pronounced effect. Amyl nitrite inhalations and nitroglycerin are transitory in their action in reducing pressure. Cook found that sodium nitrite is less transitory in its action, and that one or two grains averages a fall of from 25 to 50 mm. Hg, coming on rapidly in from five to ten minutes on an empty stomach, and its effects may last as long as four hours. *Veratrum viride* is more permanent in its effects for vasodilation than the other remedies mentioned.

The testimony of clinicians concerning pressure-figures in diseases of the *heart* are very conflicting, and I must therefore still adhere to my observations concerning this subject, and referred to elsewhere (page 239).

Janeway regards pressure as a means of differentiation between true and false *angina*, and observes that in the pres-

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ence of a pressure above 180 mm. anginoid pain is dependent on organic disease. In chronic interstitial *nephritis* high pressure is an early and important symptom. In other renal affections the question of pressure is less important. Uremic symptoms cause a rise in pressure, and that improvement spontaneous or as a result of treatment will cause the pressure to fall. In fact, many writers claim that uremic symptoms (headache, vertigo, etc.) are the result of high pressure.

In *typhoid fever* observations to be of any value must be made daily with the sphygmomanometer, just as one makes the record of the pulse and temperature. In this disease the pressure begins to fall with the development of toxemic symptoms, and one notes that this fall is progressive. The following figures of Crile are interesting: The highest pressure in 115 cases was 138 mm.; the lowest, 74 mm.; and the average, 104 mm. The average pressure in the first week of the disease was 115 mm.; second, 106 mm.; third, 102 mm.; fourth, 96 mm.; and in the fifth week, 98 mm. A rapid fall in pressure indicates hemorrhage, whereas a progressive fall suggests enfeeblement of the vaso-motor centers. If perforation occurs, there is usually a sudden rise of pressure. The fall of pressure in this disease suggests the value of cardi tonic medication, which in most instances is of more value than the measures employed for reducing the temperature.

In *surgery* blood-pressure estimations are of unquestionable value. The use of ether as an anesthetic either causes the pressure to rise, to be unaffected, or in a very small proportion of the cases to fall. Chloroform, as a rule, diminishes the pressure. Peripheral operations involving irritation of nerve-endings and nerve-trunks cause a rise in pressure, and it has been suggested that sudden death following trivial operations may be caused by rupture of

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diseased cerebral arteries, the result of a sudden increase of pressure. Hemorrhage in an anesthetized patient causes a sudden fall of pressure followed by a rise, provided the bleeding is not severe or complicated by shock. In *collapse* and *shock* a fall of blood-pressure is one of the most positive signs, and the fall is always in proportion to their severity. According to Crile, collapse is a sudden shock, a progressive fall of pressure, and in which the vaso-motor center does not respond to stimuli. In these cases the danger exists in loss of the vaso-motor and not of the cardiac function. The use of chloroform is interdicted when shock is feared and peripheral stimuli are inhibited by "blocking" large nerves by means of cocain before their division. Bishop has directed attention to a constitutional condition of low arterial tension in children in whom no heart lesion exists. Such children suffer discomfort for lack of circulation (cold feet, depression and fainting attacks). The functional heart-tests show that the heart is not compromised. Otis, of Boston, suggests that blood-pressure should be taken as a routine measure. The average blood-pressure in *tuberculous persons* is about 126, and a fall in tension is suggestive of impending hemorrhage. This latter may be warded off by ergot. In hemorrhage when the blood-pressure for the individual is high, inhalations of amyl nitrite or nitroglycerin may be used internally; if low, ergotin is injected subcutaneously.

THE VASO-MOTOR FACTOR IN BLOOD-PRESSURE.

Among the factors which contribute to blood-pressure, the resistance offered by the blood-vessels is paramount.

If the vessels are dilated, the pressure falls; if contracted, it will rise. The nervous mechanism which presides over the tonus of the blood-vessels is the vaso-motor apparatus, and while the latter, I concede, may be reflexly influenced

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by irritation from the blood-vessels themselves or from the end-organs of sensory nerves in general, we are inclined to forget that the vaso-motor apparatus may operate independently of such influences. Emotions, and the state of mind in general, greatly influence the caliber of the blood-vessels through the vaso-motor system of nerves. Take neurasthenics for a paradigm, and I have examined a large number of them at different periods under emotional influences, intense mental application, and when their brains were at rest, and in each instance my results varied. Emotional influences and intellectual application increased blood-pressure, while mental rest reduced it. Blood-pressure is also influenced by physical activity, ingestion of food, menstruation, etc. In other words, blood-pressure, to me, signifies nothing unless one takes into consideration the vaso-motor factor.

Concerning the vaso-motor factor, the following conclusions may be formulated: (1) Blood-pressure is an expression of action of two chief factors—ventricular force and vasoconstriction. (2) The inhalation of amyl nitrite dissipates the vasoconstrictor factor and brings into play the ventricular force, which is the real factor to be encouraged in a failing heart. (3) The vasoconstrictor factor may and does compensate ventricular inadequacy, for it is essential in most cardioarterial diseases for the blood-pressure to be maintained to afford better nutrition for the heart and to promote arterial elasticity as a means of establishing the circulation of the blood. (4) The recognition of the ventricular and vaso-motor factors in blood-pressure serves as a clue in the correct administration of cardiotonics.

VASO-MOTOR SUFFICIENCY is tested as follows: Take the blood-pressure of the individual first in the recumbent and then in the erect posture. Normally there is a postural

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variation. In the erect posture blood-pressure rises, owing to compensatory arteriole contraction, and this difference between recumbency and standing varies, according to my measurements with the Riva-Rocci instrument, between 15 and 30 mm. In vaso-motor insufficiency the postural variations are reversed, and this is especially true in neurasthenia, notably, the angiopathic form, and in the form described by the author as "splanchnic neurasthenia," where the blood shows an abnormal tendency to accumulate in the splanchnic area. I regard a continuously maintained high blood-pressure as the most constant factor in the etiology of arteriosclerosis, and, further, consider that the poisons absorbed from the intestinal canal are largely responsible for such high tension. The latter factor is easy of determination.

VASO-MOTOR METHOD OF TESTING CARDIAC SUFFICIENCY.—As remarked before, blood-pressure is the resultant of two chief factors, *viz.*, force of the cardiac ventricle and vasoconstriction. Remove the latter, and the ventricular force will come into play. Blood-pressure as taken ordinarily means nothing, for it is difficult to gauge how much of it is due to the action of the vaso-motor nerves and how much to the condition of the heart-muscle. The heart may be very weak, and yet show high blood-pressure, because vasoconstriction compensates a failing heart. The method is, briefly, to take blood-pressure in the usual way; next have the patient inhale amyl nitrite from a bottle until the physiologic action (flushing) of the drug is secured, at which time again take the blood-pressure. In the norm the average increase of the pressure after the inhalation is from 6 to 10 mm. In cardiac enfeeblement there is a fall instead of a rise of pressure, and the degree of fall is proportional to the degree of myocardial insufficiency. All my investigations were

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made with the Riva-Rocci instrument. Clinicians have unreservedly accepted the dictum of the physiologist that the nitrites lower the blood-pressure. The latter may be true with toxic doses, but my clinical investigations show that amyl nitrite inhalations will, in the norm, cause the pressure primarily to fall, but the systolic pressure immediately rises. It has been shown experimentally that if a nitrite is introduced into the cerebral circulation and prevented from attaining the general circulation, there is no fall in the blood-pressure.

ARTERIOSCLEROTICS, according to my clinical observations, may be classified as follows: (1) Those with high blood-pressure and strong cardiac tones who show, after amyl nitrite inhalations, a stable or a slight rise of blood-pressure. Here the cardiac musculature is not yet compromised. (2) Those with high blood-pressure and enfeebled cardiac tones, who show after the inhalation a decided decrease of blood-pressure. In this, as well as the succeeding class, the reduction in blood-tension is influenced by the elimination of the tonus of the arteries, which was maintained by the vaso-motor system of nerves, thus allowing the true endocardial pressure, which is enfeebled, to be brought into action. (3) Those with relatively low blood-pressure and enfeebled heart tones who demonstrate a still further reduction of pressure after the inhalation. In a prognostic sense the latter class of arteriosclerotics belong to the hopeless category, insomuch as the vaso-motor system of nerves is either exhausted or unable to properly usurp the functions of a failing heart.

TEST FOR ADMINISTERING HEART TONICS.—All cardiac tonics may be divided into direct or indirect; the former acting by direct stimulation of the heart; the latter, by improving the nutrition of the organ or by relieving vessel-

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tension and hastening the output of blood from the heart. I select a reliable *infusion of digitalis* for diagnostic purposes. In the therapeutic stadium—*i. e.*, after its administration for about three days—it has a dual action, slowing the pulse and augmenting blood-pressure. The latter is the product of two forces—increased heart-work and augmentation of the vessel-tone. Now, it is evident that digitalis may do as much harm as it does good. Supposing, before giving digitalis, we noted that the blood-pressure was 218 mm., and that after the inhalation of amyl nitrite it was reduced to 190 mm.; that after the use of digitalis it was 215 mm., but the amyl nitrite inhalation reduced it to 150 mm. Now, the theory of action of the drug on the patient was practically as follows: The blood-pressure was essentially the same after as before the use of digitalis, but while amyl nitrite before the use of digitalis reduced the blood-pressure only 28 mm., after its use the pressure was reduced 65 mm. This would indicate that the digitalis was unfavorable in its action, for, after the tonus of the blood-vessels was removed by amyl nitrite, the greater reduction in blood-pressure demonstrated that the cardiac force was further reduced after than before the use of digitalis. In other words, digitalis was goading a jaded heart, and the high blood-pressure was illusory.

This action is not uncommon in the administration of digitalis, owing to its vasoconstrictor influence, and when the latter implicates the coronary blood-vessels, the nutrition of the heart must suffer. In the case just mentioned digitalis showed an unfavorable action, but when it was given in combination with diuretin, which antagonizes the vasoconstrictor components of digitalis, the action of the latter drug was more favorable, the blood-pressure falling only 15 in lieu of 65 mm. Any of the nitrites may be combined with digitalis or strychnin when the vasoconstrictor effects of

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the latter are undesired. *Strychnin*, like many other drugs, has been discredited as a heart tonic because clinical measurements of the blood-pressure show no rise. The fact is that the vaso-motor mechanism which supplements the cardiac vigor increases the blood tension when the latter is enfeebled, and diminishes it when the cardiac strength is not involved. After adequate doses of strychnin hypodermatically, the vaso-motor method of estimating pressure shows the cardiotoxic properties of strychnin. In all instances cardiac auscultation and sphygmomanometry are necessary for estimating the action of cardiotonics. The sphygmomanometer only gauges the force of the left ventricle, and to determine the sufficiency of the right ventricle, auscultation of the cardiac tones is alone adequate. The cardiac chambers, even in health, are not constant as far as their diameters are concerned; on the contrary, they contract and dilate; in other words, their capacity tends to diminish with increasing cardiac vigor; hence percussion shows an increase or diminution in the area of cardiac dullness according to whether the heart is insufficient or sufficient.

SPHYGMOMANOMETRY.

The instrument employed for estimating blood-pressure is called a sphygmomanometer and it is as essential to the physician as is his clinical thermometer. All sphygmomanometers are based on the principle of circular compression of the arm by an arm-piece, *B* (Fig. 66), connected with a manometer (*A*) and an inflating apparatus (*C*). When the arm-piece is sufficiently tight to obliterate the pulse at the wrist, the height of the mercury in the manometer indicates the maximum systolic pressure. With the instruments of Janeway and Stanton, the diastolic pressure

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can also be obtained. The highest pressure in the pulse-wave is the systolic; the lowest, the diastolic; and mean pressure signifies the average of systolic and diastolic pressures. For all practical purposes it is sufficient to estimate the systolic pressure, for it is more often modified by pathologic conditions than the diastolic pressure. The diastolic pressure in a normal pulse is 25 to 40 mm. below

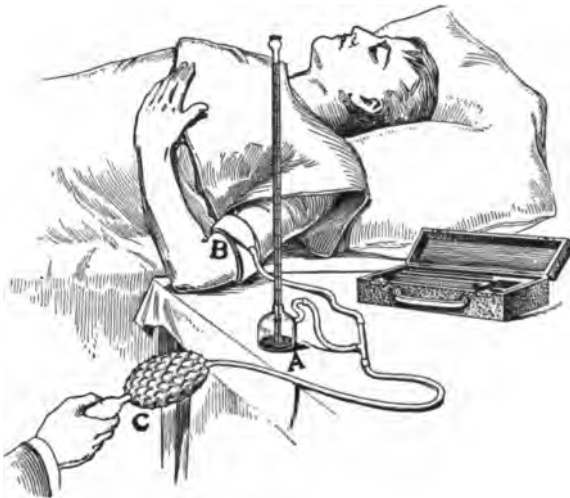


FIG. 66.—Sphygmomanometer of Riva-Rocci (Cook's modification): A, manometer; B, arm-piece; C, inflating apparatus.

the systolic pressure, and in high tension it may be as low as 50 to 80 mm. Many circumstances modify our clinical results, and certain precautions must be taken with the use of all sphygmomanometers. All observations must be made with the patient in the same position; the arm-piece should be applied at the heart-level and should fit accurately. A wide arm-piece (12 cm.) must be employed. The connections must consist of non-distensible tubing. It is, of

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course, better to employ an instrument which measures systolic and diastolic pressures.

The author has frequently noted in his observations the possibility of mistaking his own pulsations for those of the patient. To obviate this error in estimating blood-pressure, he places a rubber ring at the base of his index-finger to exclude the blood, and consequently the pulse from the latter (Fig. 67).

TREATMENT OF HYPERTENSION.

The drugs employed for reducing a high blood-pressure are known as *vasodilators*. They produce paralysis of the vasoconstrictor mechanism, which is first manifested in the



FIG. 67.—Rubber-ring for excluding auto-pulsations.

face by dilatation of the cutaneous blood-vessels (blushing). The redness is not confined to the face, but may extend over the entire trunk. With the flushing there is also a sense of heat, throbbing of the blood-vessels, headache, quickening of the pulse and respiration, and ringing of the ears. The veins are likewise dilated. The dilatation of the arterioles and veins of the splanchnic area leads to a decline in the general arterial pressure. In the administration of the drugs of this class one must push them sufficiently to secure their physiologic effects, and then reduce the dose or stop the drug when the patient complains of throbbing or a feeling of fullness in the head. Some patients show a

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remarkable idiosyncrasy to drugs of this class, reacting to insignificant doses, whereas others are resistant to very large doses. It is evident, then, that one must begin with small doses to test individual susceptibility.

Among the drugs used for lowering blood-pressure are the following:

1. *Amyl nitrite*, which is employed by inhalation. Its action is manifested within fifteen seconds and the symptoms disappear within three minutes.
2. *Erythrol tetranitrate* (tetranitrol). Its effects appear only after an hour and they last about five hours. Dose, one-half to two grains, usually in tablets.
3. *Nitroglycerin* (trinitrin). This drug acts in about two or three minutes, but its effects only last from one-half to three hours. It is official as a one per cent alcoholic solution; *Spiritus glycerylis nitratis*, dose, one to three minims.
4. *Sodium nitrite*, given in doses of from two to three grains. It corresponds in rapidity and duration of action to trinitrin.
5. *Potassium iodid*, although not an active vasodilator, clinical observations show that by its prolonged use, a lowering of blood-pressure may be achieved, probably in consequence of its vasodilator action.
6. High blood-pressure is often maintained as a result of augmented tonus of the vaso-motor center, and is quite independent of vascular disease. It is essentially a nervous phenomenon. Give such subjects sufficiently large doses of *bromids* for several days, and it will be noted that there is a considerable fall in the blood-pressure.

In the opinion of the author, pharmacotherapy is not always satisfactory in the treatment of hypertension for the reason that toleration for the vasodilators is rapidly acquired and for the additional reason that their action is evanescent.

S p o n d y l o t h e r a p y

From what has preceded, one is justified in concluding that, hypertension is often a condition which is desirable and not to be opposed, insomuch as the vasoconstriction may compensate a failing heart. In such instances, vasoconstrictors are injurious and the correct course to pursue is to strengthen the heart and the blood-pressure will fall of its own accord.

The latter effect may be rapidly attained by *concussion of the spinous process of the 7th cervical vertebra* or more slowly by the administration of digitalis.

The following case is cited as a paradigm of many like cases illustrating the preceding fact.

A patient has a blood-pressure of 240 mm. Auscultation and percussion of the heart demonstrate cardiac enfeeblement. Concussion of the spinous process of the 7th cervical vertebra is executed (duration of séance, 5 minutes). The blood-pressure is again taken and found to have fallen 30 mm. Each day thereafter, concussion is executed and, at the end of about ten days, the blood-pressure has fallen to 165 mm., the area of cardiac dullness is diminished and there is a decided strengthening of the heart-tones. Later, in consequence of over-exertion, an examination of the heart shows cardiac enfeeblement and the blood-pressure has risen to 200 mm., but with repetition of the concussion-treatment, the pressure falls to 165 mm.

Now, in a case like the preceding, an examination of the heart would not have been necessary to justify the conclusion, that the high blood-pressure was only an expression of cardiac enfeeblement; estimating the blood-pressure before and after the concussion-treatment would have sufficed to warrant the deduction.

Many erroneous conclusions are formulated concerning the vigor of the heart by aid of auscultation. Here, it is

Hypertension and Hypotension

assumed, that accentuation of the second aortic tone suggests vigor of the left ventricle of the heart, yet one may hear very loud heart-tones in anemic and emaciated persons. The fact is, that two factors contribute to the genesis of the tones of the heart, *viz.*, muscle and valves, and it is often difficult to distinguish the prolonged and dull sound of the former from the short and sharp sound of the latter.

CONCUSSION IN HYPERTENSION AND HYPOTENSION.

The writer has established empirically that, one may rapidly reduce the blood-pressure by applying the concussor (large enough to include two spinous processes, Fig. 50) of a vibratory apparatus yielding a forcible percussion stroke to the spines of the *2nd and 3rd dorsal vertebrae* and maintaining the séance for about five minutes. Hundreds of investigations thus made convince the author that, by this method, one is in possession of a means for reducing pressure heretofore unattainable by pharmacotherapy, insomuch as the results are more rapid and lasting. The following are the records of two arteriosclerotics:

1. Mrs. W.

Blood-Pressure before vibration of the 2nd and 3rd dorsal spines.....	225 mm.
One minute after vibration.....	218 mm.
Two minutes after vibration.....	185 mm.
Three minutes after vibration.....	178 mm.
Fifteen minutes after vibration.....	180 mm.
Thirty-five minutes after vibration.....	178 mm.
Two hours after vibration.....	172 mm.
The following day.....	168 mm.

2. Mr. S.

Blood-Pressure before vibration.....	228 mm.
Two minutes after vibration.....	232 mm.
Five minutes after vibration.....	210 mm.
Eighteen minutes after vibration.....	200 mm.

S p o n d y l o t h e r a p y

Not infrequently, the primary result of concussion is manifested by a temporary rise of pressure followed by a decided fall which attains its maximum in about two hours time. One must not assume, however, that the results in hypertension are always uniform. In some instances no effect is achieved, and the author is constrained to believe that, in such cases, the hypertension is due to cardiac enfeeblement, and it is only after toning the heart that a fall of blood-pressure occurs.

When the blood-pressure is diminished in arteriosclerotics by aid of concussion, it is usual to find a heart showing little or no enfeeblement. If there is no fall of pressure following concussion of the 2nd and 3rd dorsal spines and a fall is only observed *after concussion of the 7th cervical spine*, the high pressure is caused by cardiac weakness and concussion of the spine in question is indicated to reduce pressure which it does by toning the heart.

If a patient has certain symptoms which one assumes are caused by the arterial hypertension, a reduction of the latter by the foregoing method (concussion of the 2nd and 3rd dorsal spines *or* 7th cervical spine) suggests the correctness of the diagnosis and the treatment conducted along the same lines will prove in a relative sense, curable.

Thus in *cerebral arteriosclerosis*, the patient may have headache, vertigo, transient pareses or aphasia. If, following concussion, there is diminished arterial-tension and an abatement of symptoms, the diagnosis is suggested.

LOW BLOOD-PRESSURE.

(Hypotension.)

A systolic pressure below 100 mm., suggests hypotension and is observed in wasting diseases, infections, hemorrhages, collapse and shock and after the use of vasodilators.

L o w B l o o d - P r e s s u r e

SUPRARENAL INSUFFICIENCY.—The “*tache cérébrale*” is a red line with white borders produced by drawing the nail over the skin. It is a vaso-motor phenomenon present in typhoid fever and meningitis, and is without diagnostic significance. Sergent directed attention to a “white line,” which is the converse of the *tache cérébrale*. Like the latter, it is evoked by drawing the finger-nail across the abdominal skin. Within thirty to sixty seconds a white line appears, which persists from two to five minutes. Sergent found the line in Addison’s disease and in a number of specific fevers, all of which were characterized by low arterial-tension. In these cases he found that the administration of suprarenal extract caused the white line and the low tension to disappear. He therefore regards this line as useful in the diagnosis of suprarenal insufficiency and in affections of the capsules. Other French writers have confirmed this observation. The white line is caused by a reflex spasm of the capillaries, and can be provoked in vasodilatation and in conditions of low vascular tension. There is much reason to question the constancy of the white line as a diagnostic symptom. Thus, de Massary failed to observe the sign in six cases of Addison’s disease, even though the arterial tension was very low. Grünbaum finds that the oral administration of suprarenal extract to normal individuals does not cause a rise of blood-pressure, and that when a rise follows exhibition of the drug by the mouth, it indicates suprarenal inadequacy. In doubtful cases the blood-pressure is accurately determined, and then 3-grain doses of the extract are administered thrice daily for three days. The pressure is again estimated, and a distinct increase is very suggestive of Addison’s disease, provided there is no valvular lesion of the heart. Suprarenal insufficiency should be tested whenever asthenia and pigmentation are present.

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The latter are the chief symptoms of Addison's disease, but are likewise present in many other diseases. If there is no bronzing in Addison's disease the application of a mustard plaster will draw the pigment to the surface of the skin.

NEURASTHENIA is often associated with hypotension, in fact, it is the only demonstrable sign in these cases. Such patients usually complain of obscure abdominal symptoms (SPLANCHNIC NEURASTHENIA) and this is not surprising considering the fact that the loss of vaso-motor tone conduces to a large accumulation of blood in the abdominal veins.

TREATMENT OF HYPOTENSION.

It is exceedingly injudicious practice as a routine method, to have recourse to symptomatic treatment, but insomuch as physicians are human and not divine, such treatment is often imperative and indeed efficacious, when the causal factor is not demonstrable.

Thus, in hypotension, many drugs are efficient for influencing collapse and the drugs used for this purpose are the following: Strychnin, camphor, caffenin, strychnin and ether.

The foregoing cardio-vascular stimulants, however, are only temporary in their action.

Much was expected of *adrenalin* in the treatment of hypotension, but, unfortunately, disappointment has attended its employment.

This agent causes a decided rise of blood-pressure, due to its vasoconstrictor action on the blood-vessels and by its direct action on the heart. It causes retardation and strengthening of the heart-beat. The vascular constriction is most pronounced in the splanchnic and muscular vessels, and feeble or absent in the cerebral and pulmonary vessels.

L o w B l o o d - P r e s s u r e

The renal vessels are first constricted, with diminished flow of urine, but dilate with larger doses and increased flow of urine. The augmented blood-pressure almost immediately succeeds the use of the drug, but it is of short duration. It has been found that vasoconstriction is of greater duration than the rise of blood-pressure, and this is explained by the fact that the stimulating effect on the heart is of less duration than the stimulating action of the arterial musculature.

The bath-treatment of typhoid-fever has demonstrated that, the water has a decided hypertensive action on the vaso-motor system and that it produces a rise of the blood-pressure.

The latter result demonstrates the very pertinent fact that cold water acting as a peripheral cutaneous stimulant provokes the heart reflex and, insomuch as the force of the ventricular systole is the primary factor in blood-pressure, the latter rises.

Now, the author has repeatedly demonstrated that there are many individuals showing cardiac enfeeblement in whom there is no response on the part of the vaso-motor mechanism to compensate the failing heart. Here, strengthening of the enfeebled heart by means of digitalis or by concussion of the spine of the 7th cervical vertebra results in a rise of blood-pressure.

The author has established empirically that *concussion of the spines of the 6th and 7th dorsal vertebrae* will raise the blood-pressure. The results, however, are not as uniform as is the method for reducing blood-pressure, and not infrequently, the effects are only noted after a lapse of about two hours.

If the latter method is effective, the results are relatively permanent and many neurasthenics with hypotension can bear testimony to the foregoing statement.

S p o n d y l o t h e r a p y

The duration of the séances is about the same as when concussion is employed in hypertension.

ANEURYSM OF THE THORACIC AORTA.

THE AORTIC REFLEXES.

The course of the upper surface of the normal aorta in the adult of middle life may be projected on the thorax by

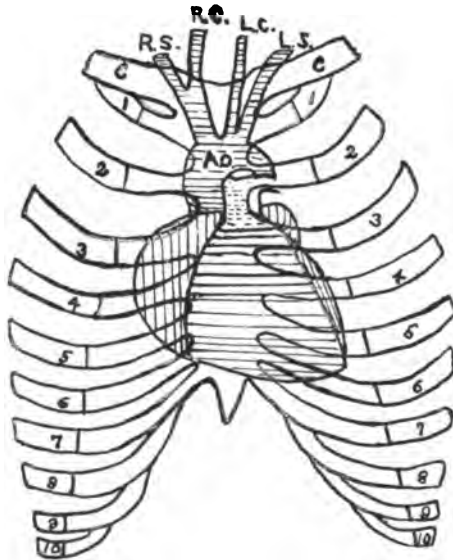


FIG. 68.—Relation of heart and aorta to the chest wall: 1-10, ribs; Ao, aorta; RS and RC, right subclavian and carotid; LS and LC, left subclavian and carotid.

drawing a curved line, beginning at a point corresponding to the right sternal line in the middle of the first intercostal space and ending at the point of insertion of the first left rib to the sternum (Fig. 68). The highest point of the aortic arch is distant about 5 cm., and the beginning 2 cm., from the anterior thoracic wall, hence a forcible percussion blow (which is propagated to a depth of 5 cm.) cannot fail to elicit the dullness of the aortic arch if dilated.

A o r t i c R e f l e x e s

In the norm, the transverse dullness of the aorta at the level of the manubrium extends 2 or 3 cm. to the right of the median line of the sternum and 1.5 to 2.5 cm. to the left of the medial line. If the transverse dullness at this point exceeds 5 cm., the aorta is either dilated or the site of an aneurysm. The aorta is nearest the anterior chest-wall at

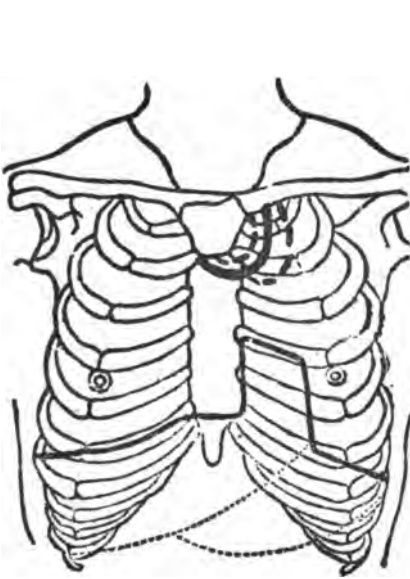


FIG. 69.—Aortic reflex of contraction and dilatation. Front.

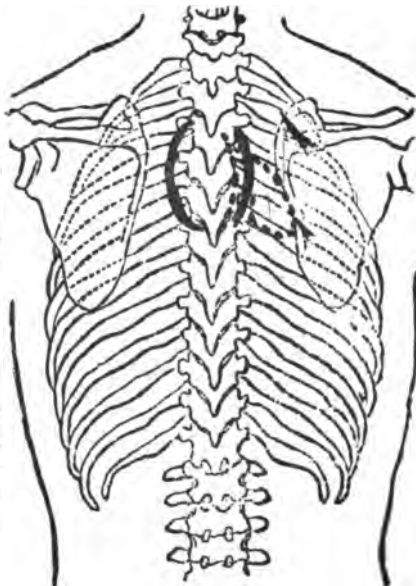


FIG. 70.—Aortic reflex of contraction and dilatation. Back.

the junction of the 2nd right interspace with the sternum. From this point as it arches over to the left, it sinks deeper into the cavity of the thorax so that it eludes percussion.

Concussion of the *four last dorsal vertebrae* (9th to the 12th dorsal vertebra) in succession, by a series of sharp, vigorous blows will, in the norm, dilate the thoracic aorta which can be demonstrated by the x-rays and by percussion. Percussion must be executed at once after concussion of the vertebral spines in question, insomuch as the duration of

S p o n d y l o t h e r a p y

the *reflex of aortic dilatation* is limited (from one-half to one minute). Vibrosuppression (page 80) will aid in defining the course of the aorta.

Concussion of the spine of the *7th cervical vertebra* causes a contraction of the thoracic aorta (*aortic reflex of contraction*). Thus it is, that when one provokes the dilatation reflex, the counter reflex of contraction will, at once, dissipate the former reflex.

Percussion of the vertebral spines is executed by means of the hammer and pleximeter or the hands (Fig. 3).

THE AORTIC REFLEXES IN DIAGNOSIS.

As before remarked, one is able to define by percussion the normal area of the arch of the aorta after concussion of the four lower dorsal vertebræ. Thus it is, that if the diminished resonance or dullness exceeds the norm, either the vessel is dilated or it is the site of an aneurysm. One may remark that if an *aortitis* is present, the reflex of dilatation will reproduce the symptoms peculiar to this affection, *viz.*, pains in the upper sternal region extending through the mediastinum and to the shoulder and arm.

A dull area in the upper thoracic region or in the back (corresponding to the site of the aorta), if caused by a thoracic aneurysm, will show a diminished area of dullness when the spine of the 7th cervical vertebra is concussed (*aortic reflex of contraction*), and an increased area of dullness, when the spines of the four lower dorsal vertebræ are successively concussed (*aortic reflex of dilatation*). Up to the present time of writing, the author has examined 45 cases of aneurysm of the thoracic aorta and has noted an absence of the reflex in only two patients in whom the aneurysms had attained enormous dimensions. All these cases were controlled by skiascopic examinations. With

Aortic Reflex of Contraction

the latter, one may note a contraction and dilatation of the aneurysmal sac when the spines of the special vertebræ are concussed. One may generally observe an almost immediate evanescence of pressure-symptoms (dyspnea, cough and pains) when the sac is brought to contraction after a single séance of vibration-treatment applied to the spine of the 7th cervical vertebra.

THE AORTIC REFLEX OF CONTRACTION IN TREATMENT.

It occurred to the writer when he first employed the aortic reflexes in diagnosis, that if concussion of the 7th cervical vertebra would cause contraction of an aneurysmal sac, this fact would prove advantageous in the treatment of a thoracic aneurysm. The results achieved have exceeded the author's expectations. Only fourteen patients with thoracic aneurysm have thus far been treated by the author according to his method, but they were all advanced cases. Absolutely no results were achieved in one case (the aneurysm had attained an immense size and the sac ruptured). This much may be said for this treatment that the results usually follow after several séances of the concussion-treatment. The first case of aneurysm of the thoracic aorta thus treated was seen in consultation with Dr. A. J. Sanderson, of Berkeley. The following record is presented:

Treatment was commenced July 7, 1905, on which date the patient complained of violent pains in the chest and dyspnea on the slightest exertion. On August 2, 1905, the x-ray shadow of the aneurysm was denser, and the aortic reflexes could not be elicited. The latter I attribute to clot-formation in the aneurysmal sac, which inhibited whatever elasticity remained in the aortic walls. At this date aneurysmal pulsations could no longer be detected by the rays. Dullness, formerly present over the sac on the anterior chest-wall could no longer be elicited. Tracheal tugging

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was barely perceptible. The thoracic pains had disappeared, and there was no longer any dyspnea on exertion. On the first of September, Dr. Sanderson stated that the only symptom which remained at the time the patient left his home was slight tracheal tugging. In all my cases the latter symptom persisted despite the disappearance of subjective symptoms.

Dr. Hubert N. Rowell, of Oakland, directed a patient (male, age 56 years) to me, who noted about four years before coming, the following symptoms: Cough, pressure in the chest, dyspnea and a sensation of suffocation when he assumed the recumbent posture. An examination demonstrated a large aneurysm of the arch of the aorta.

Just before treatment was commenced, the patient could not get more than three hours sleep at night owing to paroxysmal attacks of coughing and choking. After the first treatment he could sleep the entire night, and after two weeks' treatment consisting of daily séances (five minutes duration) by means of vibration applied to the spine of the 7th cervical vertebra, the patient was practically well and there was nothing to indicate the persistence of his original trouble beyond a slight tracheal tugging. During this brief period he gained ten pounds in weight.*

Dr. William Clark, of Alameda, made the following notes concerning a patient whom he sent to me for treatment on February 26, 1909:

Miss G. Age 30 years; native of California.

Complains of croup at night whenever she catches cold.

HISTORY: Measles, whooping-cough and diphtheria; typhoid fever thirteen years ago. Is not sure about scarlet fever. Menstrual history normal. About

*This patient, re-examined after a year, is absolutely well and shows an increase in weight of twenty pounds.

Aortic Reflex of Contraction

eight years ago noticed a choking sensation. This becoming worse, was the reason for consultation. She cannot lie on left side at night; also is quite short of breath upon exertion.

EXAMINATION: Fairly developed; *eyes protruding*; no trouble since using glasses; no headaches; has no pain. Notices that voice is more husky since I last saw her. Is slightly dyspneic at this time. Veins on the anterior part of the chest quite dilated. No pulsation over upper part of chest noticed. Examination of lungs negative. Spleen not palpable. An area of slight dullness over upper part of sternum and to the right. Loud bruit over the arch of the aorta, heard loudest at junction of the clavicle with the sternum on the left side; bruit transmitted to the subclavian and carotids, more so to the left; is also transmitted along the course of the aorta, and is heard over the abdominal aorta; also heard posteriorly over the entire course of the aorta. Radial arteries apparently not atheromatous. With laryngoscope, right vocal cord apparently not as active as the left. This, however, may be erroneous, as there is considerable difficulty in obtaining a clear view, owing to position and contour of epiglottis. No tracheal tugging detected. Left radial-pulse possibly more forcible than right. With x-ray, pronounced pulsation of the arch of the aorta noticed, and arch also noticeably elongated in a vertical line. Heart apparently not much enlarged.

DIAGNOSIS: Aneurysm or dilatation of the aortic arch.

This patient was examined by the author in association with Dr. Clark and the percussional results elicited by inducing the aortic reflexes of contraction and dilatation are noted in Fig. 71.

It was noted that, when the aortic reflex of dilatation was provoked, there was a temporary aggravation of the dyspnea

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and spasmodic cough, but they were at once subdued when the aorta reflex of contraction was elicited. Within several days after treatment was commenced, all the subjective symptoms disappeared and after five weeks' treatment by percussion-massage of the spine of the 7th cervical vertebra the patient was practically discharged. The patient's

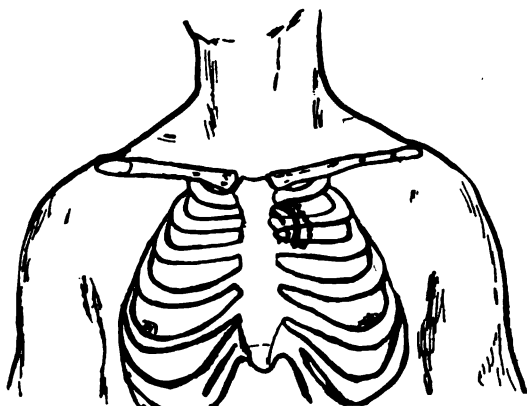


FIG. 71.—Aortic reflexes of contraction and dilatation represented by the dotted lines within and without the continuous line (which represented the area of aneurysmal dullness before elicitation of the aortic reflexes).

exophthalmos disappeared after a few treatments and further reference to this subject is made on page 280.

It is unnecessary to detail the histories of the other cases of thoracic aneurysm beyond saying that the results achieved corresponded in the main to the cases cited.*

*Since the above was written, a gentleman of approximately 53 years of age had developed an attack of whooping-cough which was epidemic. Cough and laryngitis persisted for over four months. Examination demonstrated the presence of an aneurysm of the thoracic aorta. The question naturally arose, Was the cough due to the whooping-cough or aneurysm? *Concussion of the 7th cervical vertebra* was executed and it was not until the sixth séance that the cough and laryngitis abated, showing that the aneurysm alone was responsible for his cough. Unlike my other cases of aneurysm, the cough *did not yield* to the first concussion-treatment. Again, the aneurysm as a sequela of whooping-cough is interesting. I had examined the patient while under the care of Dr. Grant Selfridge in the commencement of his attack of pertussis and found absolutely no signs of an aneurysm. The patient in question had absolutely no more attacks of coughing after the twelfth treatment and the area of aneurysmal dilatation was no longer evident by percussion.

Aortic Reflex of Contraction

Now, a few words are necessary respecting the method of treatment. In the therapeutic elicitation of the vertebral reflexes, notably, the aortic reflexes, the vibratory apparatus which the physician must employ is one giving the percussion stroke. All other motions, such as oscillations, shaking, and friction interfere with results; in other words, *one must select an apparatus which percusses*. First, dust some talcum powder over the site of the spine of the 7th cervical vertebra to avoid irritation from any friction of the pad connected with the apparatus; next, cover the spine of the vertebra with several layers of lint which are attached to the skin by adhesive plaster. After this, the percussion stroke may be communicated directly to the spine of the 7th cervical vertebra, or indirectly, if the skin is sensitive by interposing a strip of linoleum. The daily séances according to results, may last from five to fifteen minutes, but during the séance the treatment must be interrupted from time to time to avoid irritation of the skin. The latter may be avoided if the operator directs the patient to inform him the moment a burning sensation is experienced.

The author only employs the pneumatic hammer (Fig. 50) for concussion and, insomuch as there is no friction, the preceding precautions are unnecessary to avoid irritation of the skin.

In the absence of a suitable apparatus one may employ a pleximeter (a strip of linoleum) applied to the 7th cervical spine which is struck a series of rapid and moderate blows by means of a hammer to the end of which is fixed a large piece of hard rubber. It is wise in this method, to protect the spinous process with a thick layer of lint.

The author has not the hardihood to regard his method of treatment of aneurysm of the thoracic aorta as curative, for time alone is the decisive factor; yet a conservative

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estimate of the results thus far achieved prompts him to say that as a palliative method, it surpasses any which has yet been recommended to the profession.

The *diagnosis* of aneurysm of the thoracic aorta, despite our physical methods of examination, is often fraught with difficulty, but the latter is minimized if the physician will remember the following facts: Symptoms suggestive of an aneurysm of the thoracic or abdominal aorta are accentuated after concussion of the spines of the four lower dorsal vertebræ and they are mitigated after concussion of the spine of the 7th cervical vertebra, although several séances may be necessary to note the latter result.

Further, an area of percussional dullness which enlarges when the four lower dorsal vertebræ are concussed and diminishes when the spine of the 7th cervical vertebra is concussed, suggests an aneurysm.

It is reasonable to assume that an aneurysm of the abdominal aorta would be similarly influenced by the manœuvres suggested, but the author is in the possession of no evidence to permit him to cite a supposition as a fact.

ANEURYSM OF THE ABDOMINAL AORTA.

Since the foregoing was written, a patient was referred to me by Dr. E. N. Torello. The patient in question (male, age 65) had excruciating pains referred to the abdomen and thorax for nearly a year, which resisted all methods of treatment and necessitated the constant use of analgesics. An examination revealed signs of arteriosclerosis and a dullness in the left lumbar region; *the area of dullness increased when the four lower dorsal spines were concussed and diminished when the 7th cervical spine was concussed* (Fig. 72).

Beyond the latter, nothing was demonstrated, although

Abdominal Aorta

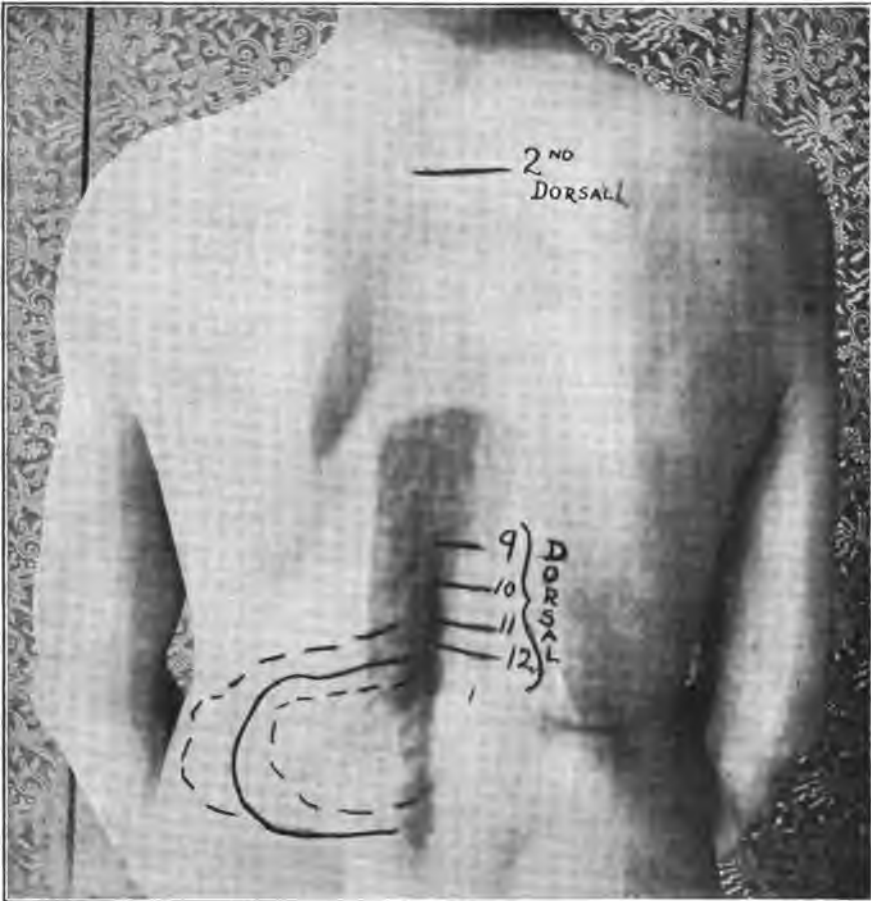


FIG. 72.—Area of dullness in aneurysm of the abdominal aorta. The continuous line represents the area of dullness before concussion, whereas the dotted line within the latter, is the aortic reflex of contraction (concussion of the 7th cervical spine), and the dotted line without, the aortic reflex of dilatation (concussion of the spines of the four lower dorsal vertebrae). It is interesting to observe that the percussion-sign in question was the only evidence suggesting an aneurysm and the diagnosis was established later by other signs.

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the latter sign suggested an aneurysm of the abdominal aorta. Some weeks later the author again examined the patient with Dr. H. Sawyer, and a definite tumor could be felt with an expansile pulsation and a slight thrill. The diagnosis having been definitely established, treatment consisting of concussion of the spine of the 7th cervical vertebra was commenced; the daily séances lasting about ten minutes. After the fourth treatment the pains continued with the same intensity (night and day) as before, but the pains were strictly localized on the left side of the abdomen. Until about the tenth séance, the patient asserted that the pains were not mitigated. The latter statement was discouraging considering the fact that in the author's experience, the symptoms of thoracic aneurysm had usually yielded to a few treatments. After the tenth séance, however, the pains gradually became less intense and analgesics were no longer required.

There was later, however, a decided interruption in the improvement of the patient owing to the fact that one morning, after considerable straining at stool, the pains recurred with almost the same violence as before, but a continuation of the treatment by concussion caused the pains to disappear gradually, and at the time of writing, the patient is practically well. It may also be noted, that coincident with the recurrence of pain after straining at stool, the dullness in the left lumbar region was demonstrable. Straining at stool increases intra-abdominal pressure and rupture of an aneurysm is very likely to occur.

The author wishes to emphasize that in all his aneurysmal patients, *concussion was the only method of treatment employed*. Considering the results attained in aneurysms of the aorta, it is not beyond the domain of reason to hope for like results in aneurysms of other vessels.

Reflex of Abdominal Aorta

REFLEX OF THE ABDOMINAL AORTA.

The 12th dorsal spine corresponds to the aortic orifice in the diaphragm and also to the celiac axis. It is known that the most frequent site of an aneurysm of the abdominal

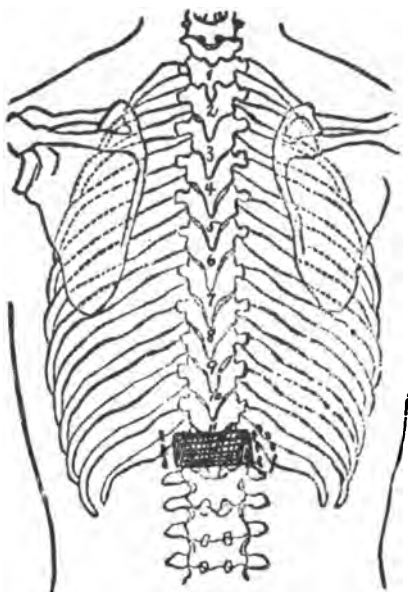


FIG. 73.—Area of dullness corresponding to the 12th dorsal vertebra and representing the reflex of the abdominal aorta after concussion the four lower dorsal spines with the hammer and pleximeter (Fig. 2). The increased area of the dullness represented by the dotted lines on both sides suggests a dilatation of the aorta, whereas the irregular dotted line on one side suggests an aneurysm.

aorta is just below the diaphragm in the neighborhood of the celiac axis. In the norm, the area over the 12th dorsal vertebra and to either side yields a resonance on percussion. If one strikes in succession the four lower dorsal spines, the normal resonance over the 12th dorsal vertebra and to either side yields a dullness which in the average subject measures about 5 cm. (Fig. 73).

If the lumbar vertebræ show resonance on percussion

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prior to the elicitation of the aortic reflex of dilatation, a dullness is likewise noted over the four first vertebræ in question.

The dullness over and to the right and left of the 12th dorsal vertebra is caused by distension of the aorta. It persists for several minutes or may be dissipated at once by evoking the counter aortic reflex of contraction (concussion of the 7th cervical spine). Vibrosuppression (*q. v.*) will accentuate the dullness. If the dullness at the 12th dorsal vertebra exceeds 6 cm. in diameter, one may conclude the existence of a dilated aorta and, if the dullness is irregular, an aneurysm of this vessel may be suspected.

Since the author has elaborated the reflex of the abdominal aorta, he has recognized several cases of abdominal arteriosclerosis (by the augmented area of dullness) and by concussion of the 7th cervical spine, he has successfully treated the cases in question.*

In this connection the author wishes to refer to the valuable observation of Buch. According to the latter, arterio-sclerotic abdominal colic is specially amenable to theobromin (1.5 to 2 gm. a day), diuretin (3 to 4 gm. a day) or tinct. strophanthi (5 to 8 drops three times a day). No other form of abdominal colic is thus relieved.

PHYSIOLOGY OF THE AORTIC REFLEXES.

Claude Bernard's interesting observations advanced the clinical study of vaso-motor phenomena. He found that when the sympathetics in the neck of a rabbit were cut,

*Thus in one patient, the disease presented the picture of a *mucous colitis*. The abdominal aorta (elicited by the reflex) measured 8½ cm. at the 12th dorsal vertebra. The attacks had resisted treatment for a year, yet three séances of concussion of the 7th cervical vertebral spine, sufficed to ameliorate the attacks and they were later inhibited by further treatment. Concussion in augmenting the contractility of the dilated aorta merely contributed to the value of this vessel as a peripheral pump, thus yielding a better supply of blood.

Clinical Observations

the blood-vessels in the ear on the corresponding side became dilated and that if the peripheral ends were stimulated, the ear became blanched. Those who are adepts in manual therapy find that manual pressure along the vertebral column will evoke either vasoconstriction or vasodilation; the former by brief and the latter by continuous pressure. It is evident that in explaining the genesis of the aortic reflex of contraction, one is concerned with stimulation of the vasoconstrictor nerves, the centers of which are chiefly in the medulla, where they pass into the cord and emerge with the anterior roots as preganglionic sympathetic fibers. These fibers are not only capable of altering the caliber of the vessel, but by means of continuous stimuli passing over them, they maintain the tone of the vessels.

The aortic reflex of dilatation is associated with stimulation of the vasodilator nerves, the reflex centers of which are located in the medulla and throughout the spinal cord. From the latter situation, they emerge with the posterior spinal nerves. The author seeks to explain the aortic reflexes by either stimulation of definite vasoconstrictor and vasodilator nerves or their centers in the cord, and he has established empirically that concussion of the 7th cervical vertebra stimulates the aortic constrictor nerves, whereas the dilator nerves are excited by concussion of the spines of the four lower dorsal vertebræ.

THE PSYCHOLOGY OF CLINICAL OBSERVATIONS.

When the author published his original communication⁵⁸ on the subject of the aortic reflexes, he was the recipient of many letters, the burden of which represented the inability of the correspondents to confirm the observations of the author. It was impossible to answer all the communications at that time and, as this is an opportune moment, I will

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now endeavor to answer some of them. One of the most eminent physiologists in this country protested that considering the pathologic condition of the walls of the aorta in aneurysm of that vessel, it could not in consequence be excited reflexly to alternate contraction and dilatation. Again, such clinical observations could not be accepted unless corroborated by physiologic investigations. No one can gainsay the fact that pulsation is an important sign of an aneurysm, and insomuch as this phenomenon is dependent on the elastic recoil of the walls, it follows, that elasticity of the vessel is not annihilated in aneurysm of the vessel. It is true, as the author has frequently observed, that the walls of the aneurysm do not contract nor dilate equally in eliciting the aortic reflexes; in fact, there may be no perceptible change under the influence of the reflexes at one point, but a decided change at another point, although in every instance some perceptible change was observed. Theoretically, at least, the aortic reflex will persist as long as the aneurysm pulsates.

It is now many years since Langenbeck employed ergot hypodermatically in the treatment of aortic aneurysms. He argued, that this drug by stimulating muscular tissue produced vasoconstriction and in this action the cure of an aneurysm could be effected. A storm of protest was engendered by this suggestion, his opponents declaring that the middle coat of the aorta did not contain sufficient muscular tissue to enable it to contract.

Theoretically, one would suppose that because the aorta is almost entirely composed of fibrous tissue, it is not likely to possess any contractile power, but it has such a power, nevertheless. In the case of a criminal executed at Würzburg, it was found to contract by aid of electricity immediately after death.⁵⁹

Clinical Observations

Even though the physiologist denies that the aorta possesses contractility he must be equally consistent and deny the evidence of the x-rays, which prove that the pathologic as well as the physiologic aorta shows contractility. Until the advent of the x-rays we accepted the statement of the physiologist that the diaphragm flattened with each inspiration, but the rays demonstrated that its curve is always maintained unaltered, and in its excursions it plunges piston-wise up and down. Physiologists have always taught that the central tendon of the diaphragm is capable of only limited movement in respiration, hence the respiratory mobility of the heart is likewise restricted. The rays, however, disproved the fallacy of this contention as well as many others which space will not permit us to cite.

The clinician no longer regards the pronouncement of the physiologist as apodictic. We have learned to discredit many statements emanating from the laboratory-investigator, not so much because the observations of the latter are faulty, but because there is a considerable difference between a laboratory and the bedside and a guinea-pig and patient. Many of the facts derived from the laboratory suggest the comment of the mathematician who, having demonstrated a new mathematical theory, thanked God that it could not be of the slightest utility to any living soul. Neither the pathologist nor the physiologist should forget that, "Pathology is the physiology of the sick." The presence of bronchodilator as well as bronchoconstrictor fibers in the vagus was conclusively established by the physiologic investigations of Dixon and Brodie in 1903, yet the author demonstrated seven years before by a simple *clinical observation* that the vagus must contain bronchodilator as well as bronchoconstrictor fibers.⁶⁹

The final court of decree of the clinician is neither the

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physiologic nor pathologic laboratory. To test a given function one must compare it with a like function in individuals of the same species. Thus, if the same quantity of uric acid were excreted in a mammal as is excreted in a normal bird, it would have to be regarded as pathologic. If disease were wholly a question of demonstrable lesions then the pathologist would be compelled to deny the existence of the so-called functional diseases. In consequence of this conflict between the laboratory and clinical investigator, a hiatus has arisen which is now occupied by clinical pathology, a branch which endeavors to conciliate scientific and empirical medicine. Several years ago, the writer observed that one could make the record of the pulsations of the head and, furthermore, that the cephalograms thus obtained in certain subjects were pathognomonic of cerebral arteriosclerosis. Investigating this subject further in the physiological laboratory of the University Hospital, London, and in Paris, the writer did not obtain the slightest clue to the cephalic pulsations and he questions, whether he is justified in rejecting a clinical observation which does not permit of physiologic demonstration in animals. One vituperator condemned my method of treating aneurysms as absurd, because it was not responsive to reason. My vituperator recalled the erudite German professor of economics who received a bed as a present. Until the small hours of the morning he busied himself with abstruse calculations to determine whether he was large enough for the bed or if the latter were large enough for him. Finally, he was struck with the happy idea of getting into the bed, and to his intense delight discovered that it was admirably suited to his proportions. If my detractor were endowed with the true scientific spirit, he would not have condemned a new method of treatment without a trial, considering the kaleidoscopic

Clinical Observations

changes constantly arising in all branches of science. The scientist rejoices one day at the birth of a new theory and officiates at its burial on the morrow. In 1903, in several issues of "*The London Lancet*," a discursive polemic was agitated on the subject of my "lung reflex." It was quite evident that one of the disputants did not rigorously execute the method for eliciting the reflex in question but failed to cite this reason for condemning it, although others employed the reflex as a clinical sign of value. Many new methods for a like reason have been relegated to oblivion. Some time ago, while in Paris, the writer found several clinicians who elicited the heart reflex as a routine method of examination and appeared quite content with the sign. The writer demonstrated that the sign as elicited was of no value, insomuch as when the precordial region was stimulated, it likewise evoked the lung reflex which also diminished the area of cardiac dullness, and that, in consequence, one could only rely on the deep area of cardiac dullness as an index of myocardial retraction. A prominent Eastern clinician spent several days at the author's office investigating visceral reflexes. One of the patients submitted had an aneurysm of the thoracic aorta. Here the aortic reflexes were the object of study. It was impossible to convince the clinician that there was any modification of the area of dullness after the elicitation of the reflexes, until the writer compelled him to close his eyes while percussing, when the results of percussion tallied.

The author regrets the necessity of obtruding his personality in the discussion of this subject, but considering the theoretic objections to his method of treatment, he feels that any merit attached to it may be obscured by its simplicity.

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THE VASO-MOTOR APPARATUS.†

The muscular walls of the blood-vessels (arteries, veins* and capillaries) are under the control of the vaso-constrictor and vasodilator nerves. The latter act chiefly on the walls of the small arteries (arterioles). If the vaso-constrictor nerves are stimulated, the arterioles contract and, in consequence, the resistance to the flow of blood is augmented, the pressure in the arteries rises and the capillary and venous pressures fall. A contrary effect is produced on stimulation of the vasodilator nerves. The nervous mechanism presiding over *vascular tone* concerns itself with the following:

1. Ganglia of the blood-vessels; example: pallor from cold and hyperemia from heat.
2. Anomalies of the sympathetic ganglia; example: facial hyperemia in lesions of the cervical ganglia.
3. Reflex action through the spinal cord; example: pallor from pain.
4. Reflex action through the medulla oblongata; example: glycosuria subsequent to sciatica.
5. Impulses from the cortex of the brain; example: blushing.

The *splanchnic area*† is most abundantly supplied with vaso-motor nerves and it is this region which is specially concerned in the distribution of blood and the general blood-pressure.

*Mall has shown that stimulation of the splanchnics will cause contraction of the portal system and thus send twenty-seven per cent of the total quantity of blood in an animal into the right heart.

†This subject is further discussed on page 278.

‡The splanchnic area includes the vessels supplied to the intestinal tract, liver, kidneys and spleen.

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In the norm, by aid of the regulatory mechanism of the vaso-motor nerves, each part of the body receives an amount of blood necessary for its activity and the greater the latter, the more blood it will receive in consequence of vasodilation. Simultaneously, the vessels in other parts of the body are contracted, and it is by this vascular reciprocity between

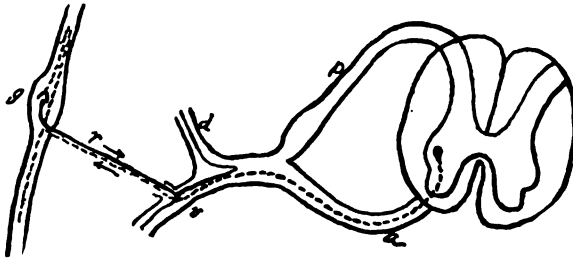


FIG. 74.—Illustrating the path of a vasoconstrictor nerve; A, anterior root, showing the course of the preganglionic fiber as a dotted line; D.V., dorsal and ventral branches of the spinal nerve; R, ramus communicans; G, sympathetic ganglion. The postganglionic fibers in each ramus come from the sympathetic ganglion with which it is connected. The preganglionic fibers entering at any ganglion may pass up or down to end in the cells of some other ganglion (Howell).

the different regions, that the normal blood-pressure is maintained.

Vasoconstrictor or dilator effects may be produced at the periphery by means of *vaso-motor reflexes*. Thus, if the right hand is immersed in cold water, the temperature falls in the left hand, and one also observes the red cheek on the implicated side in pneumonia. The vaso-motor reflex consists of sensory impulses which enter the spinal cord with the posterior nerve-roots and by irritating the centers in the cord excite constrictor or dilator effects. The cells of the vesicular columns of Clarke are supposed to be the seat of the reflexes in question.

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THE VASOCONSTRICTOR NERVES.

The vasoconstrictor nerves which supply the skin, trunk and extremities, emerge from the ganglion (Fig. 74) to the corresponding spinal nerve by way of the gray ramus, and, after attaining the spinal nerve, they accompany it to its corresponding region.

The chief center for the vasoconstrictor nerves is in the medulla, but throughout the entire length of the spinal cord (excepting the cervical region and lowest part of the lumbar region), there are subsidiary centers.

The majority of the vasoconstrictor nerves emerge from the central nervous system in the anterior nerve-roots.

The following table shows the location of the vasoconstrictor neural cells in the segments of the cord :

DISTRIBUTION.	ORIGIN.
Brain, face, scalp, mucosa of the nose, mouth, salivary glands, ear and eye.	2nd, 3rd and 4th dorsal segments.
Esophagus and stomach.	4th to the 9th dorsal segments.
Small intestines.	6th dorsal to the 2nd lumbar.
Liver.	6th dorsal to the 1st lumbar (chiefly in the 10th, 11th and 12th dorsal).
Pancreas, spleen and suprarenals.	8th to the 12th dorsal.
Large intestines.	11th dorsal to the 2nd lumbar.
Bladder, uterus, external organs of generation, ovaries, testicles and prostate gland.	11th dorsal to the 2nd lumbar segments.

THE VASODILATOR NERVES.

These nerves are characterized as follows :

1. The latent period for their stimulation is longer than that of the constrictors.

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2. It takes a longer time to attain the maximum effects on the dilators than it does on the constrictors.
3. The after-effect is longer.
4. The vasodilators, unlike the vasoconstrictors, are not in tonic activity and they appear in activity only during the functional activity of an organ as in the case of the erectile tissue of the penis.

The vasodilator neural cells supplying the blood-vessels of the head, scalp, face, eye and mouth are chiefly located in the nuclei of the cranial nerves. The vasodilator cells for the abdominal organs are found in the nucleus of the 10th cranial nerve and for the pelvic organs and the testicles in the 3rd, 4th and 5th sacral segments of the cord. Vasoconstrictor and vasodilator cells for the nutrient blood-vessels of the lungs and bronchial tubes (bronchial arteries), have been located with a degree of certainty in the 3rd to the 7th dorsal segments of the cord.

PATHOLOGY OF THE VASO-MOTOR NERVES.

(VASO-MOTOR NEUROSES.)

A vasomotor neurosis is expressed either as a spasm of the vessels (angiospasm) or less often as a paralysis (angio-paralysis).

ANGIOSPASM is characterized by pallor, coldness and trophic disturbances. If the spasm affects the superficial vessels, the following symptoms occur: sensory disturbances (tingling, anesthesia and analgesia) and *cutis anserina* (goose-skin). When the spasm involves larger vessels, one observes the condition known as *intermittent claudication*, in which the patient in walking suddenly loses the power in his legs.

Cases of temporary aphasia, numbness and paralysees are provoked by a like angiospasm of the cerebral vessels.

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The veins may likewise be implicated in a spasm and the blood, not being able to escape from the capillaries, the parts become blue and edematous, nutrition is impaired and gangrene may ensue.

ANGIOPARALYSIS may be caused either by diminished function of the vasoconstrictor nerves or by excessive action of the vasodilators. The symptoms are similar to those observed in spasm of the veins (*vide supra*). In the condition known as *causalgia*, the blue, cold and edematous part is associated with severe pains of a burning character.

In the condition known as *erythromelalgia*, pain, tenderness and congestion of the soles of the feet are associated with a burning pain not unlike that produced by a blister. The vaso-motor phenomena occur paroxysmally and are resistant to treatment.

Another vaso-motor neurosis is the so-called *angioneurotic edema*, in which there is a sudden swelling of some part (face, neck, larynx or an extremity).

Loss of vascular tone is observed in neurasthenia, hysteria and at the menopause; there are sudden flushes or pallor.

Individuals with a "poor circulation" have cold hands or feet or the face is constantly congested.

We have also the less understood *visceral angioneuroses* characterized by hyperemia, transudations and ecchymoses.

There is an old Latin aphorism, "*Naturam morborum curationes ostendunt*" (cure shows the nature of diseases). In this sense, the pathology of many diseases is revealed by the results of treatment. In accordance with the preceding aphorism, the author contends that, there are many diseases regarded as distinct affections which are merely symptomatic of a fundamental condition, *viz.*, instability of the nervous mechanism which controls local vascular tone. This faulty mechanism, which the author is pleased to call *angio-ataxia*,

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has already been referred to on page 275. It is reasonable to assume that the chief dereliction of action of this mechanism is resident in the vaso-motor centers of the spinal cord.

The author submits the following classification of angioneuroses based on the results of treatment:

ANGIOSPASM.

Symptoms: no vaso-motor reflex on irritation, skin shrunken or thrown into folds, arrested metabolism and function due to insufficient blood-supply and sensory disturbances (numbness, tingling, anesthesia and analgesia).

ANGIOSPASTIC AFFECTIONS. 1, intermittent claudication; 2, temporary paroxysms of paralysis, aphasia or hemianopsia due to spasm of the cerebral vessels; 3, reflex spasm of the vessels of the leg in *sciatica*. Nothnagel has reported five cases of the latter affection which eventuated in partial paralysis, sensory disturbances and atrophy; 4, Raynaud's disease; 5, migraine; 6, akroparesthesia.

ANGIOPARALYSIS.

Symptoms: red or mottled appearance of the skin, subjective sensation of heat, sensory disturbances (hyperesthesia and hyperalgesia), notably, a burning sensation (causalgia). The primary symptoms of redness and heat are usually succeeded by blueness, cold and impaired nutrition. The *taches cérébrales* of Trousseau, formerly regarded as pathognomonic of meningitis, is essentially an angioparalysis indicating enfeebled vasoconstrictor action. The sign is elicited by slight irritation of the skin with the finger-tip or a pencil; a white line appears followed by a bright red discoloration which persists for several minutes. *Dermatographism* is closely related to the foregoing sign: wheals in lieu of a white spot or line appear after cutaneous irritation.

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ANGIOPARALYTIC AFFECTIONS: 1, erythromelalgia; 2, acrodynia; 3, aneurysm; 4, exophthalmic goitre; 5, diabetes; 6, coryza; 7, cold extremities; 8, angioparalytic symptoms of the neuroses; 9, certain toxic conditions.

Some of the foregoing conditions will be described more fully under treatment of the vaso-motor neuroses.

TREATMENT OF THE VASO-MOTOR NEUROSES.

The author presents the following table of the vaso-motor nerves in relation to the spinous processes, the object being to stimulate clinical observations in the treatment of the vaso-motor neuroses which is conceded to be a difficult matter:

ORIGIN OF THE VASOCONSTRICTOR NERVES.

AREA SUPPLIED.	DERIVATION.	RELATION TO SPINOUS PROCESSES.
Head.	First three dorsal nerves.	6th and 7th <i>cervical</i> spines.
Arm.	Seven upper dorsal nerves.	6th <i>cervical</i> spine to the 4th <i>dorsal</i> spine.
Leg.	Five lower dorsal and first lumbar nerves.	5th to the 9th <i>dorsal</i> spine.
Abdominal Viscera.	Splanchnic nerves which are made up of fibers from the 5th to the 12th dorsal nerves inclusive.	2nd to the 8th <i>dorsal</i> spine.

ORIGIN OF THE VASODILATOR NERVES.

AREA SUPPLIED.	DERIVATION.	RELATION TO SPINOUS PROCESSES.
Buccofacial region.	2nd to 5th dorsal nerves.	6th <i>cervical</i> to the 2nd <i>dorsal</i> spine.
Eye, head and ear.	8th cervical and 1st dorsal nerves.	6th <i>cervical</i> spine.
Arm.	Five upper dorsal and last cervical nerves.	5th <i>cervical</i> to 2nd <i>dorsal</i> spine.
Leg.	6th to the 12th dorsal nerves, inclusive.	3rd to the 8th <i>dorsal</i> spine.

In the experience of the author the foregoing table is of slight value in treatment with relation to the vasoconstrictors of the head, arm and abdominal viscera (page 349), but it

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serves of no value in influencing the vasodilators in treatment.

In eliciting the aortic reflexes (page 254), *vasoconstriction of the aorta is best attained by concussion of the 7th cervical spine and vasodilation, by concussion of the spines of the four lower dorsal vertebrae.*

The author has found that the same rule holds good for practically all the vessels of the body, and this fact simplifies the treatment of the vaso-motor neuroses. Of all the methods investigated by the author for influencing the vaso-motor centers in the spinal cord, no method is comparable to that of concussion; in fact, it is the only method. Even in the norm, if concussion is executed over the 7th cervical spine, usually within a minute, vasoconstriction as evidenced by some pallor is noted in the hands, face and feet, whereas concussion of the four lower dorsal spines overcomes the constriction and redness and even congestion substitutes the pallor. These effects are more conspicuous when there is a diminished function of either the constrictors or dilators. Naturally, the conspicuity of pallor or redness is merely relative, and one must look sharply for the change.

The author has treated a very large number of patients with vaso-motor instability (angio-ataxia) and, when the affection was characterized by angiospasm, the four lower dorsal spines were concussed, whereas in angioparalyses, concussion of the 7th cervical spine was executed.

Results were achieved in practically all instances after repeated treatment, provided a reaction could be elicited, *i.e.*, when concussion of the 7th cervical spine would replace hyperemia by anemia, and when concussion of the spines of the four lower dorsal vertebrae would substitute hyperemia for anemia.

Very often the reaction could not be noted until after several treatments.

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MIGRAINE (hemicrania; sick headache).—The pathology of this disease is obscure and the innumerable affections to which its origin has been attributed probably act as exciting factors of a basic condition, *viz.*, angio-ataxia. Many writers regard migraine as a vaso-motor neurosis; in fact, a former classification of two varieties of the affection is no longer viewed with tolerance by clinicians: 1, an angio-spastic form characterized by pallor of one side of the face; 2, an angioparalytic form, manifested by redness of one side of the face. Those who support the vaso-motor theory of migraine contend that the early symptoms are caused by vasoconstrictor and the later symptoms by vasodilator influences. The author has treated about eight cases of migraine by concussion of the 7th cervical spine based on the theory of instability of the vaso-motor center in the spinal cord. The attacks were subdued in four cases, relieved in two patients and the attacks in two other patients were un-influenced. The treatment must be executed in the inter-paroxysmal periods.

EXOPHTHALMIC GOITRE (Grave's, Basedow's or Parry's disease).—This disease is characterized by protrusion of the eyes (exophthalmos), enlargement of the thyroid gland, tremor and rapid heart-action (tachycardia). The theory which has gained most favor in explaining the symptoms of the disease is, that it is caused by a hypersecretion (hyperthyroidism) of the thyroid gland conducing to a kind of chronic intoxication. There is, however, a gap in the theory which evades the question, What causes the hyperthyroidism? Based on the results of his treatment, the author is constrained to believe that the disease is essentially an angioparalytic affection and that stimulation of the vaso-motor center in the cord by concussion of the 7th cervical spinous process suffices to relieve and even cure the affection in

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question. Every successful method of treatment in this disease, medical or surgical, has been directed toward a reduction in the size of the thyroid gland, and it is reasonable to assume that one can stimulate or diminish the activity of this gland by increasing or diminishing its circulation.

Among the symptoms which yield most rapidly to treatment by concussion are tachycardia, flushing and tremor. Among six cases of the disease treated by the author the latter signs, plus the enlarged thyroid, were improved after a few treatments by concussion, but the exophthalmos in all but two cases persisted (although less pronounced). In all the cases, a decided retraction of the protruded eyes was noted after each treatment.

The following notes concerning one patient suffice to illustrate in the main the results of treatment:

The patient presented all the cardinal symptoms of the disease. The pulse-rate was 160; tremor involved practically every muscle of the body; the slightest exertion was associated with perspiration; the thyroid was enlarged.

After the third treatment by concussion, the pulse was 130, and after the eighth treatment, it was reduced to 88, and so remained after the patient was discharged. After the fifth treatment, the tremor was perceptibly diminished and perspiration following exertion no longer occurred. As shown in illustrations (Figs. 75, 76), although the exophthalmos persisted, it was less conspicuous, whereas the thyroid gland is practically normal in size.

DIABETES MELLITUS.—The pathology of this disease is obscure. In the celebrated *piquière* experiment of Claude Bernard, diabetes in an animal can be produced by irritating the floor of the 4th ventricle. Since then it has been shown that irritation of other parts of the nervous system will

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produce diabetes. In consequence of the preceding, there has arisen a neurotic theory of diabetes which supposes it



FIG. 75.—Photograph of a patient with exophthalmic goitre.

to be caused by a vaso-motor paralysis, resulting in a greater quantity of blood flowing through the liver.

The author, giving credence to the latter theory, has

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treated ten diabetics by concussion of the spine of the 7th cervical vertebra* and the results were as follows:



FIG. 76.—Same patient after three weeks treatment (concussion of the spine of the 7th cervical vertebra).

1. No results in three cases.
2. The percentage of sugar very much reduced in four cases.

*The author wishes to emphasize the following: In testing the methods of treatment employed throughout this book, recourse was had to no other therapeutic procedure. Not even *rest*, so essential in the treatment of aneurysm, was enjoined.

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3. Slight reduction in the percentage of sugar in one case.
4. Disappearance of glycosuria in two cases. The duration of treatment in the latter cases extended over a period of one and two months respectively.

CORYZA (Cold in the Head).—The prevention and treatment of this condition is a constant rebuke to progressive medicine, inasmuch as we have added nothing to that contributed by our medical ancestors. The sequelæ of a cold in the head include affections ranging from sinusitis to cerebral abscess. The prevailing theory regards coryza as a nasal infection varying in virulency according to the microbial cause. If, however, it were wholly an infection, then in a region so accessible to the employment of bactericides, the latter must be discredited. The infectious factor must be regarded in the same light as any other peripheral irritant which, acting reflexly upon the vaso-motor center, causes all the symptoms of an angioparalysis. This angioparalysis need not necessarily be excited from the nasal mucosa but from other vulnerable areas. The vaso-motor theory of coryza is partially sustained by the author's method of treatment, *viz.*, *concussion of the 7th cervical spine*. When the latter is executed in the incipiency of the affection, it may be aborted. Later, it modifies the condition either by diminishing its severity or by altering the character of the discharge.

When the nose is obstructed in consequence of congestion of the nasal mucosa, a few concussion-blows on the spine of the 7th cervical vertebra will often overcome the obstruction as effectually as cocain, and the relief thus obtained may last from minutes to hours.

Very often the author instructs a friend of the patient to strike the spinous process (after the manner shown in Fig

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3), whenever the nose is obstructed or, to execute it as a method of treatment, several times a day.

Naturally, the spinous process will become sensitive when concussed repeatedly and, in this event, it may be struck at different angles—directly or on one side or the other.

In *asthma*, reflexly provoked by congestion of the nasal mucosa, concussion as cited by giving immediate relief to the nasal congestion will inhibit the asthmatic paroxysm. The nasal mucous membrane is continuous with the lining membrane of the pharynx, Eustachian tubes, larynx, trachea and bronchial tubes and concussion is equally influential for weal in acute congestion of the same membrane irrespective of location. Thus many acute congestions of the bronchial mucosa may be aborted by concussion of the 7th cervical spinous process.

COLD EXTREMITIES.—This frequent condition has never, to my knowledge, been dignified by a technical name, and the author proposes the term *acropsychrosthesis*, signifying a feeling of cold in the extremities.

The effects of cold upon the skin (*dermatitis congelationis*) as in that common condition known as chilblain or pernio are really caused by insufficiency of the vaso-motor apparatus and the writer has successfully treated this obstinate condition by repeated séances of concussion of the spinous process of the 7th cervical spine. During treatment, if the parts are hyperemic, one may note definite areas of anemia in the hands, feet or face.

Many circulatory disturbances in the face, notably *acne rosacea*, are likewise vaso-motor neuroses and they also yield to the foregoing method of treatment.

ANGIOPARALYTIC NEUROSES.—In neurasthenia, hysteria and other neuroses, the vaso-motor symptoms seem to

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dominate the clinical picture. Here the patient complains of pulsations throughout the body, notably the head, and the face is observed to be in a condition of hyperemia. Neurasthenics have a symptom in common: a feeling of heavy weight or constriction about the head. Charcot graphically described the head-sensation as the "*casque neurasthenique*," a feeling as though the patient were wearing a tight-fitting helmet. The author has never encountered in the literature any explanation of this phenomenon, and he is constrained to conclude that it is a vaso-motor symptom considering the beneficial results of treatment consecutive to the employment of concussion of the spinous process of the 7th cervical vertebra.

TOXIC CONDITIONS.—During the change of life or MENOPAUSE, the vaso-motor disturbances are almost as common as the arrest or irregularity of the menses. Flushing, heat and perspiration alternate with pallor and chills, and these symptoms often persist despite treatment to the end of life.

DIGESTION-AUTOINTOXICATION.—The author employs this term to signify a train of vaso-motor symptoms peculiar to some individuals who, after the ingestion of a meal, suffer from fullness and pulsations of the head, followed by throbbing in the arteries throughout the body. In association with these signs, the patients are depressed or despondent and are disinclined to execute their routine work. These symptoms are regarded as neurasthenic, but they are really due to autointoxication. Our conception of the latter affection is faulty, insomuch as we regard its causation to be associated with putrefaction of albuminoid food in the intestines. We forget that there are also poisonous albumoses, *i.e.*, intermediate products manufactured in the digestion of albuminous foodstuffs, and investigations show

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that an aqueous extract of the contents of the small intestine is infinitely more toxic than an extract made from the contents of the large intestine.

Patients suffering from digestion-autointoxication experience relief as a rule, several hours after a repast.

In the treatment of these patients, the exclusion of albuminoid food is beneficial, but the best results are achieved if the vaso-motor center, which bears the brunt of the disturbance, is made resistant to the action of the poisons.

Here, treatment by concussion of the 7th cervical spine has given me excellent results.

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CHAPTER VIII.

THE RESPIRATORY APPARATUS.

PHYSIOLOGY—HISTOLOGY—POSTURAL LUNG-DULLNESS—LUNG REFLEX OF DILATATION—LUNG REFLEX OF CONTRACTION—PULMONARY ATELECTASIS—BRONCHIAL ASTHMA—SPASMODIC BRONCHOSTENOSIS—TUBERCULOSIS—HEMOPTYSIS.

PHYSIOLOGY.

THE object of respiration is to exchange gases between the tissues and the external air. The blood circulating through the lungs absorbs oxygen from the alveolar air and yields its gaseous products of decomposition, notably carbon dioxid.

There are two phases of respiration:

1. Inspiration, which is effected by elevation of the ribs and by contraction of the diaphragm.
2. Expiration, which is a passive act and requires no muscular effort.

In man, the diaphragm predominates over the rib-lifting muscles, and the reverse is the case in women; hence, the normal type of respiration in man is abdominal, and in women, costal.

When this type of respiration is reversed (page 85), it becomes the fundamental condition of many respiratory neuroses and accentuates the symptoms of organic affections of the lungs.

In Fig. 77, two extreme types of respiration are indicated: A, the diaphragmatic, and B, the thoracic type. In A, there is no thoracic movement, but the anterior abdominal wall during inspiration projects to *i*. In B, on the contrary,

Respiratory Mechanism

the thoracic wall moves forward and upward, whereas the abdominal wall instead of projecting is really drawn in.

The RESPIRATORY MECHANISM (Fig. 78) is regulated by the respiratory center in the medulla oblongata, the so-called *noeud vital* of physiologists, which corresponds in position with the vagus-nuclei. The muscles which enlarge and diminish the size of the thoracic cavity are innervated

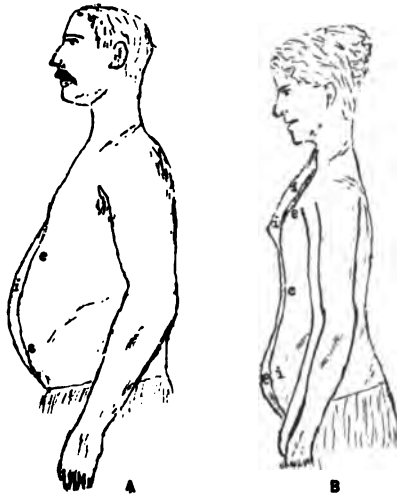


FIG. 77.—Diaphragmatic breathing in a male and the thoracic type of breathing in a female.

by nerves derived from the spinal cord; the diaphragm is supplied by the 3rd and 4th cervical roots and the phrenic nerve.

The motor nerves for the muscles of the larynx and bronchi run in the trunk of the vagus.

HISTOLOGY.

It is now known that longitudinal as well as circular muscular fibers exist in the finer bronchial tubes of rabbits, and Aufrecht has shown that a powerful layer of circular and a weaker layer of longitudinal fibers exist in man.

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These *bronchial muscles* are under the influence of the vagi and can be made to contract and relax as the result of stimulation of the vagi. Thus we have bronchoconstrictor and bronchodilator fibers in the vagus.

The chief bronchoconstrictor reflexes are elicited from the mucous membrane of the nose and larynx.

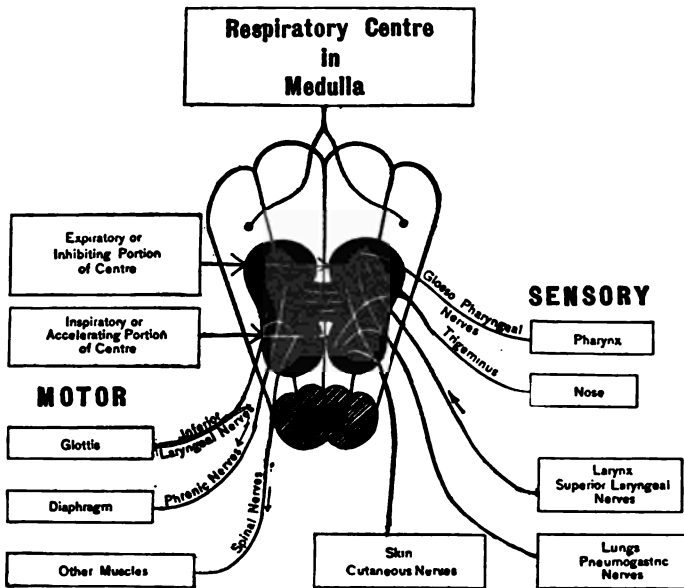


FIG. 78.—Diagram of the respiratory center (Butler).

The bronchial musculature is further discussed on page 308.

Recently, the presence of *vaso-motor nerves* in the lungs has been absolutely denied.

The author has referred⁶¹ to a condition known as POSTURAL LUNG-DULLNESS.

Any one, however, reasonably skilled in percussion will, when attention is called to the fact, recognize a decided difference in the percussion note of the lungs if percussion

Postural Lung - Dullness

is made first in the erect and then again in the recumbent posture. One will also note a difference if the patient is percussed first leaning far forward and then backward (supported by an assistant). In other words (the author is assuming an average typical normal subject), the percussion changes correspond in a minor degree to the alterations in the percussion note when fluid is present in a pleural space. The changes noted would be as follows:

Leaning far forward: Anterior chest region diffused dullness, especially marked in a definite area. Posterior chest region hyperresonant.

Leaning far backward: Posterior chest region shows diffused dullness, notably in a definite area. Anterior chest wall elicits a hyperresonant percussion note.

Leaning to one side: Side of chest wall toward which patient inclines shows dullness, whereas the other side is hyperresonant.

Lying on one side: Side of chest on which the patient lies demonstrates dullness of the lung, including the apex, whereas the other side is hyperresonant.

Recumbent posture: The anterior thoracic wall is decidedly more resonant than in any other posture.

Prone posture: The posterior thoracic region is more resonant than in any other posture.

Exaggerated Trendelenburg: Slight dullness of the pulmonary apices; lower chest region hyperresonant.

Differential Diagnosis: Postural dullness as a pathological phenomenon is frequently encountered and may be confounded with the dullness of atelectasis. Dullness dependent on atelectasis is usually circumscribed and may be dispelled by a series of forced inspirations, rubbing the skin over the area of dullness to provoke the lung reflex of dilatation and by the cocain test (page 297).

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Postural dullness is usually diffused, involving one or more lobes, and cannot be dispelled by forced inspirations, the cocain test, or by exciting the lung reflex. The dullness in question, however, disappears at once by a complete change in the posture of the patient. Assuming, for example, that the dullness is somewhere over the posterior surface of the chest, its dissipation cannot be effected until the patient assumes the prone posture.

Etiology of Postural Dullness.—After a careful consideration of this subject the author is constrained to conclude for the following reasons that the dullness provoked by posture is dependent on the blood normally present in the blood-vessels of the lungs, which is influenced by gravity, like any other fluid:

1. The blood in the lungs, unlike in other viscera, is not restricted in amount, owing to the absence of vaso-motor nerves.
2. The area of most pronounced dullness (as influenced by posture) corresponds to the situation of the largest pulmonary vessels, and is least manifested in areas where the vessels are less abundant.
3. In passive congestion of the lungs observed in cardiopaths, the dullness elicited by postural changes is most pronounced.
4. The postural dullness is uninfluenced by all the manœuvres which act upon either the bronchoconstrictor or bronchodilator nerves of the vagus.

Postural Lung Dullness in Disease.—As already observed, postural lung dullness is observed as a normal condition, or perhaps, to speak more definitely, in the norm, lung resonance is modified by posture. In passive congestion of the lungs it is most pronounced. In pulmonary tuberculosis I have noted only slight impairment of lung resonance as determined by posture, and this observation applies with equal cogency to the pretuberculous lung. For this reason

Postural Lung - Dullness

I seek to augment the quantity of blood in the apices of the lungs by having my tuberculous patients raise the foot of the bed so that the blood will gravitate toward the apices. After this manner I endeavor to induce a passive hyperemia of the regions in question. I cannot speak of results, inasmuch as this innovation has not been subjected to the test of time. Sir James Barr, in his erudite Bradshawe lecture before the Royal College of Physicians, London, refers to the frequency of atelectasis in exhausting diseases, which may be mistaken for a pleural effusion. He furthermore says: "Atelectasis is often mistaken for hypostatic congestion of the lung, and forcible rubbing of the affected side, acting through the lung reflex of Albert Abrams, causes some expansion of the lung and clears up the percussion note." My observations do not tally with the latter. On the contrary, ever since I recognized the method of differentiating lung atelectasis and lung hyperemia, I am convinced that what is frequently regarded as atelectasis is in reality a passive congestion.

Postural Dullness in Treatment.—The empirical treatment of pulmonary affections by external applications to the thoracic wall is fully justified, since the lung reflex of dilatation has been recognized. The postural treatment of diseases of the lungs is equally justified by the foregoing observations of the author. One fact, however, must be emphasized, and that is, the posture assumed by the patient must be an extreme one. Thus, to contend against hypostatic congestion the patient must assume the prone posture at least for a time several times a day. In hemoptysis, the correct posture can be determined when the area involved in the bleeding yields a resonant percussion note and indicates the exsanguination of the area in question.

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THE LUNG REFLEX OF DILATATION.

This reflex demonstrates the important fact that the respiratory area may be influenced indirectly by stimuli acting on the vagi. In a contribution by Moscucci,⁶² the suggestion was made that when ether was sprayed over the left half of the abdomen, marked reduction in volume of the spleen was observed in twelve cases. In repeating the experiments, I likewise noticed a decided reduction in the area of splenic dullness in all individuals on whom this method was tried, irrespective of the fact whether enlargement of the spleen existed or not. Investigations convinced me that this diminution in the area of splenic dullness was not real, but only apparent. When the ether spray was directed over the region of the heart, the percussional area of that organ was reduced at once; in fact, the superficial area of cardiac dullness could be obliterated by the manœuver. Similarly, when the spray was directed over the hepatic region the superficial area of dullness of that organ could be reduced at once. When the spray was directed over the border of the lungs posteriorly, the lung borders could be made to descend from two to four inches, dependent on certain conditions. It was further ascertained that dislocation of the lung-borders by forced inspiration never approached the dilatation of the lungs produced by the cutaneous application of the ether spray. Further experiments demonstrated in brief the fact that the application of any cutaneous irritant, whether the latter be mechanic, chemic or electric, would always induce *acute dilation of the lungs*. Even in emphysematous individuals the application of a cutaneous irritant still further augmented the existing lung-dilatation. The question naturally arose, by what means could we establish the fact that the application of any

Lung Reflex of Dilatation

cutaneous irritant would cause acute dilation of the lungs, a condition which, it may be mentioned parenthetically, is only of a few minutes duration. Such a hypothesis was made tenable by the aid of conventional physical signs and the use of the fluoroscope. These aids show that when the skin is irritated by means of cold, by friction, or by a strong Faradic current, lung dilation will ensue. The degree of lung dilation is dependent upon the character of the irritant and the severity of its application. The response of the lung to dilation is always greatest in that part of the lung contiguous to the source of cutaneous irritation. Lung dilation may be recognized by the following physical signs: 1. Diminished respiratory excursions of the lung borders. 2. Extension of the pulmonary percussion note and obliteration of the cardiac and splenic areas of dullness. 3. Hyperresonance of the lungs. 4. Obliteration of the apex beat. Auscultation is of no value as a physical sign, inasmuch as the artificial dilation does not last longer than three minutes after the source of cutaneous irritation has been removed. Lung dilation spreads from the source of cutaneous irritation involving primarily circumscribed parts. In lungs showing resonance, the latter could always be increased by cutaneous irritation over the part percussed. The x-rays show how the brightness of the lungs is increased by cutaneous irritation. By gradually applying the irritant to different parts of the skin of the thorax, one may note that eventually the entire lung may be made to yield a more intense luminosity. This increased luminosity, however, does not last longer than three minutes in the average person, after which time the lungs resume their normal appearance.

In a number of measurements made during the study of the lung reflex after cutaneous irritation, I found

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the average dislocation of the lower border of the lung, as follows :

Right sternal line.	3½ cm.
Right parasternal line.	3½ cm.
Right mammillary line.	4 cm.
Right axillary line.	6 cm.

In another communication, I demonstrated that acute dilation of the lungs can be evoked in healthy persons by irritation of the nasal mucosa and conversely, that this condition can be dissipated after the removal of the source of irritation. The pulmonary neurosis of dilation can be obtained by firmly compressing cotton in both nasal cavities. The degree of lung dilation with its concomitant phenomena will naturally vary according to circumstances which modify other reflex acts. After the introduction of the cotton, a few moments elapse before percussional results are noted. One will then observe superresonance and immobilization of the lung-borders and diminution of the areas of hepatic and cardiac dullness, in the latter instance, even to obliteration. Irritation of one nasal cavity with cotton does not yield manifest results. If the mucosa of both nasal cavities has been thoroughly cocaineized before the introduction of the cotton, no lung dilation ensues. I have frequently encountered in my clientèle, individuals presenting the symptomatic picture of pulmonary vesicular emphysema in whom was associated, some abnormality of the nose. The anomaly was a simple coryza, spurs, deflection of the septum, hypertrophic rhinitis or polypi. At any rate, after eradication of the nasal anomaly, the symptoms of pulmonary dilation disappeared. The form of emphysema here cited is in reality an acute lung dilation, an eradicable condition dissociated with the anatomico-pathologic conditions conventionally allied with emphysema. The typical clinical picture

Lung Reflex of Dilatation

of acute lung dilation could nearly always be made to disappear by the aid of the *cocain test*, which constitutes in this form of pulmonary neurosis a diagnostic aid of unquestioned value. After application of a solution of cocain to the nasal mucosa, the lung-borders will recede and the lung resonance and normal vesicular respiration are restored. In patients suffering from *asthma* of presumable nasal origin, impaction of cotton in one or both nasal cavities may induce a typic asthmatic paroxysm. This fact is of undoubted diagnostic value. I maintain that the phenomena of lung dilation can be provoked at any point in the extensive course of distribution of the pneumogastric nerves, and that the stimuli may act indirectly on the vagi through the terminal fibers of the trigeminus or, by irritation of the cutaneous sensory nerves contiguous to the lungs.

It is necessary to hypothesize the existence of two distinct functions of the vagus nerve, or, at any rate, different fibers, with two distinct functions—fibers which can dilate (bronchodilator nerves) and fibers which contract (bronchoconstrictor nerves) the lungs upon application of the appropriate stimuli. In the action of these two sets of nerve fibers, the vasoconstrictor and vasodilator nerves of the vaso-motor system may be cited as analogous.

It may be interesting to observe that the author's hypothesis concerning the existence of bronchodilator and bronchoconstrictor fibers in the vagus was confirmed seven years later by the well-known physiologic investigations of Dixon and Brodie.

Respecting the *diagnostic value* of the lung reflex, attention has already been directed to its importance in *percussion* (page 204).

In England, Auld and Sir James Barr, and in Italy, Plessi, direct reference to the reflex in the differentiation of

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atelectasis and consolidation of the lung; in atelectasis, irritation of the skin contiguous to the affected area will convert the dullness into resonance, whereas if the dullness is due to a consolidation, the lung reflex will not influence the dullness.

In x-ray examinations of the lungs, an area of opacity due to atelectasis may be mistaken for consolidation; the lung reflex would immediately clear the opacity in atelectasis but would not influence the shadow caused by a consolidation.

Cesare Minerbi, of Ferrara, Italy, regards the absence of the lung reflex posteriorly as one of the earliest and most trustworthy signs of pulmonary tuberculosis. This conclusion was based on a study of 300 cases and 14 autopsies.

THE LUNG REFLEX OF CONTRACTION.

Cherchevsky directed attention to a sign of early arteriosclerosis. He found that in the norm, the diameter of the aorta varies at different times. It became dilated if the region of the chest over the arch of the aorta is struck with the percussion hammer, while it shrinks in size if the blows are struck in the epigastrium. In arteriosclerosis it is impossible to produce these variations in diameter.

Cherchevsky has misinterpreted the phenomenon obtained by his manœuvre. What he really elicits is a circumscribed lung-contraction adjacent to the part struck on the chest by the hammer and the blow on the epigastrium merely causes the collapsed lung-area to dilate (lung reflex of dilatation), thus supplanting dullness by resonance. Dullness may be elicited in practically any chest-region by using a plexor and pleximeter. The circumscribed dullness thus induced lasts but a few seconds, but may be made to disappear at once by striking the epigastrium.

Observed with the x-rays, the lung reflex of contraction

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is an interesting study. After the blow is struck, the adjacent lung-area becomes gradually dark, showing that the air has been expelled from the lungs, whereas in a few seconds the lung-area becomes bright again. This lung reflex of contraction cannot be obtained if the nasal mucosa has been previously cocaineized.

This reflex may be elicited from the nasal mucosa or the vertebral region so that both lungs are brought simultaneously into a condition of contraction and when the reflex is thus obtained, it proves of great therapeutic value in the treatment of *asthma* (page 312).

PULMONARY ATELECTASIS.

The proponent of any new method of treatment, may, in his enthusiasm, permit the imagination to run riot, thus presenting assumptions which can neither be demonstrated nor corroborated by experience.

The author has endeavored to avoid the Scylla and Char-ybdis of medical theorists and, for this reason, will only discuss certain diseases of the respiratory apparatus which experience has taught him can be successfully combated by methods advocated in this book.

It is the accumulation of our experiences, observes Mundy, that makes our empirical knowledge, at last, scientific fact.

Pulmonary atelectasis or lung-collapse, refers to a condition in which the vesicles of an entire lung or only lung-areas are collapsed and contain little or no air.

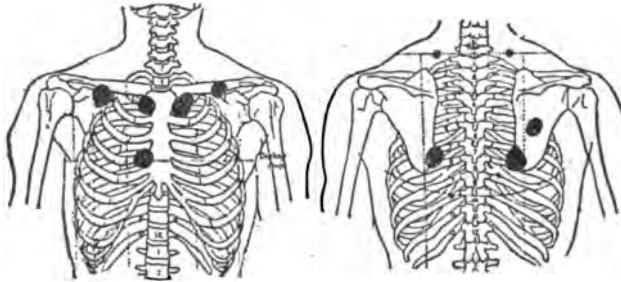
We may here disregard the many causes of atelectasis and confine ourselves to the discussion of two frequent causes :

1. Obstruction somewhere in the air-passages (atelectasis of obstruction); 2. Defective expansion of the chest.

ACUTE BRONCHITIS is a common and very rarely a serious

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disease in healthy adults. In young and old subjects, however, there is always danger of an extension of the catarrhal process downwards to the finer tubes, thus conducing to an atelectasis of obstruction. Such atelectatic areas are frequently the site of *broncho-pneumonic patches* or, as it is also called, capillary bronchitis. The author has frequently observed that in children suffering from broncho-pneumonia, the areas of dullness are not wholly due to the broncho-pneumonic condition, but to adjacent areas of atelectasis which may be readily be dissipated by elicitation of the lung reflex (page 294).



FIGS. 79 AND 80.—Atelectatic zones on the anterior and posterior surfaces of the thorax.

DEFECTIVE EXPANSION OF THE CHEST.—Any loss of inspiratory power may induce lung-collapse independent of any other factor. Weak and rickety children with their feeble muscular development lack this inspiratory power and one observes this enfeebled power in old age, long continued fevers and in individuals who are bedridden.

Even in the norm, certain portions of the lungs are collapsed and deprived of sufficient air to yield a dullness and, in some instances, flatness on percussion. Not infrequently, the apex of the lung in its entirety may be atelectatic and for this reason alone, some individuals have been pro-

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nounced phthisical by physicians who fail to recognize atelectasis of the lung. These areas of lung-collapse or *atelectatic zones*, as the author has called them, usually disappear after a series of deep inspirations or upon application of the lung reflex test (page 298), *i.e.*, by vigorous rubbing of the skin over the site of atelectatic dullness.

Not infrequently, reflex irritation of the bronchoconstrictor fibers in the vagus by some anomaly of the nasal mucosa may maintain a condition of atelectasis. In the latter instance, cocainization of the nasal mucosa by inhibiting the action of the constrictor fibers will translate the dullness of an atelectatic patch into resonance.

In the accompanying illustrations (Figs. 79 and 80), a composite picture is projected defining the usual situation of atelectatic zones based on an examination of over one hundred apparently healthy individuals (children as well as adults).

These zones are frequently mistaken for areas of lung-consolidation, either when detected by percussion or seen at an x-ray examination. The zones bear a definite relation to the points of election and paths of distribution of the lesions in chronic pulmonary tuberculosis and they are frequently present in what the author has called "PULMONARY ANEMIA."

The latter condition is more frequent in children than in adults and fails to yield to ferruginous preparations. The syndrome of anemia, however, disappears after a course of methodic respiratory exercises. Should the anemia reappear, its recrudescence is almost invariably associated with a reappearance of the zones of atelectasis.*

*For a more extended discussion of the subject of *pulmonary anemia*, the reader is referred to the author's books, *Diseases of the Heart*, page 46, and *Diseases of the Lungs*, page 20.

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TREATMENT OF PULMONARY ATELECTASIS.

Among the various methods for expanding the lungs and thus opposing the condition of atelectasis, the following manœuvres are suggested :

1. By action on the cutaneous sensory nerves.
2. By forced voluntary breathing.
3. By developing the muscles of respiration.
4. By aid of posture.
5. By vertebral concussion.

The two latter methods are advocated in cases of emergency.

I.—We have already shown that the lung reflex of dilatation and the heart reflex of contraction may be evoked by cutaneous stimulation. The stimulation of the respiratory center is greater through the cutaneous nerves than through the branches of the vagus to the respiratory organs. In animals which have been made apneic, cutaneous stimulation induced strong respiratory movements. We must therefore regard cutaneous stimulation as a simple and powerful stimulant of the centers of circulation and respiration.

The empirical treatment of pulmonary affections by external applications (poultices, friction with liniments and hot and warm compresses) to the thoracic wall is fully justified, since the lung reflex of dilatation has been recognized.

In acute pulmonary affections, and in infectious diseases like typhoid, the author employs carbonated baths and the cutaneous irritation thus induced powerfully influences cardiac and pulmonic vigor. In these affections we must be prepared to dismiss antipyresis as the great desideratum in the acute infectious diseases.

II.—Forced voluntary breathing may be achieved by

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respiratory exercises and for rapid lung-development, the aid of the pneumatic cabinet is unquestionably the best method.

III.—Feebly developed muscles of the thorax may be strengthened by stimulation of the respiratory muscles peripherally or, better still, centrally (to secure symmetrical development, page 11), by aid of the sinusoidal current.

IV.—Reference has been made to postural lung-dullness on page 290. Here it is important to recall the necessity of frequent and complete changes in posture to obviate the tendency to atelectasis and passive congestion of the lungs.

V.—Concussion of the spines of the third to the eighth dorsal vertebræ will provoke a rapid dilatation of both lungs, thus inducing the lung reflex of dilatation which, however, is of short duration only; hence the necessity of a frequent repetition of the manœuver.

Other rapid methods of eliciting the latter reflex are:

1. Stimulation of the nasal mucosa by irritating vapors; strong vapors like those of ammonia must be avoided owing to their inhibiting action on the heart (Fig. 56).

2. By tapping the epigastrium lightly. Here, forcible percussion like the "*Klopf-Versuch*" of Goltz, will inhibit the heart's action.

3. By placing the patient in a warm bath and directing cold water from a pitcher to strike the nape of the neck and flow down the back.

BRONCHIAL ASTHMA.

If we regard this affection as a distinct neurosis of the respiratory apparatus, it may be defined as a series of paroxysmal dyspneic attacks in which no organic disease can be recognized in its causation. Whatever the etiologic factor, three conditions are essential:

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1. Diminished resistance of the center of respiration.
2. Asthmogenic points somewhere.
3. Irritation of the asthmogenic points.

The asthmogenic point may exist anywhere in the course of the distribution of the vagus nerve, or the bronchoconstrictor fibers of this nerve may be irritated reflexly.

The usual sources of irritation are:

1. The nose. Here a probe may detect some sensitive spot (asthmogenic point) and irritation of this spot may induce a typical asthmatic paroxysm or symptoms approaching it like dyspnea or a feeling of constriction about the chest. In these cases of asthma of nasal genesis, if the nose is firmly packed with cotton (considering the fact that no asthmogenic point can be detected), an asthmatic attack may be elicited. A spray of cocain introduced into the nose may inhibit a paroxysm of asthma if it is of nasal origin. It is better in such cases to cocainize first one, and then the other nostril to determine which side of the nose is responsible for the irritation. By so doing, the side on which the nasal anomaly is present may be corrected and thus cure of the asthma may be effected.

2. The asthmogenic point may be located in the larynx (pharyngo-laryngeal asthma). Here, likewise, the probe may be used for diagnostic purposes.

3. The point of irritation may be intrabronchial dependent on bronchial catarrh and one observes in the interparoxysmal period all the symptoms of bronchitis. It is difficult, however, to determine during an asthmatic paroxysm which of the *râles* heard during auscultation are due to bronchitis and which to bronchial spasm. This question is determined by the author by having the patient inhale nitrite of amyl and carrying it to its full physiologic effects;

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the *râles* due to spasm will disappear temporarily, whereas the *râles* of bronchitis will persist.

4. The source of irritation may be the stomach (dyspeptic asthma) caused by indigestion. Here an emetic or vomiting may inhibit an attack.* Intestinal worms may also cause asthma (asthma verminosum).

Among other causes of asthma may be briefly mentioned the sexual apparatus in men and women, the kidneys (renal asthma), the heart (page 212), malaria, hysteria, neurasthenia, etc.

Suggestion, as a factor, often casts discredit on the etiology of asthma just the same as it does on any other neurosis. The operations of the gynecologist and rhinologist, and the treatment of the neurologist act in many instances by the mere suggestion which is thrown out by the therapeutic manœuvres.

If asthma can be produced by suggestion, the same factor can cure it. Thus odors, particularly of flowers, may bring on an asthmatic paroxysm, and one physician induced an attack by allowing the patient to smell an artificial rose.

Of late, exposure of the chest to the action of the x-rays in asthma has been followed by cure, and here again, suggestion cannot be excluded. Thus I recall a patient who was brought to my office for an examination of the chest. She had asthma and the x-rays were used for a diagnostic object, yet her physician whom I saw several months later assured me that the patient was cured. She was under the impression that the rays were used for a therapeutic object and a single exposure sufficed to cure her.

There are numerous conditions, the number of which is rapidly multiplying, which are operative in etiology, and

**Vide* page 320, concerning the etiology of asthma from odors.

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which, when corrected, lead to the cure of asthma. To relegate asthma to the category of the neuroses is a simple task, but to do so will deprive many sufferers from ultimate recovery. The trend of modern medicine is to deny the existence of functional diseases as mere entities, but to endow them with distinguishing attributes.

THEORIES OF CAUSE.

1. Spasm of the bronchial muscles.
2. Paralysis of the bronchial muscles leading to loss of expiratory power (Walshe).
3. A bulbar neurosis consisting of an excessive reflex irritability of the center of respiration (See).
4. A spasm of the diaphragm (Wintrich).
5. A spasm of the inspiratory muscles (Budd).
6. A microbic inflammation of the bronchial tree (Berkart).
7. Hyperemia of the bronchial mucosa analogous to urticaria (Clark).
8. The asthma-crystals found in the sputum of asthmatics irritate the peripheral ends of the fibers of the vagus and induce reflex spasm of the bronchial musculature (Leyden).
9. Swelling of the bronchial mucosa as demonstrated by tracheoscopic examination (Stoerk).
10. An exudative bronchiolitis which induces expiratory dyspnea (Curschmann).
11. Epilepsy of the lungs (Trousseau).

Among the more recent theorists, Kingscote contends that a dilated ventricle (right) of the heart predisposes to and maintains a condition of chronic asthma. He assumes that a paroxysm occurring at night is associated with the recumbent posture; the dilated heart striking the vagi

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which lie immediately behind the heart on the bony spine.

The theory of Haig assumes that the uric acid in the blood irritates the vagi.

The x-rays, in the opinion of the author, who has examined many asthmatics during a paroxysm, show the incorrectness of several theories. Thus, while the diaphragm is retarded in its excursions, it is not sufficiently immobile to warrant the theory of diaphragmatic spasm.

Again, the heart does not approximate the spine in the recumbent posture to the extent of obliterating the triangular space between the heart and the spine; hence the author cannot accept the theory of Kingscote.

A study of the pathologic anatomy of bronchial asthma reveals the pertinent fact that nothing is suggested concerning the etiology of the disease and even the pathologist in consequence, contends that it is a reflex neurosis.

We are thus constrained to determine the pathology of the disease by clinical observations.*

Based on clinical observations, the author assumes the following theory concerning asthma: *A spasm of the circular muscular fibers of the bronchi with inability on the part of the weaker (paralytic) longitudinal fibers to expel the residual air imprisoned by the spasm of the circular fibers.*

The foregoing mechanism has its analogue in the bladder musculature, when, in consequence of a spasm of the sphincter vesicæ, the weak detrusor vesicæ cannot expel the urine and ischuria spastica results. The spastic retention

*A. G. Auld (*The Lancet*, Oct. 17, 1903), in commenting on "THE LUNG REFLEX OF ABRAMS," observes, "It was not, however, until recent years that anything like a satisfactory demonstration of the presence of bronchodilator, as well as bronchoconstrictor fibers in the vagus was made by Roy and Brown, and during the present year this seems to have been conclusively established by the work of Dixon and Brodie. But it undoubtedly stands to the credit of Abrams to have proved, at least, seven years since, by a simple *clinical observation* that the vagus must contain bronchodilator as well as bronchoconstrictor fibers."

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of air in the lungs during an asthmatic paroxysm is schematically represented in Fig. 81.

In support of the author's *spasmo-paralytic hypothesis* of asthma, the following evidence is presented:

1. Histologic and physiologic facts.
2. Clinical facts: A. The picture of the asthmatic paroxysm; B. Results achieved by treatment.



FIG. 81.—A, the normal appearance of the terminal branch of a bronchial tube; B, in consequence of a spasm of the circular fibers the bronchial tube is partially occluded and, inasmuch as this occlusion cannot be combated by the enfeebled longitudinal fibers (which can, in the norm, open the bronchial tubes when the latter are contracted) the retention of air causes a dilatation of the lung-structures peripheral to the site of occlusion.

Aufrecht⁶³ has shown that the musculature of the finer bronchi consists of a stout layer of circular and a weaker layer of longitudinal fibers. The clinical observations of the author, which were subsequently confirmed by the physiologic investigations of Dixon and Brodie, demonstrate that the vagus contains fibers which can either dilate or constrict the bronchi. The lung reflex of dilatation (page 294) demonstrates the predominant action of the circular fibers of the bronchial musculature, whereas the counter-

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reflex of lung-contraction (page 298), shows the predominant action of the longitudinal fibers.

In asthmatics, the lung reflex of contraction is obtained with difficulty owing to enfeeblement of the longitudinal fibers, hence any therapeutic manœuvre which will accentuate this reflex will arrest asthmatic paroxysms and will prevent their recurrence. This is the basis of the author's method of treatment in bronchial asthma.

In the norm, the lung reflex of contraction may be elicited in the following ways:

1. By forcible concussion over any area of the lungs by means of a plexor and pleximeter. This manœuvre will only elicit a circumscribed lung reflex of contraction (page 298).

2. By inhalation of *amyl nitrite* after previous cocainization of the nose. Here the lung reflex of contraction, as evidenced by dullness of the lungs on percussion, is most conspicuous in the infraclavicular regions. It will be noted that amyl nitrite inhalations are currently employed to arrest an asthmatic paroxysm, but its effects are usually transitory. The reason for this is evident. Any irritant to the nasal mucosa will provoke the lung reflex of dilatation, but if the nasal mucosa is previously cocainized, amyl nitrite, like many other drugs, will reflexly stimulate the broncho-constrictor nerves and by inducing the lung reflex of contraction will arrest an asthmatic paroxysm.

3. There are several preparations used in a nasal atomizer which are efficacious in arresting an asthmatic paroxysm but which are not curative. One is a secret preparation known as the *Nathan Tucker remedy*.

Coincident with the relief attending its use, the hyper-resonant lungs become dull on percussion and the dullness is always in proportion to the relief obtained. In other

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words, this preparation by provoking reflexly from the nose the lung reflex of contraction brings relief to the asthmatic. From various analyses made of the Tucker remedy, some claim that no cocain is present, but according to the observations of the author, it is impossible to obtain any decided effects without its presence. The author suggests the following as a cheaper substitute for the Tucker remedy:

Cocain. 3 per cent.
Atropin sulphate. gr. ii.
Natrii nitrosi. gr. ix.
Glycerin. gr. xxx.
Aquæ destil. oz. ss.
M.S.—Atomize for two minutes in each nostril and inspire deeply.

It may be necessary to reduce the percentage of atropin insomuch as in several instances mild atropin intoxication has followed the use of the spray.

4. By concussion of the spines of the 4th and 5th cervical vertebræ and by sinusoidalization of the same spines. This will be discussed under the treatment of asthma.

On page 297 reference was made to the cotton test in asthma. Here reference will be made to another test in support of the spasmoparalytic theory of asthma. By concussing the spines of the dorsal vertebræ (3rd to the 8th), one may provoke a decided lung reflex of dilatation and in one predisposed to asthma, an attack or symptoms of an attack (dyspnea, constriction about the chest) may be provoked. If now, the spines of the 4th and 5th cervical vertebræ are concussed, the attack, or the symptoms, may be temporarily inhibited. In the first manœuver the lung reflex of dilatation brought the circular muscular fibers into action and in the second manœuver the action of the circular

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fibers was inhibited by contraction of the longitudinal fibers.

5. By the *tracheal traction test*.⁶⁵ During the time the head is thrown forcibly backward, the normal resonance obtained by percussion over the manubrium, the anterior chest and the lower lobes of the lungs posteriorly, becomes translated into a dull or flat sound. This manœuvre is called the tracheal traction test by the author and is similar to another vago-visceral reflex described elsewhere (page 321). This test is positive in health and in all cardio-pulmonary affections, but it is negative in all cases of idiopathic asthma. This test is present in the interparoxysmal asthmatic periods of asthma, and is thus of value in the differential diagnosis of other spasmodic affections which suggest an asthmatic genesis. Tracheal traction evokes contraction of the bronchial muscle by stimulation of the bronchoconstrictor nerves in the vagus. In asthma the tone of the bronchial muscle is so-reduced that it no longer responds to vagus stimulation when the neck is forcibly extended on the sternum; hence the test is negative in asthma. The dull sound supplanting the resonance in the normal subject by tracheal traction is due to contraction of the bronchial muscle, which puts the air in the trachea and bronchi under considerable tension.

There is another affection closely related to asthma which the author has called SPASMODIC BRONCHOSTENOSIS, and in which, like asthma, the tracheal traction test is negative. Patients with bronchospasm suffer from a persistent spasmodic cough, with or without expectoration, in other words, spasmodic bronchostenosis is asthma without paroxysms.

Many physicians have encountered persistent spasmodic coughs in subjects with bronchitis and have no doubt com-

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mented on the intractability of the cases. In such instances, a *bronchospasm* complicates the disease. Here climate yields immediate results. The patients often lose their spasmodic cough at once if sent to another climate. Here the spray described on page 310 is very efficient in controlling the spasmodic cough, and the same may be said of the smoke from various antispasmodic agents. The following formula, which owes its efficacy to pyridin, may be used:

Powdered stramonium.
Powdered belladonna.
Powdered hyoscyamus.
Powdered potassium nitrate.aa 1 oz.

M.S.—Burn one-half teaspoonful or more and inhale fumes.

6. The picture of an asthmatic paroxysm suggests the spasco-paralytic theory. The lungs are in an acute emphysematous condition, and the dyspnea is expiratory in character. The moment the spasm is relaxed by appropriate treatment, the lung reflex of contraction is provoked.

The table on page 212 gives the *differential diagnosis* of cardiac and bronchial asthma.

TREATMENT OF BRONCHIAL ASTHMA.

An attack of asthma may be jugulated by any manœuver which will promote the expiratory phase of respiration or which will induce the lung reflex of contraction. The author recalls a patient seen in consultation, whose asthmatic paroxysm was of two days' duration despite complete anesthetization with chloroform and recourse to the conventional methods yet, a few minutes rhythmical compression of the chest during expiration sufficed to control the attack. This simple method has been used with success in other cases.

As before remarked, the lung reflex of contraction can

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be provoked by concussion of the spines of the 4th and 5th cervical vertebræ and, in the absence of a hammer and pleximeter, the hands may be used (Fig. 3). The latter manœuver often succeeds in arresting a paroxysm, but it may be necessary to repeat it several times. In the treatment of asthma, one frequently observes astonishing cures reported by the rhinologist and other specialists. Here the source of irritation (asthmogenic point) is removed, but the enfeebled condition of the bronchial musculature is uncorrected and any other irritant may be operative in provoking an attack.

In the following method of treatment suggested by the author, an attempt is made to increase the vigor of the longitudinal fibers of the bronchial musculature with the object of inducing the lung reflex of contraction. This is best effected by a strong sinusoidal current—one electrode over the spines of the 4th and 5th cervical vertebræ and the other electrode over the sacrum. The treatment must be executed daily and each séance may last from fifteen minutes to one hour. Very often an interrupting electrode at the cervical region may be advantageously employed with the object of exciting more vigorously the bronchoconstrictor fibers of the vagus. All sinusoidal machines are not equally efficient, and to test the latter one electrode is placed over the spines of the 4th and 5th cervical vertebræ in a normal subject and the other electrode over the sacrum. If the former lung-resonance is converted into dullness, after a few minutes action of the current, the latter is efficient, and its efficiency is always in proportion to the degree of lung-contraction which it provokes. This method of treatment will often yield phenomenal results even in cases of asthma of many years' duration.

Until the bronchial musculature is strengthened, the

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attacks of asthma will continue (with less violence) and to combat the attacks, the nasal spray (page 310) may be used.

Adrenalin chlorid is one of the most efficient agents in inhibiting an attack of asthma, and the author employs it in doses of from eight to fifteen minims hypodermatically. The action of this drug is to provoke the lung reflex of contraction and, when effective in asthma, the previously

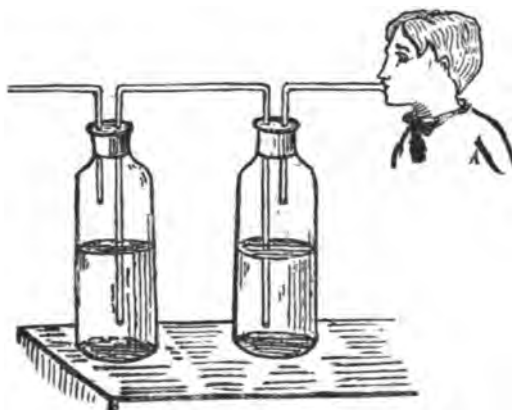


FIG. 82.—Arrangement of bottles for promoting lung-contraction.

resonant percussion tone of the lungs is converted into a dull or flat sound. Like action on the percussion sound is observed in the normal subject.

In addition to sinusoidalization as suggested, the patient should be instructed to execute respiratory exercises at least twice daily with the object of increasing the expiratory force. The latter is best attained by extinguishing with the breath the flame of a candle; the distance of the latter from the patient is gradually increased. At first, the effort of blowing may provoke asthmatic symptoms, but gradually the latter yield. The latter method may even be employed in arresting an asthmatic paroxysm.

H e m o p t y s i s

Another efficient method of promoting the muscles of expiration is to instruct the patient to practice daily for a definite time, to blow water by air-pressure from one bottle to another. Each bottle should hold, at least, a gallon, and by the arrangement of tubes, as in the Wolff bottle, the force of expiration will transfer the water from one bottle to another (Fig. 82). Osler and others claim that the method just cited will expand the lungs, but the author has shown that the effect is to contract the lungs.

EMPHYSEMA is an affection associated with enfeeblement of the longitudinal fibers of the bronchial musculature. Here sinusoidalization as suggested in the treatment of asthma (page 313) is often very efficient in the treatment of emphysema provided, one can elicit the lung reflex of contraction (dullness of the lungs on percussion) even in a moderate degree.

TUBERCULOSIS is associated with a too voluminous lung and the lungs are practically in an emphysematous condition. The lungs always show deficient expiratory force. Here the bronchial musculature may be brought to contraction by sinusoidalization as in the treatment of asthma (page 313).

HEMOPTYSIS may yield to posture (page 293) and the inhalation of amyl nitrite carried to its physiologic effects *after cocainization of the nose*. This is the most efficient drug we possess in arresting hemorrhage of the lungs. Unless it is efficient after the first inhalation, it is usually without any action. The blood-vessels of the lungs have no vaso-motor nerves and any constriction of the blood-vessels must be effected by provoking the lung reflex of contraction. Cocainizing the nose increases the efficacy of the inhalations. Whereas, amyl nitrite may effect its object without the previous use of cocain, the latter drug increases its efficacy for the reason cited on page 309.

CHAPTER IX.

THE DIGESTIVE SYSTEM.

THE STOMACH—THE STOMACH REFLEXES—PERCUSSION OF THE STOMACH—TREATMENT OF DISEASES OF THE STOMACH—THE INTESTINES—THE INTESTINAL REFLEXES—DISEASES OF THE INTESTINES—TREATMENT OF CONSTIPATION—THE INTESTINAL NEUROSES.

THE STOMACH.

By means of the *movements of the stomach* the food is mixed with the gastric juice. The motor nerves of the stomach are derived from the vagus and sympathetic nerves. Fig. 83, after Openchowski, shows the nerves of the musculature of the stomach.

THE STOMACH REFLEX OF CONTRACTION.**

This consists of a contraction of the walls of the stomach elicited by the following manœuvres:

1. Concussion of the Traube area.
2. Concussion or sinusoidalization of the spines of the three first lumbar vertebræ.
3. By elicitation of the vago-visceral reflex.
4. By pressure in definite paravertebral areas.

I. The Traube area or space (Fig. 84) is that half-moon-shaped space which normally yields on percussion a tympanitic sound, owing to the presence of the cardiac end of the stomach. It is bounded above and laterally by the contiguous borders of the liver, lung and spleen. Fixing our pleximeter firmly in the center of the Traube area of tympanicity, we strike the pleximeter with a hammer a series of vigorous blows, and then proceed to percuss the

Stomach Reflex of Contraction

area of Traube. One observes at once that this region which formerly yielded a tympanitic sound now presents on

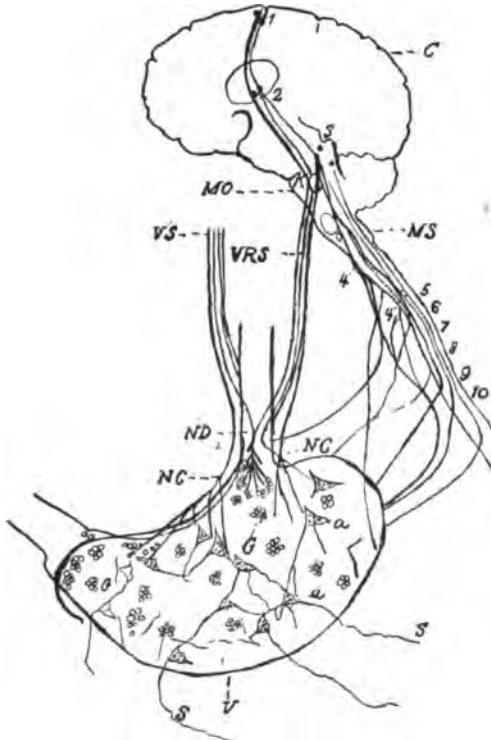


FIG. 83.—Nerves of the stomach musculature. C, the cerebrum; V, stomach; MO, medulla; MS, spinal cord; 5-10, thoracic roots; VRS, right vagus; VS, left vagus; ND, dilators of the cardia; NC, constrictors of the cardia; A, Auerbach's plexus; S, S, fibers from the sympathetic plexus; 1, sulcus cruratus; 2, corpus striatum; 3, corpus quadrigemina; 4, centers in the spinal cord. The dilator center for the cardia inhibits the movements of the pylorus.

percussion a dull or even flat sound. The phenomenon thus elicited is the stomach reflex of contraction.

II. Concussion of the spines of the 1st, 2nd and 3rd lumbar vertebræ will also produce the stomach reflex of contraction.

III. *Vide* percussion of the stomach, page 321.

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IV. Firm and deep pressure with the thumb alongside of the spines of the first three lumbar vertebræ on the left side will also elicit the reflex in question.

THE STOMACH REFLEX OF DILATATION.

This reflex, consists of a dilatation of the stomach provoked by irritation of the skin over the area of Traube,

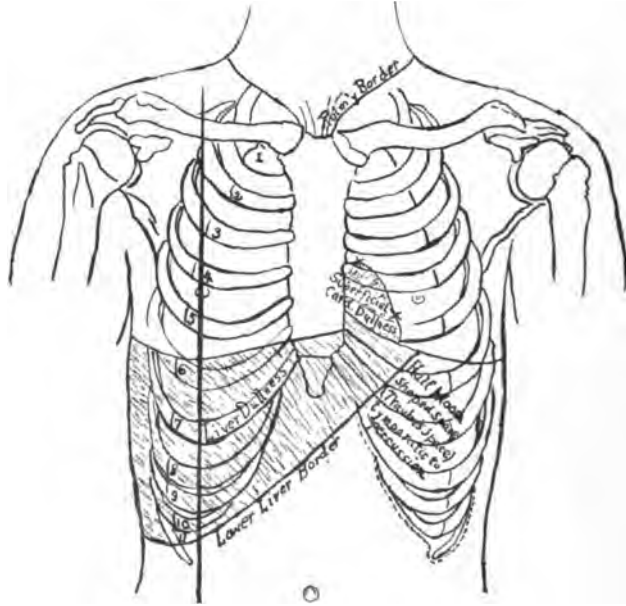


FIG. 84.—Normal percussion-boundaries of the lungs, liver and spleen, and Traube's space—anterior view (Sahli).

after tapping the epigastrium, by deep and firm pressure to the left of the spine of the 11th dorsal vertebra and by concussion or sinusoidalization of the latter spinous process (Fig 85).

Both stomach reflexes may be confirmed by the vago-visceral reflex which is described under percussion of the stomach.

Stomach Reflex of Dilatation

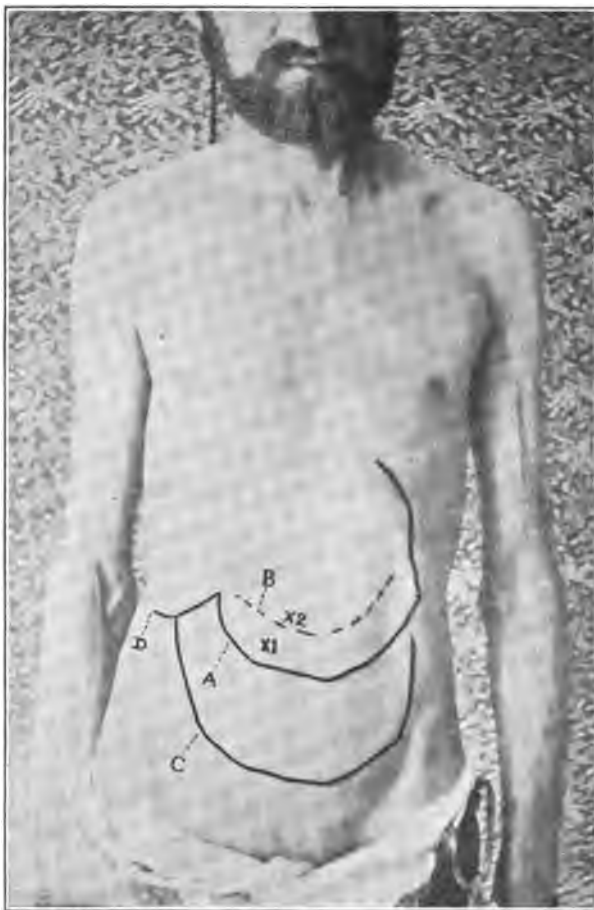


FIG. 85—Effects of the inhalation of ether on the stomach: continuous line (A), the lower border of the stomach before and (C), after the inhalation of ether. Also illustrating area of gastric tenderness. If a point of tenderness exists at x_1 , it is shifted to x_2 , after eliciting the stomach reflex of contraction, which causes the lower border of the organ to recede from A to B.*

*Dilation of the fundus is not shown, although it occurs. This illustration is further described on page 323.

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There is, perhaps, no greater excitant of the stomach reflex of dilatation than irritation of the nasal mucosa by irritating vapors. The effects of inhaling ether are shown in Fig. 85. The reflex in question thus excited is of longer duration than any other visceral reflex. In one patient the stomach remained dilated for fully eight hours. Chloroform vapor is less active than ether in provoking the reflex. In this reflex the fundus of the stomach likewise dilates and the author believes that the *asthma from odors* is due to pressure of an acutely dilated stomach on the heart. Thus, one patient who suffered an asthmatic paroxysm from the odor of hay, demonstrated an enormously dilated stomach. When the latter was reduced by concussion of the spines of the first three lumbar vertebræ, the paroxysm ceased. When the nose was previously cocainized, no asthma could be provoked from the odor of hay. The effect of insufflation of the stomach on the heart is shown in Fig. 33.

In the literature, a number of cases of *acute dilatation of the stomach* have been reported following operations which are characterized by sudden onset, symptoms of collapse and vomiting of large quantities of fluid. The cause is obscure, but the author's investigations seem to show that the dilatation is associated with the irritating action of the vapors employed as anesthetics. Here the condition is a reflex due to irritation of probable gastro-dilator fibers in the vagus. As the author has shown (page 202) irritating vapors will inhibit the heart, but if the nose has been previously cocainized such action does not ensue. He therefore suggests the use of cocain in the nose as a routine method before employing anesthetics to inhibit the action of the vapors on the heart and on the stomach. Fig. 85 shows the effects of inhalation of ether (duration of inhalation, one minute) on the stomach.

Percussion of the Stomach

It may be noted that concussion of the spines of the first three lumbar vertebræ will at once reduce the lower border of the stomach to the norm; otherwise the dilatation continues for some time. Such concussion may be of service in acute dilatation of the stomach following operations.

PERCUSSION OF THE STOMACH.

No gastrologist can lay any claim to distinction in his chosen speciality until he has devised some original method for percussing the stomach, and the result has been a number of complicated and, in some instances, faulty methods of examination. The author contends that any physician who is able to appreciate percussion-sounds can accurately percuss not only the lower border of the stomach, but the upper border of the organ as well (Fig. 86) by the following simple method which elicits the vago-visceral reflex of stomach-contraction.

By directing the patient to draw the head slowly backward, though forcibly, thus inducing hypertension of the cervical muscles, the pneumogastric nerves are stimulated and this stimulation is manifested clinically:

1. By inhibition of the heart (page 228).
2. By the tracheal traction test (page 311).
3. By the stomach reflex of contraction.

To obtain the latter reflex, the borders of the stomach are percussed during the time the patient forcibly extends his head as far back as possible. When he is unable to do this satisfactorily, an assistant may do it for him. During the time tension of the muscles of the neck is maintained, the stomach yields a dullness on light percussion with the patient standing.*

*The dullness is accentuated if an assistant compresses the spinal column during percussion (page 8c).

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To explain the altered percussion sound in the stomach reflex of contraction, one must have recourse to the Skodaic interpretation of the condition which exists when dullness supplants tympanicity. In the stomach reflex of contraction, the gastric walls become tense, thus putting the air or gas within them under increased tension, and, for this reason, we have the physical elements necessary for the transition of a tympanitic to a dull sound.

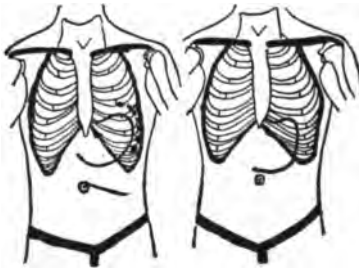


FIG. 86.—Percussion of the stomach by aid of the vago-visceral reflex (the head to be fixed as shown in Fig. 65). The illustration with the dotted line indicates an increased area of the organ after irritation of the skin of Traube's area. The other illustration demonstrates the outline of the stomach in a case of gastroptosis.

Reference to Fig. 5 shows that concussion of the spines of the first three lumbar vertebræ is not available for percussion. While the latter manœuvre is advantageous in treatment, it also provokes the intestinal reflex of contraction and as the latter yields a dullness on percussion, the dullness of this reflex cannot be differentiated from the dullness of the stomach reflex of contraction.

THE STOMACH REFLEX OF CONTRACTION IN DIAGNOSIS.

Reference has already been made to the value of this reflex in percussion of the stomach.

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It remains to consider its value in determining the *motor power* of the organ and the *localization of pain*.

Having determined the lower border of the organ by aid of the vago-visceral reflex, we concuss rather forcibly the area of Traube and note the difference of the lower border before and after such concussion. Naturally, the head must be maintained properly during the time percussion of the stomach is executed. It will be noted in Fig. 85, that the lower border of the stomach shifts from A to B, which represents the degree of the stomach contraction which is in direct ratio to the motor power of the organ. In the norm the degree of recession of the lower border of the stomach varies from 2 to 4 cm.

Let one assume that the patient has a fixed point of sensitiveness in the epigastrium and it is a question whether this area of tenderness is or is not associated with the stomach. In the former event, concussion of the area of Traube by causing contraction of the stomach, will shift the area of tenderness from X₁ to X₂ (Fig. 85). Within a minute, however (the duration of the reflex), the area of tenderness will again be located at X₁*.

The presence of a *growth* and its association with the stomach may be shown to exist by aid of the stomach reflex, for elicitation of the latter will cause a dislocation of the growth upward and to the left. Eliciting the stomach reflex of dilatation (concussion of the spine of the 11th dorsal vertebra) will cause an area of tenderness or a growth to be dislocated downward.

*The author suggests this manoeuvre in the differential diagnosis of a gastric and duodenal ulcer. The employment of this manoeuvre will not cause a dislocation of the area of tenderness on palpation if the ulcer is duodenal.

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TREATMENT.

MOTOR-INSUFFICIENCY, or lack of power of the muscular wall of the stomach to discharge its contents, results from many causes, notably the burden thrown upon it by indiscreet eating. This insufficiency of the organ, which practically always eventuates in dilatation of the stomach (gastrextasis), is usually regarded as a dyspepsia, inasmuch as the symptoms are dyspeptic in character. Many so-called neuroses of the stomach are dependent on the same cause. The author realizes that he gives expression to heterodox views when he attempts a classification of all diseases of the stomach into two main classes: organic and functional. To the former belong chiefly ulcers and tumors, whereas, the latter are not diseases but merely symptoms. In his early professional career, the author religiously executed the conventional gastric analyses, and while he was able to determine anomalies in the gastric secretion, he rarely succeeded in curing his patients; he was successful as a diagnostician and a failure as a therapist. The moment he departed from traditional lines and sought a constitutional cause for the symptomatic affections of the stomach, he began to achieve a modicum of success in the treatment of his cases.

There is an element of nervousness in all dyspepsias, and this nervousness is maintained by an enervated nervous system. In all instances of functional diseases of the stomach, treatment must be addressed to an enfeebled nervous system; this is essentially the basis of gastrotherapy.

In the experience of the author, the most constant condition identified with functional diseases of the stomach is an insufficiency of the muscular walls with a moderate dilatation of the organ and the relief of this condition, which

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is possible after the manner to be cited, is of greater value than any other symptomatic method of treatment.

To contract the stomach and to augment the tone of its musculature two methods are available: 1. By aid of the sinusoidal current; one electrode over the space of Traube and the other over the spines of the first three lumbar vertebræ. 2. By concussion of the spines of the first three lumbar vertebræ. Treatment by either method must be executed daily and each séance should, at least, last fifteen minutes.

In gastric or intestinal TYMPANITES, concussion of the spines of the first three lumbar vertebræ to elicit the stomach and intestinal reflexes is a very effective method.

THE INTESTINE.

The movements of the intestine are controlled by the central nervous system and the small intestine receives its efferent nerves through the vagus and the splanchnic. Respecting the action of these nerves there is no unanimity of opinion. It may be remarked, however, that vagus-stimulation by contraction of the muscles of the neck (page 228) while it influences the heart, bronchi and stomach, is absolutely without any influence on the percussion sound of the intestine.

THE INTESTINAL REFLEX OF CONTRACTION.

This reflex consists of a contraction of the intestine and is evidenced by dullness on percussion supplanting the tympanitic tone prior to the elicitation of the manœuver. Of all the visceral reflexes described by the author, this particular reflex is of longest duration. In some individuals it may persist for five or more minutes, and it is more evident and longer in duration in children than in adults. It is

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best elicited by concussion or sinusoidalization of the spines of the first three lumbar vertebræ. Firm and deep pressure alongside of the spines of the first three lumbar vertebræ (Fig. 48) will also evoke this reflex; pressure on the right side of the spines in question will contract the intestine only on the right side, whereas pressure on the left side will only influence the intestine on that side.

Concussion of the spines in question, however, evokes contraction of the intestine on both sides.

THE INTESTINAL REFLEX OF DILATATION.

This reflex consists of a dilatation of the intestine and may be elicited in one of the following ways:

1. By irritation of the skin of the abdomen. Here the intestinal dilatation is very circumscribed and practically limited to the area of cutaneous irritation.

2. By firm and deep pressure at the side of the spine of the 11th dorsal vertebra. Here the intestinal dilatation is limited to either the entire right or left side of the abdomen dependent on the side subjected to pressure.

3. By concussion or sinusoidalization of the spine of the 11th dorsal vertebra. Concussion is more potent than sinusoidalization in discharging this reflex. Here the intestinal dilatation involves all of the intestine. The reflex of dilatation is less pronounced and of shorter duration than its counter-reflex of contraction.

DISEASES OF THE INTESTINES.

It is generally conceded by the gastro-enterologist that in intestinal and gastric diseases, the chemical or digestive functions are subservient to the more important motor functions. In the functional intestinal diseases, one again notes muscles in antagonism (page 11), and the anomaly

in function is expressed by the predominant action of either the longitudinal or circular muscular fibers. The *movements of the intestines* as revealed to us by the physiologist are of little or no clinical value. The chief form of intestinal movement is known as peristalsis. The peristaltic movement is essentially a constriction of the intestinal wall, commencing at a definite point and passes downward from segment to segment, whereas the parts behind the advancing zone of constriction relax slowly. The physiologist does not account for the action of the longitudinal fibers in peristalsis, but assumes that, insomuch as constriction is the attribute of the circular layer of muscles, the latter layer is the chief factor in peristalsis.

CONSTIPATION.

In one class of patients, constipation may exist without any symptoms, whereas others complain of headache, anorexia, lassitude, mental depression, etc. The latter symptoms have been dignified by the term *copremia*, which is supposed to indicate fecal poisoning. The fetich of many neurasthenics is the water-closet, and the elysium of others is a purgative. It is easier to take a simple pill than to pursue a prolix dietetic régime, hence the prestige of the purgative habit.

What constitutes constipation? We do not, as a rule, seek to analyze this question, and content ourselves with the bare statement of the patient. Grant suggests the following test for constipation: The patient is given a tablespoonful of animal charcoal. Normally it appears in the stools in twenty-four hours. By this means, even though the patient affirms that he is or is not constipated, the charcoal test will decide the question. Dr. C. M. Cooper of San Francisco, resorts to the following test to determine the origin of

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constipation. The test is based on the fact that, in the norm, the passage of charcoal or bismuth (which blacken the feces) from the stomach to the rectum is attained in from twelve to forty-eight hours. If more than seventy-two hours elapse before colored feces are detected in the rectum, constipation is present. Hertz, of London, has shown that, if after the lapse of forty-eight hours the rectum is empty, or, as Cooper shows, if the sigmoidoscope demonstrates the presence of blackened feces lodged in the sigmoid, there is some retardation from the middle of the transverse colon. If the feces lodge in the rectum longer than twenty-four hours, then the constipation is rectal in origin, dependent on one of the following causes: Loss of the reflex of defecation from anesthesia or neglect (indolence, false pride, pain of fissures or hemorrhoids), atony or paresis of the rectum and weakness of the voluntary muscles of defecation.

One must differentiate two forms of constipation: atonic and spastic. In some instances the latter are combined.

ATONIC CONSTIPATION is recognized by the dilated intestines which cause a protuberance of the abdomen and percussion of the latter yields a tympanitic sound. Here, concussion of the spines of the first three lumbar vertebræ, fails to yield as in the norm a decided intestinal reflex of contraction as revealed by the dull percussion note. Not only are we thus able objectively to determine this form of constipation, but can also say what part of the bowel is implicated. Very often the dullness is obtained only over the ascending or descending colon, showing that wherever dullness is obtained, that portion of the intestinal canal is not involved in atonic constipation.

SPASTIC CONSTIPATION is less frequent than the atonic form. The former is caused by a tonic contraction of intestinal segments which hold back fecal masses, whereas

Treatment of Constipation

the latter is dependent on an inherent enfeeblement of the intestinal musculature. There is always a feeling in the spastic form as if the evacuation were unsatisfactory. The patients press a great deal at stool and evacuate long, thin and flattened fecal masses.

On palpation of the abdomen one may detect localized contractions, especially of the transverse colon (*corde colique*). The implicated intestinal segment may be rolled under the finger like a cord. Percussion over the spastic intestinal areas yields a dull in lieu of a tympanitic sound. Normally, when one scratches the abdominal skin over a dull intestinal area, or by a few blows directed against the epigastrium, the dullness becomes tympanitic, owing to temporary dilatation of the intestine (intestinal reflex of dilatation). The percussion sound of the spastic intestine does not change. As a rule, the spastic form does not lead to meteorism, yet in rare instances, there may be symptoms corresponding to ileus and even celiotomy has been performed by mistake.

In the spastic form not only are cathartics useless, but they accentuate the symptoms. When olive oil is effective in constipation in tablespoonful doses one-half hour before each meal, it is almost diagnostic of the spastic form of constipation.

TREATMENT OF CONSTIPATION.

Whatever treatment is employed in this condition, one must always conciliate a psychic factor. The psychic factor takes into consideration the fact that the desire to go to stool is a habit. Habit in itself is a great economizer of nerve-force, for it is automatic in action and reduces cerebral participation to a minimum.

Thought directed toward a part will increase its functional activity. The mental state influences the intestinal canal

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and one may recall the frequency of nervous diarrhœa. The diarrhœa of students before an examination, of nervous women and men during transient periods of excitement, etc., is of this nature. Canstatt tells of a surgeon who had an attack of diarrhœa before every important operation.

From what has preceded, the treatment of *atonic constipation* consists in methods which have for their object the elicitation of the intestinal reflex of contraction. In the experience of the author, the latter is best elicited by sinusoidalization or concussion of the spines of the first three lumbar vertebræ. Concussion appears to be more effective in the treatment of atonic constipation. If the sinusoidal current is employed, one electrode is fixed over the sacrum and the other over the spines of the first three lumbar vertebræ. Strong currents must be used and the daily séances should last fully fifteen minutes. Within a week, usually, the treatment is effective, but must be continued thereafter less often.

Spastic constipation is remedied by the method for eliciting the intestinal reflex of dilatation, *viz.*, sinusoidalization or concussion of the spine of the 11th dorsal vertebra.

When neither form of constipation predominates, sinusoidalization or concussion at the same séance may alternate between the spine of the 11th dorsal vertebra to stimulate the longitudinal muscular fibers and the spines of the first three lumbar vertebræ to excite contraction of the circular fibers of the intestines.

INTESTINAL NEUROSES.

Among the motor neuroses favorably influenced by the methods suggested in this work are the following:

I. NERVOUS DIARRHŒA.—This condition presumes an absence of all anatomic changes in the intestinal wall. The

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subjects are usually neuropaths. The treatment consists of alternate toning of the circular (concussion or sinusoidalization of the spines of the first three lumbar vertebræ) and longitudinal muscular fibers of the intestines (spine of the 11th dorsal vertebra).

2. PERISTALTIC UNREST.—In this condition (*tormina intestinorum*) patients suffer from loud noises, which may often be heard by others. The peristaltic movements may be so loud as to interfere with sleep. The movements are often visible and may be palpated. The same treatment may be used as indicated in nervous diarrhoea.

3. ENTEROSPASM.—In this condition the intestinal spasticity may be limited or diffused, and in the latter instance the abdomen is retracted.

Enteralgia is quite independent of the colicky pains observed in enterospasm and is caused by a tetanic contraction of the enteric musculature. The treatment in both affections consists of relaxing the spasm by concussion or sinusoidalization of the spine of the 11th dorsal vertebra.

4. NERVOUS CONSTIPATION.—This is frequently associated with atony of the intestines and the subjects are usually hysterical and suffer paroxysmally from meteorism. There is always a tendency to *meteorism* whenever there is any weakness of the intestinal musculature. The treatment of this condition is similar to that described under nervous diarrhoea.

THE LIVER.

There are two LIVER REFLEXES: that of contraction and that of dilatation. The *liver reflex of contraction* may be elicited in three ways:

1. By irritation of the skin over the liver.
2. By fixing a pleximeter anywhere in the hepatic region.

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and striking the pleximeter a series of vigorous blows with a hammer.

3. By concussion or sinusoidalization of the spines of the first three lumbar vertebræ.

The latter manœuver is the most effective. By any of the foregoing methods, percussion demonstrates (Fig. 87) a contraction of the liver. In percussing the lower border



FIG. 87.—Demonstrating the liver reflex of contraction. The continuous lines represent the borders of the organ before and the interrupted lines the borders after eliciting the liver reflex of contraction. The latter reflex in this patient was elicited by concussion of the spines of the first three lumbar vertebræ. The liver in the mammary line measured 12 cm. and was reduced to 7 cm.

of the liver, the dullness of the lower border of the organ is facilitated by inclining the body backwards or by having an assistant fix the hand upon the spinal column to prevent vibrations of the latter (Page 80).

The *liver reflex of dilatation* is evidenced by an enlargement of the organ subsequent to the execution of the following manœuvers :

Pathologic Physiology of Liver

1. By deep and firm pressure with the finger to the right of the spinous process of the 11th dorsal vertebra (Fig. 48).

2. By sinusoidalization or concussion of the spine of the 11th dorsal vertebra. This is the more effective of the two methods.



FIG. 88.—Illustrating enlargement of the liver by concussion of the spine of the 11th dorsal vertebra. The continuous lines represent the area of dullness before, and the interrupted lines the area after eliciting the liver reflex of dilatation. The liver in the mammary line measured 12 cm. and was increased to 16 cm.

PATHOLOGIC PHYSIOLOGY.

Circulatory Disturbances.—During digestion there is a physiologic congestion of the liver, but in persons who eat and drink to excess, this congestion may become pathologic and may even conduce to organic change. The fullness or distress in the right hypochondrium, to which reference is frequently made by dyspeptics, may be caused as Osler suggests, by hyperemia of the liver. The amount of blood contained in the liver is equivalent to one-fourth the amount

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of blood contained in the body. During digestion this amount is very much increased, hence the drowsiness after eating, especially in dyspeptics, the result of brain-anemia from portal congestion and the cold extremities and chilly sensations. Hyperemia of the organs has been noted in suppression of the menses. Passive congestion is frequent in all conditions leading to venous stasis in the right ventricle of the heart, and is associated with swelling of the organ.

HEPATIC TOXEMIA.—Any hepatic disease may be associated with a variety of toxic symptoms connected with the nervous system.

In the norm, the poisonous substances in the intestinal canal are either not absorbed or, if they are, they are made innocuous and rapidly excreted. Auto-protection of the organism against self-poisoning is achieved by organs which either arrest or transform the poisons or eliminate them.

The *organs of defense* practically represent the bodily resistance. This, equationally expressed for germ-infection, is applicable to auto-poisoning, *viz.*:

$$D = \frac{PTA}{R}$$

D, the disease, equals P, the poison, multiplied by T, its toxicity, multiplied by A, its amount, the product being R, the resistance of the individual attacked. The liver is unquestionably the chief organ of defense. It converts the poisons into non-toxic and assimilable substances, filters them, and excretes them in the bile. When the liver-function becomes insufficient, the poisons destined for destruction enter the blood, and the clinical picture of hepatic toxemia results. If the liver is excluded from the general circulation by connecting the portal vein with the inferior vena cava, nervous manifestations and even death may follow the ingestion of meat. The condition known as *autointoxication* is, practically speaking, an hepatic toxemia.

Intestinal Autointoxication

Intestinal autointoxication, as we now comprehend it, may be briefly summarized as follows: During digestion, a number of poisons or enterotoxins are manufactured as a result of putrefaction of albuminoid food in the intestines. These enterotoxins attain the liver by way of the enterohepatic circulation where they are made innocuous. From the liver they pass into the general circulation and are excreted in the urine. If albuminoid putrefaction is excessive, or if the liver and kidneys (notably the former), prove inadequate in either neutralizing or excreting the poisons, autointoxication ensues. Intoxication is expressed by a motley group of symptoms, which often parade under the equivocal designation, neurasthenia. Now, this conception of intestinal autointoxication is only partially correct. While the usual enterotoxins are bacterial products, there are also poisonous albumoses, *i. e.*, intermediate products manufactured in the digestion of albuminous foodstuffs. It is well known that when peptones and albumoses (normal products of digestion) are injected directly into the blood, they are poisonous and even fatal in their effects. Falloise has recently had an excellent opportunity of studying this subject in a patient with a fistula of the small intestine. He concludes that albuminoid-putrefaction is not the only process concerned in autointoxication, and that an aqueous extract of the contents of the small intestine is infinitely more toxic than an extract made from the contents of the large intestine. Hence, if we accept the prevailing opinion that putrefaction of the albuminous molecule is limited in the norm to the large intestine, factors other than putrefaction of the albuminous molecule must be concerned in intestinal autointoxication.

Contrary to current belief, I have found that, in those suffering from self-poisoning, diarrhoea, or at any rate,

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looseness of the bowels prevails rather than constipation, and it appears as if this were a compensatory attempt on the part of the organism to rid itself of noxious products. Strassburger has shown that retarded bowel-action rather indicates diminished products of decomposition which normally stimulate the action of the intestines. If one were guided in the diagnosis of autointoxication by the statements of the patient, the condition would rarely be recognized. The fact is, the patients infrequently complain of symptoms of indigestion. It is only in aggravated cases that one encounters the conventional symptoms of dyspepsia. In most instances, nervous symptoms precede the local signs of indigestion.

Another supposed classical symptom of the affection is indicanuria; yet my experience shows that it is comparatively infrequent.

If one electrode of a sinusoidal current is placed over the sacrum and the other over the spines of the first three lumbar vertebræ, or, if the spines in question are concussed, one evokes the liver reflex of contraction. Either manœuver will promote the excretion of indican in the urine and its presence in the urine may be demonstrated after a single séance lasting fifteen minutes, even though previously absent. Naturally the urine must be voided before and after the application of the current and the specimens compared after examination is made for indican. For the examination of the latter I prefer the simple test recommended by Porter:

Add in a test-tube equal quantities of urine and chemically pure hydrochloric acid. To this mixture add three drops of a one-half per cent solution of potassium permanganate. If indican is present in the urine there will be formed a purplish cloud in the fluid in the test-tube. Then add a few drops of chloroform then one drop

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more of the potash solution and a few drops more of chloroform and shake vigorously. The deep-blue color resulting is due to precipitation of indican by chloroform and the amount and intensity of the precipitated indican determine the extent of the putrefactive changes going on in the alimentary tract.

SPLANCHNIC NEURASTHENIA.—In his book on this subject, the author has described a condition dependent on intraabdominal venous congestion superinduced by insufficiency of the splanchnic vaso-motor mechanism, and that the neurasthenic symptoms resulting therefrom may be corrected by relief of the congestion and by manœuvres which will increase the efficiency of the liver as an organ of defense. The fact is, splanchnic neurasthenia is intimately associated with autointoxication. When this venous congestion exists it interferes with a proper supply of arterial blood, and in consequence, the tissues and organs are bathed in pools of stagnant blood—they are practically asphyxiated. Again, the impeded circulation cannot remove the toxic products of digestion, and instead of the latter being at once conveyed to organs of elimination like the kidneys, they are arrested or transformed by organs like the liver, which soon prove inadequate to discharge their anti-toxic function; then we have the creation of symptoms which belong to the category of self-poisoning.

TREATMENT.

CIRCULATORY DISTURBANCES.—Every condition conducive to a stagnation of blood in the right heart is eventually followed by passive congestion of the liver. Merklen and Heitz have shown that coincident with the elicitation of the heart reflex, there is a reduction in the size of the liver (Fig. 58). Here, the heart momentarily awakens from its lethargy and by pumping an augmented quantity of blood

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into the circulation temporarily reduces the congestion of the liver.

Many Anglo-Indian physicians directly aspirate eighteen or more ounces of blood directly from the liver and it is claimed that excellent results ensue from this hepato-phlebotomy. This method was suggested by observing the reduction in the volume of the liver after bleeding from piles.

Now, in many instances, one may regard congestion of the liver as a process of compensation, the liver acting as a reservoir for the redundant blood which correspondingly reduces the work of the heart.

By enlarging the volume of the liver by concussion of the spine of the 11th dorsal vertebra, the patient may be bled into his own vessels for, even in the norm, this organ contains approximately one-fourth of the amount of blood in the body.

In other instances, the organ may be depleted by exciting the liver reflex of contraction by sinusoidalization or concussion of the spinous processes of the first three lumbar vertebræ.

INTESTINAL AUTOINTOXICATION.—Food as a factor in the treatment of autointoxication is a much-abused commodity. Someone has observed that the ultimate trend of the physician was to prove that even food was poisonous and what has been suggested as a facetious prognostication, appears to have been endowed with reality, when one seriously contemplates the endeavors of dietetic revolutionists. Many dietetic vagaries are as consistent as the perfervid plea of the poet Shelley, who wanted us to become vegetarians and marry our sisters. By opposing alimentary insufficiency we possess a formidable weapon in immunizing the tissues against interminable dietetic insults. One must not forget that there is such a condition as "indigestion toxemia," due either to an excessive production of poisons

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or to enfeeblement of the defenses. Thus there is an hepatic as well as a gastric and intestinal dyspepsia and the liver dare not be ignored even in the treatment of an ailment so plebeian as dyspepsia.

Intestinal asepsis is, in my experience, a purely theoretic conception which is rarely realized in practice. Intestinal antiseptics is difficult, if not impossible, for the following reasons: 1. An antiseptic strong enough to destroy germs is equally destructive to the intestinal mucosa. 2. Germicides will destroy the innocent germs which are concerned in digestion. 3. Germicides are rapidly absorbed or are made chemically inert. Recourse is also had to purgatives, but they often accentuate the symptoms of autointoxication because they concentrate the poisons already absorbed and remove the intestinal epithelium and mucus which practically act as barriers against the absorption of enterotoxins. We have discarded the swab in infectious diseases of the throat, for the reason that it mechanically injures the membrane of the throat and thus opens up new portals of infection. In this sense, the purgative is essentially an intestinal swab.

Intestinal autointoxication is a misnomer; the term of qualification refers only to the site where the poisons are manufactured.

The offending viscus in autointoxication is usually the liver and, if this organ is made equal to the task of destroying the poisons, the subject of self-poisoning would be simplified.

In autointoxication the liver is congested, enlarged and extremely sensitive to pressure; in fact, when the latter signs are present in the absence of organic disease, we are in the possession of the most positive evidence of hepatic inadequacy. Reference has already been made to the increased excretion of indican following the elicitation of the liver reflex of contraction (page 336) and the manoeuvre for

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exciting the latter is the method employed by the author in correcting hepatic inadequacy in autointoxication. To best elicit the reflex in question sinusoidalization or concussion of the spines of the first three lumbar vertebræ is executed daily.

The results even after a single treatment is evident; the liver is reduced in volume and palpation shows diminished tenderness.

It would be manifestly inconsistent were the author to contend that the method suggested is curative to the exclusion of other methods of treatment. On the contrary, he is more disposed to say that concussion or sinusoidalization of the lumbar spines is more effectual as an individual method of treatment.

Excessive albuminous food, that is to say, a diet containing a large quantity of meats and eggs, augments intestinal putrefaction, and even though the organs of defense are relatively normal, they are incapable of performing their functions when an increased burden is thrust upon them.

It will be necessary for us to briefly consider other methods of treatment in autointoxication. Some contend that if indican can be detected in the urine, even by a feeble reaction, it is an indication that it is excreted in excessive quantity. Indican in the urine (*indicanuria*) suggests bacterial putrefaction of the proteid substances in the intestines, for in perfect digestion of the proteids, it cannot be detected in the urine.

Intestinal putrefaction as already suggested results from the action of proteolytic bacilli on albuminous food and the primary indication in treatment is to modify the culture medium of the intestine so as to render it inimical to the germs in question.

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The best and most certain method of treatment is by means of an antiputrid régime.

It has been suggested that a sterile régime will destroy the virulence of the bacterial flora of the intestine, but observations show that sterile food will diminish but does not completely inhibit intestinal putrefaction.

An aseptic régime is best attained by the avoidance of crude vegetables and fruits, for no matter how thoroughly they are washed they still remain contaminated.

The cooking of foods will diminish the danger of infection by destroying bacterial growths and larger parasites (tapeworms and trichinæ). The cooking of vegetable foods breaks up the starch grains, bursting the cellulose and thus permitting the digestive fluids to come into immediate contact with the granulose.

ANTIPUTRID RÉGIME.—As before remarked, this is the most satisfactory means of antagonizing intestinal putrefaction. The putrescent aliments are the proteids and if the latter could be completely eliminated, there would be no putrefaction, and consequently, no intestinal autointoxication. All investigations show that intestinal putrefaction augments parallel with the quantity of albuminous foodstuffs. We know, however, that the proteids or albuminous foodstuffs are true tissue-builders and repairers and consequently cannot be eliminated without compromising nutrition. We know, furthermore, that the proteid requirements of the individual have been exaggerated and that the experiments of Professor Chittenden show that men can maintain health and muscular efficiency for long periods on about half the amount of proteid which is usually consumed. It would be difficult now to maintain, as did Herbert Spencer, that the consumers of meat showed superior physical strength to the consumers of rice, which would be equivalent to saying the Russians demonstrated more physical endurance than the Japanese. One may conclude conservatively that we ordinarily consume more proteid food than is necessary and that ingested in excess, it is either conserved for future uses of the economy, or remaining undigested, it must be reduced by bacterial digestion. Instead of the individual requiring one hundred and twenty grams daily of proteid according to the diet table of Moleschott, or one hundred grams according to the diet table of Ranke,

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the amount of proteid may be reduced considerably without prejudice to the individual.

If an individual were desirous of taking his daily supply (100 grams) of proteid in the form of meat, it would be necessary for him to consume a little more than one pound (500 grams) of meat. It was at one time supposed that fats exercised no influence on intestinal putrefaction, but more recent experiments have demonstrated that this observation is faulty and that fats do increase intestinal putrefaction.

The lacto-farinaceous diet of Combe is the antiputrid régime *par excellence* in the treatment of autointestinal intoxication; it acts not by any destructive influence on the intestinal flora, but seeks only to modify the soil in which the microbes live.

MILK.—Of all aliments, milk is probably the most resistant to putrefaction, and it has been found by Winternitz that if a certain quantity of milk is given with a meat diet, it will diminish the production of enterotoxins. Milk owes its antiputrid properties to the lactose which it contains and which, under the influence of the aerobic bacilli of the small intestine (*coli* and *lactis aerogenes*) is decomposed into succinic and lactic acids. These acids inhibit the action of the proteolytic bacilli in the large intestine from acting on the albuminous foodstuffs. Cow's milk contains about 3.5 per cent of proteids (chiefly caseinogen) against 12.2 per cent in the white of eggs and about 20 per cent in meats.

I find that some individuals cannot tolerate even small quantities of milk (raw or boiled) without causing diarrhoea. In such instances, I employ lactose (milk sugar). Cow's milk contains 5 per cent of lactose; hence if the individual will take about 400 grains of lactose at each meal, he will have consumed an amount equal to about three pints of milk daily. Very often raw milk is tolerated when boiled milk is not.

It has also been proposed to substitute milk by a number of aliments which already contain lactic and succinic acids and many of them are more digestible than the ordinary cow's milk. They are as follows:

1. Curdled milk.
2. Whey.
3. Buttermilk.

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4. Koumiss.
5. Kefir.
6. Fresh cheese (*fromage à la crème*).

Buttermilk, owing to its small amount of fat and casein (chief proteid of milk), is a very desirable product in autointoxication, inasmuch as one knows that these substances favor putrefaction. Again, the presence of lactic acid and lactose enables the latter to produce lactic acid *in statu nascenti*. Condensed buttermilk may be obtained in flasks containing 330 grams, and to prepare the buttermilk one mixes the contents of one flask with 660 grams of a decoction of cereals, thus obtaining one liter of porridge (*potage au babeurre*).

The composition of Koumiss varies with its age, containing on the first day about .96 per cent of lactic acid and about one per cent on the twenty-first day after its preparation. It contains nearly the same percentage of alcohol as beer. Koumiss is an agreeable and easily digestible preparation.

Fresh soft cheese contains considerable assimilable casein and therefore subserves a useful purpose in proteid nutrition and it has all the advantages and none of the disadvantages of milk. Thus the soft cheese known as *petit suisse* contains the following: Albumin 4 per cent; casein, 24 per cent; lactose, 2 per cent; and lactic acid, .60 per cent.

FARINACEOUS ALIMENTS.—Combe* formulates the following conclusions:

1. The carbohydrates, or sugary foods, prevent proteid putrefaction in the intestine.
2. That in natural digestion, the farinaceous foods (rice, farina of cereals and their derivatives) surpass all other carbohydrates because they are less easily absorbed and they penetrate more profoundly into the intestine and only gradually furnish lactic and succinic acids.
3. That the maximum quantity of farinaceous food must be given with each repast and, if possible, to carry out this cramming process, this food must be given five or six times a day.

*L'Auto-Intoxication Intestinale, Paris, 1907. There is an English translation of this book published by the Rebman Company.

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4. Interdict as far as possible, all albuminous foodstuffs but choose among them the least putrescent (like eggs) and when they are used, combat their action by an excess of farinaceous food.

5. In the ordinary forms of autointoxication, milk mixed with farinaceous food is better supported than milk alone.

6. Avoid fats, which augment putrefaction, and choose butter in preference.

If one is desirous of carrying out, if only for test purposes, an antiputrid régime, one may select the following:

1. Milk, or lactose as a substitute.
2. Cooked vegetables, preferably as purées.
3. Preserved or cooked fruits.
4. Weak coffee, tea or cocoa.
5. Toast with little butter.
6. Farinaceous foods prepared as puddings, or otherwise.
These must be consumed in abundance.
7. Buttermilk or Koumiss.
8. Fresh cream cheese.

Later, if the condition of the patient is ameliorated, easily digestible albuminous foodstuffs like eggs, ham and cold meat, together with fresh fruits (preferably bananas), may be permitted.

ANTAGONISTIC MICROBES.—Ever since Metchnikoff directed attention to the fact that sour milk microbes are antagonistic to the microbes of putrefaction, it is quite the custom in France to employ the former in the treatment of autointoxication. The chief characteristic of the intestinal flora of the autointoxicated, is the marked diminution of the saccharolytic aerobic bacilli and the preponderance of the proteolytic anaerobic varieties. To modify the foregoing condition a vegetarian or lacto-vegetarian or lacto-farinaceous diet is indicated on account of the small quantity of proteid matter which it contains and the lactic acid which it produces. Another method is to feed the subject with lactic acid ferments or microbes which are innocuous but exert an inhibitory influence on the microbes of putrefaction. There are now several lactic acid culture mediums on the market, but many of them seem to lose their therapeutic action when prepared in the form of tablets or globules.

Splanchnic Neurasthenia

Unquestionably, the *liquid lactobacilline*, as it is called, is the most efficient. It may be taken in milk or water directly from the small bottles in which it is sold, and one bottle (containing about half a teaspoonful) a day is the average dose. During the first few days, digestive disorders may follow its use but soon constipation ceases, the stools lose their putrid odor, the breath sweetens and the tongue becomes cleaner. The signs of autointoxication disappear slowly but surely. To make these good results permanent, the treatment is continued on an average for two and a half months. The ferment is ordinarily employed in association with the diet, although some writers claim that nearly all the effects can be secured from the ferment alone. According to Cohendy, it takes about six days before the lactic acid microbes change the intestinal flora. If diarrhoea is caused by intestinal putrefaction, it is said to be arrested by this bacterio-therapeutic method.

If lactic acid culture mediums cannot be obtained, then buttermilk or koumiss may be used. Holt suggests the following formula for the domestic manufacture of koumiss: one quart of fresh milk, one-half ounce of sugar, two ounces of water and a fresh piece of yeast cake (one-half inch square), are put in wired bottles and kept at a temperature between 60 and 70 degrees F. for one week. The bottles are shaken five or six times a day. They are then put on ice and kept ready for use.

This bacterio-therapeutic method may have to be employed to the exclusion of the laco-farinaceous diet for there are some individuals who suffer from dyspeptic symptoms if the latter is pursued too vigorously.

SPLANCHNIC NEURASTHENIA. — The chief abdominal symptoms of this affection are: abdominal sensitiveness, tenderness and enlargement of the liver, and gaseous accumulations in the bowels. The dominant symptoms of the affection are resident in the nervous system. Depression, or as it is popularly called, an attack of "the blues," is scientifically speaking, an exacerbation of splanchnic neurasthenia and coincident with the depression, there is hepatic enlargement and tenderness. Eliciting the liver reflex of contraction will

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at once dissipate partially or completely the liver tenderness and enlargement, and will ameliorate the condition of the patient. Splanchnic neurasthenics find that their symptoms are accentuated after meals and this may be accounted for by the augmented amount of blood in the liver at this particular time.

The factors which contribute to the development of splanchnic neurasthenia are essentially nerve-force lacking



FIG. 89.—Illustrating the cardio-splanchnic phenomenon. The shaded area indicates the dullness obtained after vigorous compression of the abdomen. The contiguous area is the superficial area of cardiac dullness.

in the muscles of the abdomen and in the nervous mechanism which regulates the supply of blood in the abdominal vessels.

The former factor indicates reduced intraabdominal tension, for the greater the latter, the less blood will be contained in the abdominal vessels. It is for this reason, that one finds in splanchnic neurasthenia the objective signs of reduced intraabdominal tension (page 145). There is

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another sign which the author has called the *cardio-splanchnic phenomenon*⁶⁷ (Fig. 89). There is a tendency of the blood to accumulate in the splanchnic area, with consequent syncope.

Like the generality of veins, the great splanchnic veins are very susceptible to pressure, and the amount of blood within them is greatly influenced by the pressure of the abdominal walls. Mere pressure of the latter suffices to squeeze out of them a large quantity of blood. More blood accumulates in the splanchnic veins in the erect than in the recumbent posture, and it is not an uncommon observation for syncope to occur in bedridden patients who are suddenly constrained to get out of bed. The removal of stays in women often induces a feeling of faintness, and the same symptom may occur when a large quantity of ascitic fluid is removed and, in susceptible subjects, when the bladder is emptied or feces discharged.

Hill has shown that in consequence of some failure, the blood gravitates into the splanchnic veins from the right heart, and that pressure upon the abdomen will send back the blood from these veins to the right heart, and thus re-establish the circulation.

If the lower sternal region, *i. e.*, the part of the sternum contiguous to the heart, is first percussed, the sound elicited is one of resonance or hyperresonance; if now, one makes vigorous compression of the abdomen, percussion again shows that the region in question has become dull or even flat. This is the cardio-splanchnic phenomenon and is present even in the norm, but when there is intraabdominal venous congestion as in splanchnic neurasthenia, this phenomenon is much exaggerated and the area of dullness is more diffused.

By percussing the lower end of the sternum in the erect

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posture, one obtains a resonance, but when the patient assumes the recumbent posture, a dullness supplants the resonance. This is the attitudinal cardio-splanchnic phenomenon. It is present in health but absent when the splanchnic vaso-motor mechanism is defective.

The splanchnic circulation is partly venous and partly arterial, and consists of the portal vein and its branches and the arterial branches of the celiac axis. When a person stands, the splanchnic vaso-motor mechanism causes a constriction of the splanchnic vessels and the blood-pressure rises, but, if ineffective, it fails to rise or falls. Now, in splanchnic neurasthenia, the splanchnic vaso-motor mechanism is exhausted and it is inadequate to prevent a flow of blood to the splanchnic vessels. The following test demonstrates an adequate automatism of the vaso-motor mechanism:

PULSE-RATE.	SYSTOLIC BLOOD-PRESSURE.
Lying..... 60	118
Standing..... 60	130
—	—
Difference..... 0	—12 mm.

In the following test, the vaso-motor mechanism is insufficient:

PULSE-RATE.	SYSTOLIC BLOOD-PRESSURE.
Lying..... 60	104
Standing..... 100	90
—	—
Difference . . . —40	—14 mm.

The intraabdominal venous congestion in splanchnic neurasthenia is influenced in a variety of ways:

1. By abdominal massage and abdominal exercises.
2. By strengthening the abdominal muscles (page 146).
3. By abdominal supporters.
4. By eliciting the liver reflex of contraction (page 331).
5. By toning the splanchnic vaso-motor mechanism.

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Respecting the latter method. The dorsal region of the spinal cord represents the origin of the majority of vaso-constrictors in the body. The splanchnic vaso-motor mechanism which controls the vessels of the abdominal viscera consists of the splanchnic nerves which are composed of fibers issuing from the cord in the 5th to the 12th dorsal nerves, inclusive. Reference to Fig. 10, shows that the dorsal nerves in question correspond to the spines of the 2nd to the 8th dorsal vertebræ inclusive.

Now, if the spines in question are sinusoidalized, or better still, concussed, the cardio-splanchnic phenomenon (page 346) is at once brought into evidence. In other words, the blood is expressed from the abdominal vessels to the right heart.

Concussion then, of the 2nd to the 8th dorsal spines, inclusive, is a very active means of augmenting the tone of the splanchnic vaso-motor mechanism and constitutes a very efficient method of treatment in splanchnic neurasthenia and in all forms of intraabdominal congestion even without nervous symptoms.

In *Glénard's disease*, or enteroptosis, the prolapse of one or more abdominal organs is associated with neurasthenic symptoms and the wearing of an abdominal supporter affords much relief to the wearer. The relief thus attained is not due wholly to reposition of the organs, as is instanced in the observations of Bial. The latter applied transparent bandages to cases of gastroptosis and transilluminated the stomachs before and after the application of the bandages. No change in the position of the stomach could be noted, and it is therefore most likely that abdominal supporters act chiefly by compression of the viscera, which, in turn, squeeze the blood out of the turgid abdominal veins.

The author has treated many cases of Glénard's disease

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based on the principle that the symptoms are often dependent on a faulty vaso-motor mechanism and by increasing the tone of the latter, by sinusoidalization or concussion of the spines of the 2nd to the 8th dorsal vertebræ, one may ameliorate the symptoms.

CHAPTER X.

MISCELLANEOUS REFLEXES.

THE SPLEEN—REFLEXES OF THE SPLEEN—SPLENIC REFLEXES IN TREATMENT—UTERUS REFLEX—DYSMENORRHEA—THE BLADDER REFLEX—THE KIDNEY REFLEXES—NERVOUS SYMPTOMS; PARALYSIS, CONTRACTURES, ATAXIA.

THE SPLEEN.

THIS enigmatical organ of the physiologist, like the other viscera, is not constant in size; on the contrary, the spleen contracts and expands synchronously with the periods of digestion. It attains its maximum dimensions at about the fifth hour after a meal and then slowly returns to its previous size. According to Schaefer, motor nerve-fibers are contained in the splanchnic nerves which, when stimulated, cause either a contraction or a dilatation of the spleen. No doubt the contraction and dilatation of the organ are dependent on its intrinsic musculature, that is, the plain muscle tissue existing in the capsule and the trabeculæ. It has been found that when the spleen contracts the liver becomes enlarged. It is the popular belief that the spleen is influenced by the nervous system and Botkin found that depressing emotions increased its size and exhilarating ideas diminished it.

The latter observer also noted that the application of the induced current to the skin over the spleen in a case of leukemia caused the organ to contract and that each stimulation was followed by an increase in the number of colorless corpuscles in the blood and the condition of the patient improved. We will note presently that the spleen may be made to contract even in the norm.

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In fevers there is an acute swelling of the spleen and a chronic enlargement of the viscus is observed in malaria and leukemia. Enlargement of the organ (*splenomegaly*) is associated with other diseases of the blood, notably pernicious anemia, Hodgkin's disease, congenital syphilis and Banti's disease.

REFLEXES OF THE SPLEEN.

Like the other viscera, two reflexes of the spleen may be elicited, *viz.*, that of contraction and dilatation.

For diagnostic purposes these reflexes, like other visceral reflexes, are obtained by several concussion blows with the hammer on a pleximeter while the latter is resting on definite vertebral spines. The *splenic reflex of contraction* is elicited by concussing in succession the spines of the first three lumbar vertebræ, whereas the *splenic reflex of dilatation* is obtained by concussing the spine of the 11th dorsal vertebra. The spleen may be brought into evidence by this reflex even when percussion shows no area of splenic dullness.

The contraction and dilatation of the organ are evidenced by percussion and to aid the latter, the vibrations of the spine and sternum may be suppressed after the manner detailed on page 80.

The results of the concussion manoeuvres just cited are shown in Fig. 90.

THE SPLENIC REFLEX IN TREATMENT.

Only the splenic reflex of contraction has thus far been employed by the author for therapeutic purposes, although he believes that careful hematologic examinations after eliciting both reflexes, may shed some light on the functions of the spleen which have thus far baffled physiological investigations.

Splenic Reflexes



FIG. 10.—Illustrating the splenic reflexes. The continuous line represents the area of dullness of the spleen before vertebral manipulation. The interrupted line within the continuous line represents the splenic reflex of contraction whereas the interrupted line outside of the continuous line represents the splenic reflex of dilatation. The latter reflex measures 9 cm. and the reflex of contraction only 3 cm. in the anterior axillary line.

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The fact that the spleen is endowed with contractility has engendered the employment of therapeutic measures to the splenic region like electricity and heat and cold with the object of reducing the volume of the organ. Such measures are, however, only illusory, inasmuch as any irritation of the skin in the region of the spleen produces a dilatation of the lungs (lung reflex of dilatation, page 294) which, descending over the spleen, gives the erroneous impression that the spleen has contracted.

It was the erroneous observation of Adamo Moscucci that led the author to first discover the lung reflex of dilatation. Moscucci reported the cure of enlarged spleens in malaria by spraying ether over the splenic region. In attempting to confirm the observations of Moscucci, the author found that the ether acted as a cutaneous irritant and by dilating the lungs gave the impression that there was a reduction in the volume of the spleen.

The anatomic structure of the spleen suggests its function, *viz.*, a lymph-gland which acts as a receptaculum for foreign and noxious elements circulating in the blood. No doubt the leukocytes in the spleen assist by their phagocytic action in destroying the noxious elements which have been filtered by the organ. Weidenreich has shown that the splenic vein contains seventy times as many leukocytes as the splenic artery.

The spleen is a favorite repository for microorganisms and it has long been recognized as the habitat of the *plasmodium malariae*. Indeed, Laveran avers that the plasmodium here finds protection from destruction in the circulation.

The fact has been recognized that cutaneous irritants (douches, electricity, etc.) in the splenic region may precipitate a malarial paroxysm in latent malaria. Here it is assumed, that the therapeutic manœuvres in question

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contract the spleen and thus dislodge mechanically into the circulation the plasmodia which have lodged in the organ. *Quinin* has a specific action on smooth muscle and contractions of the spleen, uterus and intestines have been observed.

Now, quinin in its action shows a specific toxicity to the organisms of malaria, yet even when the plasmodia cannot be demonstrated in the blood of the periphery, a single dose of quinin by contracting the spleen may force the plasmodia into the circulation and thus make their demonstration evident.

Samuel Hahnemann's homeopathic theory of *similia similibus curantur* was founded on this untoward effect of quinin. Hahnemann, at one time, had malaria, and suffered from no attack for many years, until one day he tried the effect of cinchona upon himself for experimental purposes. The ingestion of the drug was followed by a violent rigor and a well-marked attack of ague, and thus he argued: If cinchona is a remedy for ague, and if in me it has precipitated an attack of the disease, it must follow that a small dose of the drug which produces certain symptoms will cure the same symptoms when they are caused by the disease.

The author has shown that the splenic reflex of contraction may be elicited most effectually by concussion of the first three lumbar spines and he has utilized this reflex in the diagnosis and treatment of malaria. Thus, in *latent malaria*, he has precipitated a typical paroxysm (chill, fever and sweating) by such concussion. He has also demonstrated after the latter manœuver the presence of plasmodia in the blood, although absent previous to the concussion.

In the *treatment of malaria*, he employs concussion in connection with the use of quinin and, in this way, he has achieved excellent results.

Several cases of pernicious malaria and malarial cachexia

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are recalled which resisted the action of quinin alone, but when the latter was used in combination with concussion, treatment was effective.

It may also be observed that although in these cases, months and even years may elapse before there is any reduction in the size of the spleen, concussion of the spines of the first three lumbar vertebræ will cause the ague-cake to disappear after several weeks treatment.

Puncture of the spleen has often been done with the object of aspirating the juice of the spleen to demonstrate in the latter, the plasmodia and typhoid bacilli. The latter are almost constantly found in the spleen. Splenic-puncture is by no means a harmless procedure and, for this reason, it has been abandoned by conservative clinicians.

Isolation of typhoid bacilli from the blood is a useful procedure in the diagnosis of *typhoid fever*, and the author suggests concussion of the lumbar spines to facilitate the demonstration of the bacilli in the blood. He has had, however, no proof to justify the suggestion.

The following cases are interesting:

I. A young man had symptoms suggesting the latent or ambulatory form of typhoid fever. The spines of the first three lumbar vertebræ were concussed during a séance lasting ten minutes. The following day, the typic symptoms of typhoid fever appeared and convalescence was not established until the fiftieth day.

One could, with reason, regard the development of the symptoms following concussion as a mere coincidence, yet a like observation in two other cases of a similar nature would seem to justify the conclusion that, in consequence of contraction of the spleen following the manœuvre, typhoid bacilli were forced into the general circulation by contraction of the spleen.

II. A young lady had apyrexia for one month fol-

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lowing typhoid fever. Her spleen was enlarged and she suffered pain (as often occurs from tension of the capsule of the spleen) in the region of the organ. An effort was made to reduce the volume of the organ by concussion of the spines of the first three lumbar vertebræ. After three treatments, she suffered a relapse lasting fifteen days and roseola, diarrhoea and a step-like temperature were prominent symptoms.

The conditions favoring a relapse in typhoid fever are unknown. A relapse is associated very often with some indiscretion in diet.

The author supposes that in these cases reinfection results from contraction of the spleen forcing the typhoid bacilli into the circulation. Indiscretions in diet are followed by an enlargement with subsequent contraction of the spleen. For this reason, the author suggests concussion as a therapeutic manœuvre not only to prevent relapses but to hasten defervescence in typhoid fever.

This same therapeutic manœuvre suggests itself in the treatment and diagnosis of other infectious diseases associated with an enlargement of the spleen.

It has been known for some time that enlargement of the spleen was associated with anemia and cachexia, and the condition was specified as splenic anemia or *splenomegalia cum anemia*, but Banti demonstrated that the splenomegaly was not secondary as in leukemia, but autochthonous and responsible for the symptomatic complex known as *Banti's disease*.

The author has successfully treated one case of the latter disease by elicitation of the splenic reflex of contraction after a number of séances of concussion of the spines of the three first lumbar vertebræ.

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THE UTERUS REFLEX.

If one electrode from a sinusoidal current is applied over the sacrum and an interrupting electrode is fixed over the spines of any of the first three lumbar vertebræ, a distinct contraction of the uterine walls may be observed through a speculum. The author has had no experience with this reflex in treatment and is therefore unable to determine its practical value.

DYSMENORRHEA.

Painful menstruation is subdued in conventional practice by treatment of the cause and the use of some analgesic during the paroxysm of pain. The author has thus far examined about fifty patients who suffer from painful menstruation and has noted points of tenderness located either to the right or left side or both sides of one or more of the spines of the first four lumbar vertebræ. Firm pressure made with the end of the thumb (page 170) over one or more sensitive areas will abolish the pain for several hours or during the entire period of the menstruation. The latter excellent result, however, is infrequently achieved, and it may be necessary to repeat the manœuver several times during the menstrual period. The areas of tenderness may be marked with a stick of nitrate of silver and some member of the family may be taught the method of making pressure. In other instances the areas of tenderness may be frozen (page 172) and the effect may last during the entire menstrual period. Freezing, if effective, is decidedly more lasting in its results than pressure.

THE BLADDER REFLEX.

The author has investigated this reflex in association with Dr. Henry Meyer of San Francisco, an acknowledged

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expert with the cystoscope. With one electrode over the sacrum and the interrupting electrode at the spine of the 5th lumbar vertebra, a decided contraction of the wall of the bladder and its sphincter can be observed with the cystoscope. The sinusoidal current was used and contraction of the abdominal wall was excluded. No doubt there is a distinct vertebral site for contraction of the sphincter and for the detrusor vesicæ. However, the reflex in question is merely cited as a suggestion to cystoscopists for its elaboration. The bladder reflex may be utilized in atonic conditions of the musculature of the bladder.

THE KIDNEY REFLEXES.

PERCUSSION OF THE KIDNEYS.

Among the cognate branches of medicine, physical diagnosis is the least progressive. It still bears the imprint of tradition and any attempt to improve upon the methods of the founders—Auenbrugger, Lænnec, Skoda and others—is viewed as an act of sacrilege. It is suggested in the text-books, that owing to the anatomic position of the kidneys (Fig. 11), their boundaries cannot be limited by percussion and that the thick layers of muscles behind yield a dullness which an organ as thin as the kidney could not increase. It may be affirmed, however, that, as a rule (excluding non-resonant impacted feces in the colon), one may determine the lower and a portion of the outer border of each kidney by contrasting its dullness with the tympanicity of the ascending and descending colon which lie anterior to each organ. If it is a question of tympanicity which obscures the dullness of the kidney, this objectionable feature may be obviated by suppressing the vibrations of the spine by having an assistant fix his hand on the latter during percussion (*vide* vibro-suppression). If it is a question of

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dullness of the spinal muscles, have the patient lean far backward to relax the muscles during percussion. Having defined the kidneys by percussion, concuss in succession with the hammer and pleximeter (Fig. 2), the 6th, 7th and 8th dorsal spines; percussion executed at once now demon-

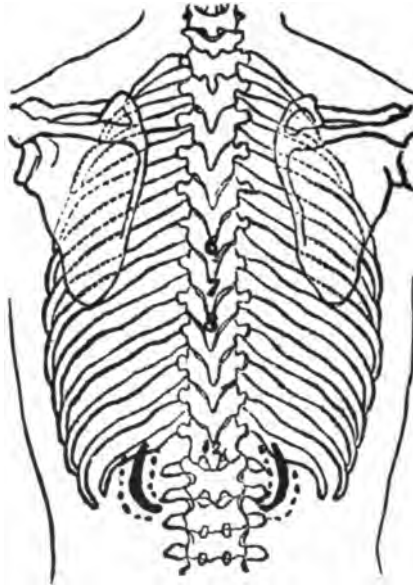


FIG. 91.—Kidney reflexes of contraction and dilatation. The continuous line represents the area of kidney-dullness and the dotted lines within and without the reflexes of contraction and dilatation respectively.

strates an increase in the area of renal dullness which is the *kidney reflex of dilatation*. Concussion of the 12th dorsal vertebral spine causes a decrease in the area of renal dullness, which is the *kidney reflex of contraction* (Fig. 91). The latter, like other visceral reflexes, are of limited duration. It is known that by means of the oncometer, that the kidney, like the spleen, shows variations in volume. The real volume of the living kidney depends upon the distension of

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its structural elements, upon the quantity of lymph and specially upon the amount of blood in its blood-vessels. When the latter dilate the kidney increases in size and when the vessels contract, the kidney diminishes in volume.

THE KIDNEY REFLEXES IN DIAGNOSIS AND TREATMENT.

Insomuch as the kidney reflexes have only recently been discovered by the author, anything he may say concerning their value in diagnosis and treatment can only be theoretic. One could assume that backache due to distension of the capsule of the kidney could be relieved by diminishing the volume of the organ by concussing the 12th dorsal spine with the hammer. Pain due to the presence of a renal calculus would be intensified by the same manoeuvre.

A dull area supposed to be the kidney would increase with elicitation of the kidney reflex of dilatation and would decrease by elicitation of the counter kidney reflex. Surgery has been invoked in the treatment of chronic nephritis.

Thus, some surgeons have resorted to puncture (reni-puncture) of the kidney and others to incision of the capsule, thus assuming that the fundamental condition demanding relief was tension of the organ. Others assume that nephropexy relieves the condition by establishing vascular adhesions which carry an additional supply of blood.

The author has treated only one case of parenchymatous nephritis by concussion, but the results are nevertheless interesting. Acting upon the theory that a better blood-supply was essential, the treatment consisted of daily séances of concussion to elicit the kidney reflex of dilatation. After about seven treatments, the albumin increased in the urine, the blood-pressure became higher and edema of the extremities developed. Concussion of the spine of the 12th dorsal vertebra was then executed to elicit the reflex of

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contraction and thus diminish the volume of the kidney. After a few treatments the edema rapidly disappeared, the blood-pressure sank to 165 mm. (from 210 mm.) but the albumin continued in the urine (at this time of writing), although slightly diminished in percentage.

In interstitial nephritis, increasing the volume of the kidney (by eliciting the kidney reflex of dilatation) would theoretically be indicated.

NERVOUS SYMPTOMS.

PARALYSIS.

Reference has already been made on page 11 to the *spinal muscular reflexes*.

In electrotherapeutics, the average neurologist concerns himself with the employment of only the Galvanic and Faradic currents. He has little faith in influencing the site of the lesion and contents himself with stimulation of the paralyzed muscles, hoping that such irritation may act indirectly at the site of the lesion.

Reference has already been made to the action of the sinusoidal current on page 11, in provoking contraction of the muscles by central stimulation. Other currents are not effective in achieving this object. By vertebral stimulation, one may provoke contractions of muscles which are not possible by the conventional method of peripheral application. The contractions of the muscles are bilateral, and the latter fact is of great importance in comparing the contractions on both sides of the body. The illustration on page 13 will aid the physician in contracting definite groups of muscles. Thus, as an example, one may cite the following: Assuming that the patient cannot extend the leg upon the thigh. Here the quadriceps femoris is implicated. Reference to Fig. 14 shows that the cell-bodies of origin of the quadriceps femoris are located in the 2nd and 3rd lumbar seg-

Contractures and Ataxia

ments of the cord and that these segments correspond to the 10th dorsal spinous process (page 14 and Fig. 10). To stimulate the muscle in question the exciting pole, *i. e.*, the interrupting electrode of the sinusoidal current is fixed at the spinous process of the 10th dorsal vertebra, whereas the indifferent electrode is placed over the sacrum.

CONTRACTURES.

When definite groups of muscles are weakened or paralyzed, the antagonistic muscles not encountering the normal resistance to their action, move the limb in an abnormal position and hold it there. The latter is a passive contracture. If a limb is fixed in an abnormal position by a tonic contraction of certain groups of muscles, one is dealing with an active or spastic contracture. Concerning the reciprocal action of antagonistic muscles, the researches of Sherrington show in brief that the inhibition of the tonus of a voluntary muscle may be brought about by the excitation of its antagonist. To overcome contractures, vertebral sinusoidalization is very effective in stimulating groups of muscles antagonistic to the shortened muscles after the method of segmental localization just described under paralysis.*

ATAXIA.

The attention of the reader is directed to the remarks on page 28, concerning the knee-jerk in locomotor ataxia. It is generally conceded that in the latter affection the ataxia is caused either by a loss or disturbance of the afferent impulses from the deep tissues, joints and muscles. In addition there is a disturbance of the muscular sense and hypotonia (*q. v.*) is present.

Attention has already been directed on page 165 to the re-education of co-ordinated movements in locomotor ataxia

*For further reference to this method of treatment, *vide* footnote on page 147.

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which has yielded excellent results. The re-education method is based on the observation that if an ataxic individual repeats a movement several times in succession, the ataxia in such a movement becomes less evident. The tabetic patient has an erroneous idea of the movement which he is executing, with the consequence that the movement is faulty. The "movement-memories" which he had in health no longer subserve his purpose and a new series of "movement-memories" must be acquired corresponding to the impressions which are received through neurons which are still intact.

The author has shown that whereas the afferent paths are compromised, the descending or motor paths may not be impaired. Taking advantage of the latter fact he effects re-education of the defective movements by vertebral sinusoidalization with results which prompt him to say supersede the conventional exercises in rapidity of action. The method, in brief, is to bring into action definite muscle-groups of the lower extremities by applying one large electrode to the region of the sacrum and the interrupting electrode over definite spinous processes (page 13). The author cautions against the employment of a strong sinusoidal current. The latter should only be sufficiently strong to provoke slight contractions of the muscles; otherwise, a hypertonicity of certain muscles ensues, resulting in muscle-bound extremities making locomotion even more difficult than before the use of the current in question. Not infrequently, the large electrode may be fixed in the lower dorsal region, and the interrupting electrode over definite spinous processes. One of my ataxic patients had difficulty in locomotion owing to abduction of the lower extremity. By bringing the *adductors* into play by vertebral sinusoidalization the difficulty was corrected. The relief of PAIN in locomotor ataxia may be attained by the methods suggested in chapter XI.

Therapeutics of Pain

CHAPTER XI.

THE THERAPEUTICS AND DIAGNOSIS OF PAIN.

SEGMENTAL-ANALGESIA — CONCUSSION-ANALGESIA — SEGMENTAL-LOCALIZATION—THE TRIGEMINUS NERVE—SINUSOIDAL-ANALGESIA—SEGMENTAL-PSYCHOTHERAPY—SEGMENTAL-ANALGESIA OF THE VISCERA—SEGMENTAL-ANALGESIA IN DIAGNOSIS—PHYSIOLOGY OF SPONDYLOTHERAPEUTIC METHODS.—SPINAL NERVE-TRUNK ANALGESIA—CORTICAL SINUSOIDALIZATION.

THE pharmacotherapy of pain concerns itself with the use of drugs known as anodynes or analgesics which annihilate sensation either through the brain (opium and its derivatives) or by enfeebling the heart, which relieves the hyperemic pressure on the nerve-tissues.

LOCAL ANESTHESIA is effected by cocain and its substitutes. *Aconite* primarily causes local irritation followed by anesthesia, but it produces no inflammation of the part.

Among the aromatic series, *carbolic acid* is the most important local anesthetic. By applying a drop of the acid to the skin, one is able to puncture the latter without pain. Among the mechanic methods are: protracted tepid baths, freezing, cupping and counterirritation.

In the treatment of pain by methods other than drug-giving, it is customary to employ agents at the peripheral site of the pain, thus ignoring the "*law of eccentric projection,*" viz., in stimulation of a nerve, irrespective upon which point of the course of the nerve it acts, the perception of a pain is transferred to the periphery. Pain perception results from an accumulation of individual stimulations in the gray substance of the spinal cord. Thus, in the employment of our peripheric methods, we usually disregard the true origin

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of the pain. That the average physician ignores the central origin of pain may be exemplified by the following case:

A middle-aged individual suffered for four years from a brachial neuritis. The pains were so violent that morphin was habitually used; in fact, his last physician instructed him how to use the hypodermic syringe. Ever since his trouble commenced he has traveled from city to city seeking relief. Every conceivable method known in physiotherapy was employed, but *always at the peripheral site of the pain*. An examination revealed a few points of vertebral tenderness at the exits of some of the spinal nerves, whereas others were developed as a result of manipulation of the peripheral areas of tenderness. The paravertebral area of vertebral tenderness was frozen most thoroughly and for the first time in four years the patient had a surcease of his pain for about eight hours. A second freezing gave relief for two days, and a few further freezings sufficed for a cure.*

SEGMENTAL-ANALGESIA.

Under this caption the author refers to the annihilation of pain in skin-areas and viscera related to different spinal-segments. Cutaneous and visceral analgesia may be achieved by the following methods:

1. Concussion.
2. Slow sinusoidal current.
3. Freezing.
4. Pressure (*vide* page 170).

Other remedial measures (such as the high frequency current, *rapid* sinusoidal current, Galvanic and Faradic

*All cases of neuritis are not equally amenable to such rapid results, and it may be necessary to freeze the sensitive peripheral nerves as a palliative and curative measure, insomuch as they may represent the site of a neuritic process and not as is usually the case, at the points of exit of the spinal nerves.

C o n c u s s i o n - A n a l g e s i a

electricity, phototherapy, cupping and counterirritation) have been tried with the same object in view but without results.

CONCUSSION-ANALGESIA.

The fear of employing forcible concussion of the spinous processes and the use of ineffectual apparatus have deterred physicians from obtaining more definite and decided results from vibro-massage. Reference to the foregoing facts has already been made on page 178. Here, as elsewhere in this work, the results cited have been achieved by the pneumatic hammer, but any other apparatus yielding a series of strong percussion blows, will no doubt yield like results.

Preliminarily, the following facts are worthy of emphasis :

1. Concussion and sinusoidalization stimulate the motor component of a spinal-segment and subdue its sensory constituent.

2. The sensory component of a normal spinal-segment is less amenable to concussion, sinusoidalization and freezing than a hyperesthetic segment.

In other words, concussion, sinusoidalization and freezing show a more decided analgesic action on hyperesthetic viscera and peripheral areas than when the tissues in question are normal. In the employment of the foregoing methods, the analgesia is bilateral.

SEGMENTAL-LOCALIZATION.

Reference has already been made to this subject on page 30. Assuming that the patient has pain in one of the skin-areas (Fig. 15), it is not difficult to ascertain the relation which a given area bears to a spinous process by consulting Fig. 10.

Thus, a patient suffers from pain on the anterior surface of the toes (Fig. 15) involving the second sacral segment.

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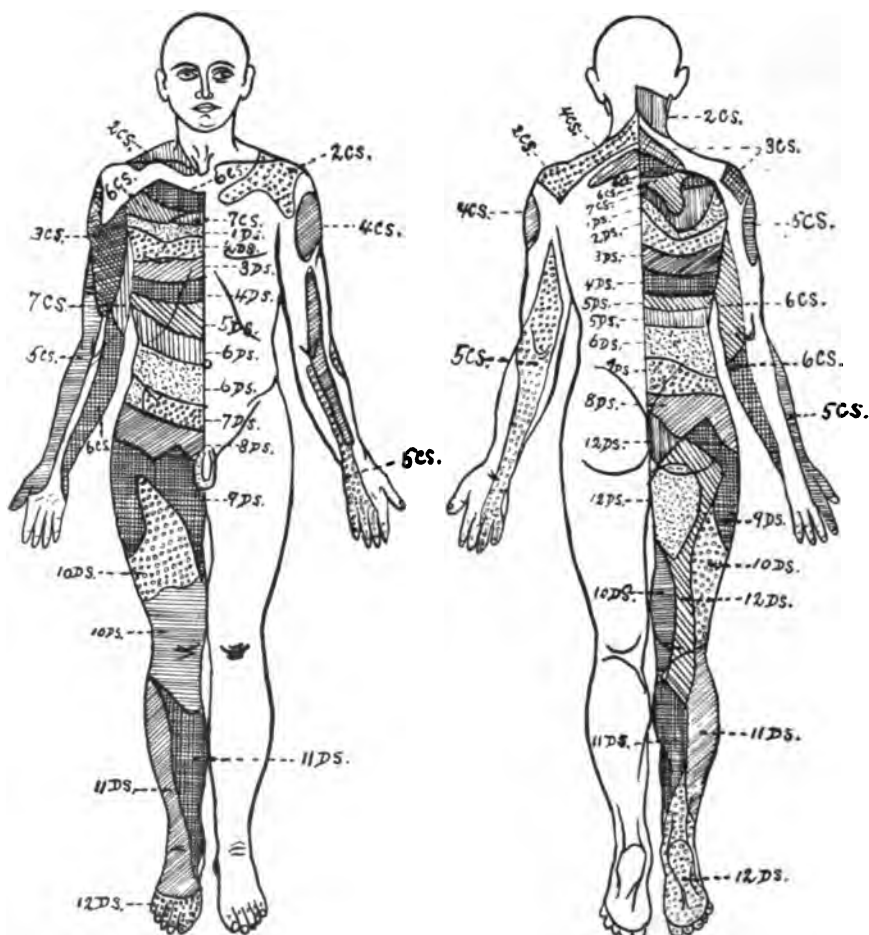


FIG. 92.—Showing skin-areas corresponding to the different spinal-segments. The numbers refer to the various *spinous processes* which are related to the segments and which, when concussed, sinusoidalized or frozen, cause *analgesia* in the different skin-areas. C, cervical; D, dorsal; S, sacral. Thus 5DS signifies that concussion, sinusoidalization or freezing of the region corresponding to the fifth dorsal spine will render the skin-area analgesic related to the 8th dorsal segment.

FIG. 93.—Showing skin-areas on the posterior surface of the body corresponding to the different spinal-segments. The numbers refer to the various *spinous processes* related to the segments of the cord.

Segmental - Localization

Reference to Fig. 10, shows that the segment in question is related to the 12th dorsal spine. The author has simplified segmental-localization in Figs. 92 and 93.

Assuming that a patient has a neuritis in the region of the arm corresponding to the 5th cervical segment (C5, Fig. 90). If one now concusses the 3rd cervical spine (which is related to this segment), the spontaneous pain disappears and analgesia may be noted objectively in C5.

Concussion is without doubt superior to slow sinusoidalization and freezing in effecting this object.

In most instances, this analgesic effect is noted after concussion for about three minutes, although a longer time may be necessary to effect this object. The duration of the analgesia, *i. e.*, insensitiveness to the prick of a pin, is usually of shorter duration than the relief from pain experienced by the patient. Although the pain-sense is abolished, the sense of touch may be intact.

Another example may be cited illustrating the importance of segmental-analgesia. A patient has lumbago and the sensitiveness of his skin does not permit of the local application of a sufficiently strong sinusoidal current. Note that the skin of the lumbar region corresponds approximately to the 9th, 10th and 11th dorsal segments, which in turn are related to the 5th, 6th and 7th dorsal spines. If the latter spines are now concussed for several minutes, the analgesia of the lumbar region permits of the electric application equal to at least three times its original strength.

SEGMENTAL-LOCALIZATION BY THE ELICITATION OF VERTEBRAL TENDERNESS.

This subject has already been discussed on page 71. In brief, when a sensitive peripheral structure is subjected to pressure (*e. g.*, a sensitive nerve), or manipulated (*e. g.*, a

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sensitive joint), within a minute an area of vertebral tenderness (corresponding to the roots of the spinal nerves) may be elicited by deep pressure at the exits of the nerve or nerves. This area of paravertebral tenderness is usually of short duration.

To locate the segment of the cord related to this area, the spinal nerve may be traced to its segment (Fig. 10), or the table on page 37 will show its relation to the spinous processes.

The fact of the matter is that the author's method of concussion-analgesia shows that the skin-areas ordinarily accepted as related to definite spinal-segments are only partially correct. It is, for the latter reason, as will be discussed later (under freezing), that segmental-localization by the elicitation of vertebral tenderness is often preferred.

A patient has an inflammation of the shoulder-joint (omarthritis) with adhesions. It is necessary in consequence of the latter to give relief to the ankylosis and pains, but owing to the pain consequent upon manipulation of the joint, it is impossible to execute sufficient force. There are no areas of vertebral tenderness until after manipulation of the joint for several seconds, when tender points may be detected corresponding to the 2nd, 3rd and 4th dorsal spines. The spinal nerves which make their exit at these points correspond approximately to the 2nd, 3rd and 4th dorsal segments. Therefore, after concussion of the 6th and 7th cervical spines and 1st dorsal spine for about three minutes, the shoulder-joint may be manipulated with almost as little pain as though the patient were under the influence of an anesthetic.

From a therapeutic standpoint, it may be argued that the relief of pain secured by concussion is merely palliative and is productive of no better results than from the employ-

T r i g e m i n u s N e r v e

ment of the conventional analgesics. In a sense, this contention is correct for the author has had recourse to concussion daily or even twice daily, for weeks in many cases of neuritis and other painful affections, securing thereby only relief from pain.

However, in some chronic painful affections, concussion was almost marvelous after several applications in giving permanent relief.

Here one is constrained to conclude that the lesion is not peripheral, but central, and that direct spinal-concussion effects some intra-spinal change (*vide* physiology of spondylotherapeutic methods).

SEGMENTAL LOCALIZATION OF THE PERIPHERAL NERVES.

Lesions of the peripheral nerves yield symptoms quite distinct from those of the spinal cord itself. The sensory symptoms consist essentially of numbness and tingling in the areas related to the peripheral nerves and the perception of pain, touch and temperature are usually only slightly impaired. The affected nerve is very sensitive to pressure and *points douloureux* (page 185) may be detected along the course of the nerve. The peripheral distribution of sensory nerves (after Bailey) is shown in Figs. 94 and 95, and by consulting Fig. 10, their relation to the spinal-segments may be determined. The latter fact is of importance when it is desired to annihilate (by concussion-analgesia) pains of the nerves in question.

THE TRIGEMINUS NERVE.

Reference to Fig. 15 shows that only a small part of the skin of the head and face is supplied by the cervical spinal nerves. The sensory division of the trigeminus supplies

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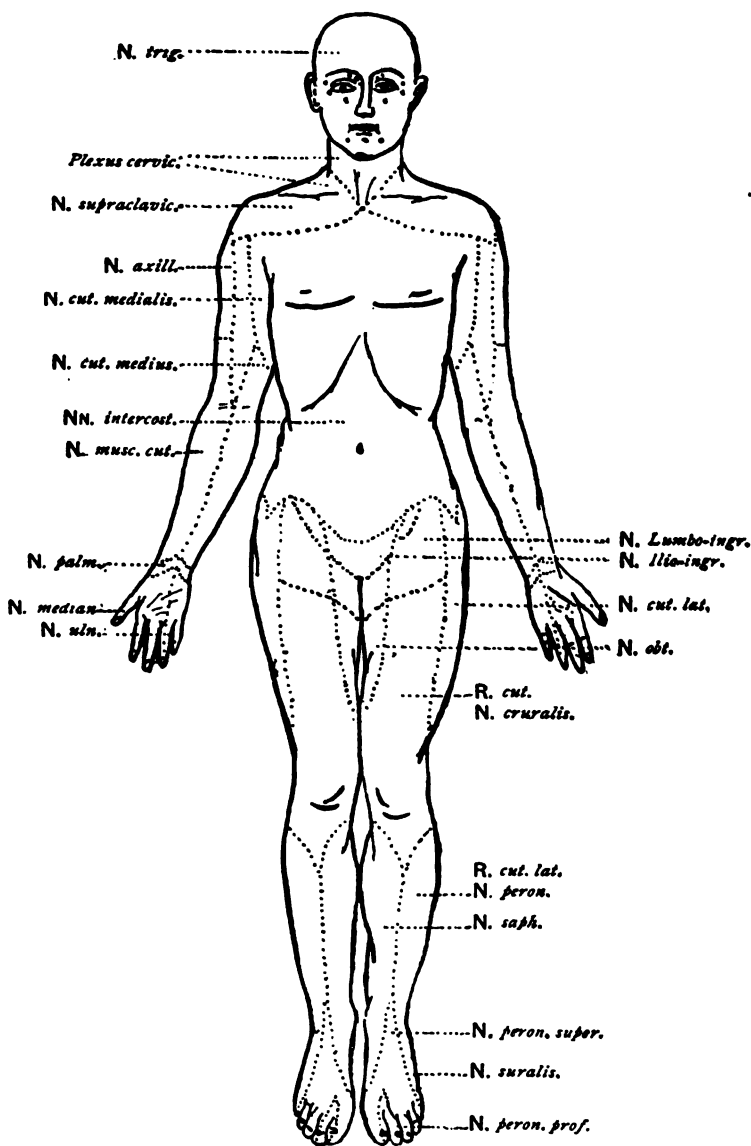


FIG. 94.—Peripheral distribution of sensory nerves.

S e n s o r y N e r v e s

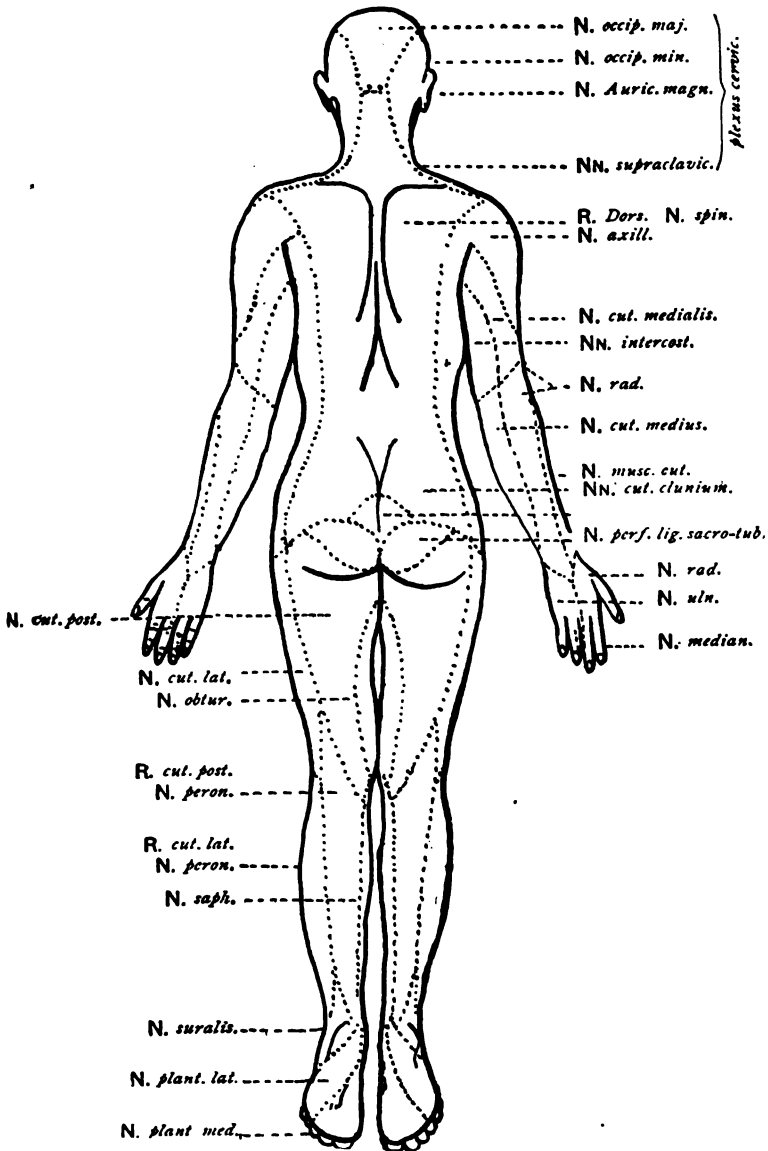


FIG. 95.—Peripheral distribution of sensory nerves.

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the skin of the face, the mucosa of the mouth and nasal cavities and the cornea.

The author has endeavored to influence the sensory functions of the trigeminus by concussion, sinusoidalization and freezing over the site corresponding to the location of the Gasserian ganglion (Fig. 96), from the sensory cells of which the sensory root of the trigeminus arises. The results have not been as good as when the spinal nerves are similarly influenced. Here freezing (at the site of the Gasserian gan-



FIG. 96.—The trigeminus or 5th cranial nerve with its three chief branches arising from the Gasserian ganglion.

glion) and sinusoidalization are more effective than concussion.*

SINUSOIDAL-ANALGESIA.

The sinusoidal current is less effective than concussion in producing segmental-analgesia. Only the *slow sinusoidal current* is effective for this purpose and it is obtained from the Victor multiplex sinusoidal outfit. The current bombards the segment with a series of painless concussion-blows. A

*The author has not had a sufficient number of cases of neuralgia of the trigeminus nerve to test the value of freezing and the *slow sinusoidal current* (one electrode to the back of the neck and a smaller electrode over the Gasserian ganglion). The suggestion having been given, however, dentists may elaborate on the method and test its efficiency.

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strong current must be used and the duration of the séance must not be less than five minutes. Small electrodes are placed on either side of the spinous process (corresponding to the segment), or, if more spinous processes represent the segmental area of pain, the electrodes are placed along the line of the spine so as to cover the entire segmental area.

SEGMENTAL-PSYCHROTHERAPY.

Reference has already been made on page 172 to the subject of psychrotherapy. Freezing acts more rapidly than the slow sinusoidal current and concussion in producing segmental analgesia. It is used exclusively by the author in influencing visceral sensation. The effects, however, in comparison with the other methods are not as permanent, and one is handicapped in its repetition by the soreness of the skin which it produces. It may be repeated, however, several days in succession when ether is employed for congelation.

To inhibit peripheral and visceral pain either the spinous process over the segmental area is frozen or what is equally efficient, freezing is executed over the areas of vertebral tenderness corresponding to the point of exit of the spinal nerves from a given segment.

A patient has a painful shoulder-joint in association with a neuritis. Manipulation of the joint develops areas of vertebral tenderness (previously absent) at the points of exit of the 2nd, 3rd and 4th spinal nerves. These areas are marked with a pencil. Pressure over the sensitive nerve develops an area of vertebral tenderness at the 7th cervical nerve corresponding to a point between the spines of the 6th and 7th cervical spines. The latter area is also marked with a pencil. Thorough freezing over the 2nd, 3rd and 4th spinal nerves inhibits the pains in the shoulder-joint and freezing over the 2nd,

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3rd and 4th spinal nerves arrests the pains of the neuritis. The treatment to be effective must be repeated daily. In some instances it is advisable to freeze not only the points of exit of the spinal nerves, but likewise the segments corresponding to these nerves. In intractable cases, the author has recourse to re-enforced freezing (page 173) or he connects a large hypodermic needle with his atomizer by means of rubber tubing and freezes (with ether) the subcutaneous tissues by aid of the needle.

SEGMENTAL-ANALGESIA OF THE VISCERA.

The reader is referred to page 58, where consideration was given to the dermatomes of Head. It may be observed that the latter noted that the distribution of the lesions in patients with herpes zoster corresponded with the areas of cutaneous pain and tenderness occurring in certain visceral affections and by comparing the areas implicated in cases of herpes zoster with disturbances of sensation in a number of cases of nervous diseases (with lesions of the spinal cord), he was able to map out the dermatomes. The latter correspond to the segments of the cord and not to the peripheral distribution of the posterior roots.

In the following table the author has located the segments of the cord related to the viscera after the following manner: repeated manipulation of a sensitive viscus will develop an area of vertebral tenderness corresponding to the roots of the spinal nerves. Having located the sensitive nerves, it was not difficult to trace their relation to definite spinal-segments.

S e g m e n t a l - A n a l g e s i a

SPINAL-SEGMENTS ASSOCIATED WITH VISCERAL SENSATION.*

ORGAN.	SEGMENT OF CORD.	RELATION TO SPINOUS PROCESS.
Heart.	III C and I, II, III D.	2nd, 6th and 7th C.
Lungs.	IV C and I, II, III, IV, V, VI, VII, VIII, IX D.	2nd, 6th, 7th C and 1st, 2nd, 3rd, 4th and 5th D.
Breast.	IV and V D.	1st and 2nd D.
Esophagus.	V, VI, VIII D.	2nd, 3rd, 4th and 5th D.
Stomach.	III and IV C and VI, VII, VIII, IX D.	1st and 2nd C and 3rd, 4th and 5th D.
Stomach (<i>Cardiac end</i>).	VI and VII D.	3rd and 4th D.
Stomach (<i>Pyloric end</i>).	IX D.	5th D.
Intestines.	IX, X, XI and XII D.	5th, 6th, 7th, 8th D.
Appendix.	X and XI D.	7th D.
Rectum.	II, III, IV S.	12th D.
Spleen.	XI D.	7th D.
Liver and Gall-bladder.	VII, VIII, IX, X D.	4th, 5th and 6th D.
Kidney.	X, XI, XII D.	6th, 7th, 8th D.
Ureter.	XII D and I L.	8th, 9th D.
Bladder.	XI, XII D, I L and I, II, III S.	7th, 8th, 9th, 12th D.
Prostate.	X, XI, XII D, III L and I, II, III S.	6th, 7th, 8th, 10th, 12th D.
Epididymis.	XI, XII D and I L.	7th, 8th, 9th D.
Testicle and Ovary.	X D.	6th D.
Uterus and appendages.	X, XI, XII D, I L and I, II, III, V S.	6th, 7th, 8th, 9th, 12th D.

SEGMENTAL-ANALGESIA IN DIAGNOSIS.

“The Paris Neurological Society” concluded that all the symptoms legitimately included under *hysteria* are imposed by suggestion, and this conclusion refers with all cogency to the traumatic neuroses. The latter, it is argued (spinal commotion), cannot give rise to symptoms of the character

*C, cervical; D, dorsal; L, lumbar; S, sacral.

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and duration complained of by the victims of "railway spine." The foregoing contention cannot be correct inasmuch as the author has endeavored to show that concussion of definite spinal-segments in even normal subjects will produce analgesia and anesthesia in definite regions of the body.

Suggested, auto-suggested and hysteric pains are amenable to diagnosis by segmental-analgesia.

Let one assume that the patient has a joint-pain. If the skin over the segment corresponding to the joint in question is frozen, or the spine is concussed, temporary evanescence of the pain should ensue. The foregoing observation is equally applicable in the hyperalgesia of neurasthenic patients.

NEURALGIC PAINS may be *peripheral, i. e.*, they are localized in areas corresponding exactly to the peripheral distribution of the nerve-trunk or nerve involved (Fig. 94).

Here, thorough freezing over the entire area of sensitiveness will inhibit the pains. The pains may be due to *irritation of the sensory roots*. Here, freezing at the vertebral exit of the affected nerves will assuage the pains.

The pains may be *intravertebral in origin* (spinal-tumors, tabes, myelitis, syringomyelia, etc.) Here, freezing of the spinal segments is alone effective in inhibiting the pains.

In *pains of visceral origin*, the author employs freezing to the exclusion of other expedients in diagnosis.

Let us assume that the differential diagnosis rests between an appendicitis and a liver or gall-bladder disease. Referring to the table on page 377, it will be noted that the 10th and 11th dorsal segments are related to the appendix. If now, one freezes *thoroughly* the region corresponding to this segment (7th dorsal spine), the pains, if caused by appendicitis, will be inhibited.

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Again, after such freezing, the previously sensitive appendix may be palpated without pain.

Thus it is, one may exclude definite viscera as implicated in disease.

Assuming one has palpated a sensitive organ supposed to be the kidney.

In the table already referred to, the 6th, 7th and 8th dorsal spines are related to the segments associated with the kidney. If the spines in question are concussed or the skin over them is frozen, manipulation of the organ (if it is the kidney) should be painless.

The *dermatomes of Head* should no longer be in evidence if definite spinal-segments related to the different viscera are frozen or concussed.

Associated painful areas related to visceral disease (Fig. 27) should disappear when the segments corresponding to the viscera are concussed, sinusoidalized or frozen.

In visceral disease, the irritation develops an area of vertebral tenderness which is accentuated by palpation of a sensitive organ (page 369). Here, freezing of the area of tenderness will not only inhibit the pain, but will permit of painless palpation of the organ. The vertebral tenderness from cutaneous or visceral irritation is usually temporary in duration, and when the tenderness persists, it is probably due to changes in the roots of the spinal nerves (ascending neuritis). It is in this way only that one is able to account for the pains which outlast the cure of a visceral disease (excluding, of course, conditions in juxtaposition to the organ). The author has never been able to influence the sensibility of the rectum.

PHYSIOLOGY OF SPONDYLOTHERAPEUTIC METHODS.

Physiologists are not in accord whether the spinal cord,

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like the peripheral nerves, reacts directly to electric and mechanic stimuli. Those who oppose the excitability of the cord claim that any reaction is dependent on stimulation of the roots of the spinal nerves which give rise to movements or sensation.

The clinician, however, has evidence to show that the spinal cord is excitable to direct stimulation.

Experiments show that most motor nerve-cells discharge their motor impulses at a rate of about ten per second, and if these cells are stimulated artificially, the motor discharge is about the same rate as the normal.

This reaction of the nerve-cells of the cerebrum and cord is endowed with a definite rhythm which has been compared with the rhythmical beat of the heart.

After the discharge of an impulse the cells fall into a refractory phase for a period of time lasting about 0.1 second. When a nerve-cell has discharged a strong impulse as a consequence of summation of its stimuli, it is exhausted, and requires a certain time to be recharged.

CONCUSSION is a mechanic stimulus and is equivalent to a blow, pressure, pinching or section. Mechanic stimuli are only effective when they are applied with sufficient rapidity to produce a change in the form of the nerve-particles. When a motor nerve is stimulated, the resultant is motion and pain if a sensory nerve is stimulated.

If the continuity of the nerve is interrupted or the molecular arrangement is disturbed by a mechanic stimulus, conduction of an impulse is interrupted and the excitability of a nerve is either diminished or extinguished. In conclusion one may say that concussion of short duration augments the excitability of the nerves, but when prolonged, the excitability is diminished or abolished.

PRESSURE if continued upon a mixed nerve, paralyzes

Physiology of Methods

the motor earlier than the sensory fibers. If the pressure is applied gradually, the nerve may be rendered inexcitable without demonstrating any evidence of its being stimulated. Pressure on a mixed nerve extinguishes reflex conduction sooner than motor conduction.

SINUSOIDALIZATION is the equivalent of an electric stimulus. An electric current shows its most powerful action upon the nerves at the moment it is applied, and at the moment when it ceases, and any increase or decrease in the strength of a current acts as a stimulus. When the current is flowing through a nervous structure, a condition known as electrotonus occurs, whereby the physiologic properties of the structure are greatly modified.

The rapid sinusoidal current is stimulating, whereas the slow sinusoidal current yields a series of electric shocks. In the application of the latter current to the spine no motor effects are observed, the action being limited to subduing the sensory component of a spinal-segment.

FREEZING.—The author has endeavored, by a series of histologic examinations, to explain the rationale of freezing as a remedial agent, but the microscope affords no clue. It certainly does not act by counterirritation, insomuch as the latter shows none of the immediate analgesic effects of congelation. The local application of cold probably acts as a shock, thereby diminishing the conductivity of the nerves and annulling the functions of the centers in the cord. The initial contraction of the vessels and tissues is followed by a greater dilatation and turgescence. The sensory nerves are paralyzed with loss of sensibility. In fact, when the temperature is sufficiently low, the excitability of all the nerves is diminished.

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SPINAL NERVE-TRUNK ANALGESIA.

It is known that if *cocain* is injected into the tissues about a nerve-trunk, anesthesia follows in the area supplied by the nerve. Anesthesia ensues in about five minutes and lasts about fifteen minutes. It is evident that if the injection is effective, there is an absolute block to the transmission of afferent and efferent impulses. The foregoing fact is of great importance in spondylodiagnosis and spondylotherapy.

For local anesthesia, *cocain* is usually employed, but owing to the occasional toxic symptoms arising from its use, it has been substituted by *eucaïn hydrochlorate*, *stovain* and other local anesthetics.

The danger from *cocain* is minimized if the following precautions are taken: 1, Never inject more than one-third of a grain hypodermatically; 2, Never inject the drug into a vein; 3, Never use it if the kidneys are inefficient; 4, The patient should be in the recumbent posture; 5. Use the infiltration-anesthesia of Schleich. Schleich's formula may now be obtained in tablets and one tablet is dissolved in 100 minims of sterilized water. This formula is absolutely innocuous: the formula No. 3 containing only 1-100 grain of *cocain*.

The infiltration can be made painless by touching the point where the needle is inserted with pure carbolic acid or by freezing the spot. It is well to remember that if one-quarter of a pound of ice (broken into fine bits) is mixed with one-eighth of a pound of salt and placed in a gauze-bag, the application of the latter to a part causes analgesia in about fifteen minutes.

A hot solution of the Schleich formula is more efficient than a cold solution.

A moderately long needle attached to the barrel of the

Cortical Sinusoidalization

syringe is used and made to penetrate the tissues of the back approximating the exit of the spinal nerves as shown in Fig. 10. Assuming that one wishes to make the ulnar nerve analgesic. Reference to Fig. 10 shows that the nerve from which it arises makes its exit between the 7th and 1st dorsal vertebræ and between the 1st and 2nd dorsal vertebræ, hence the infiltration-anesthesia must include the paravertebral area in question.

One may also recall the fact, if cocain, or its substitutes, are interdicted, that infiltration of the tissues with warm or cold sterile water is often very efficient in causing anesthesia.

CORTICAL SINUSOIDALIZATION.*

In 1870, Herbert Spencer declared that different parts of the cerebrum must subserve different kinds of mental action.

Hughlings Jackson affirmed that the gray matter of the convolutions was really excitable, but physiologists regarded his observations as ingenious speculations insomuch as there was no evidence that the cerebral cortex responded to any of the ordinary stimuli of nerves.

In 1870, Fritsch and Hitzig, established a new era in cerebral physiology, viz., that the application of the galvanic current *to the surface of the cerebral hemisphere* in dogs, gave rise to movements on the opposite side of the body. The latter are movement complexes bringing into play several muscles concerned in various movements or acts and not individual muscles. Thus, the effect of injury to a definite area of the cerebral cortex is the inability to execute particular movements or acts.

*The author's reference to this subject is in the nature of a preliminary report. Its intimate relation to the vertebral reflexes (page 7) justifies its consideration. It has only been investigated physiologically, but its possibilities in clinical pathology are far-reaching.

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Our knowledge concerning the psychomotor area in the cerebral cortex emanates from the following sources: 1, Experiments upon the cerebral cortex of monkeys; 2, Electric stimulation of the cortex in human subjects during the progress of a cerebral operation for the object of localizing a diseased area; 3, Clinical observations confirmed by autopsy in cases of cerebral tumors and Jacksonian epilepsy.

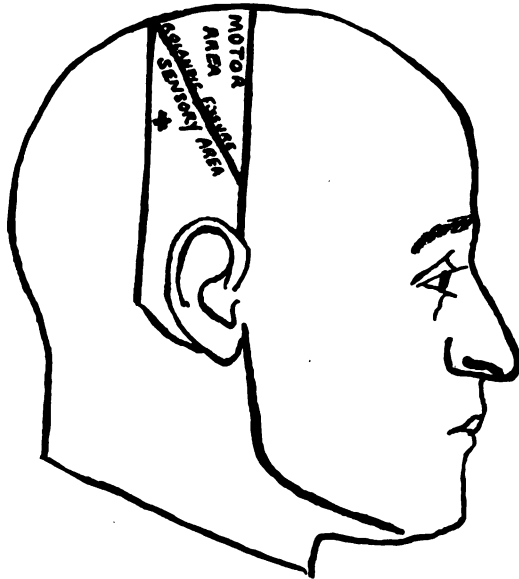


FIG. 97.—Localization of the motor area. This may be determined approximately by drawing two perpendicular lines, one from the depression in front of the external meatus, and the other from the posterior border of the mastoid process at its root; †, most prominent part of parietal eminence.

It has already been shown that spinal muscular reflexes could be elicited by sinusoidalization of definite spinal segments (page 11), and it occurred to the author that the motor area of the cerebral cortex could be similarly influenced. That this is true is evidenced by execution of the following method: Having cocainized the skin of a bald-headed individual, corresponding to the motor area

Cortical Sinusoidalization

(Fig. 97), a powerful sinusoidal current (rapid sinusoidal from the Victor or the Kellogg apparatus) was conveyed to the motor area either by an interrupting bipolar electrode or with one interrupting electrode over the motor area and the other over the sternum. By opening and suddenly closing the circuit, muscular contractions were observed in the muscles of the face, arm and leg on *both sides of the body*. Later, it was found that local anesthesia was unnecessary to obtain contractions of the muscles of the face and arm. It is better to employ a bipolar interrupting electrode over the motor area to exclude from participation in the muscular contractions the motor areas of the cord.

One must not conclude that because the co-ordinated movements do not occur exclusively on the opposite side of the body, the clinical observations of the author do not correspond with the physiologic evidence.

On the contrary, stimulation of an area on one side in animal experimentation results in bilateral movements in the case of corresponding muscles on opposite sides of the body that usually act together. Thus, Exner contends that such muscles appear to have a center not only in the opposite but also in the hemisphere of the same side. All observers have noted that stimulation of the facial center results in identical movements on *both sides* of the face.

It has always been a question with physiologists whether similar areas exist in man. If the evidence adduced by the author is sufficient, the question may be answered in the affirmative.

By placing one electrode of a slow sinusoidal current (Victor apparatus) over the *sensory area* (Fig. 97) and the other at an indifferent point and using a strong current for about ten minutes, a moderate grade of hemianesthesia may be produced on the opposite side of the body. Both

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sides of the body may be similarly anesthetized by fixing the electrodes on either side of the cranium corresponding to the psychosensory centers of the cortex.

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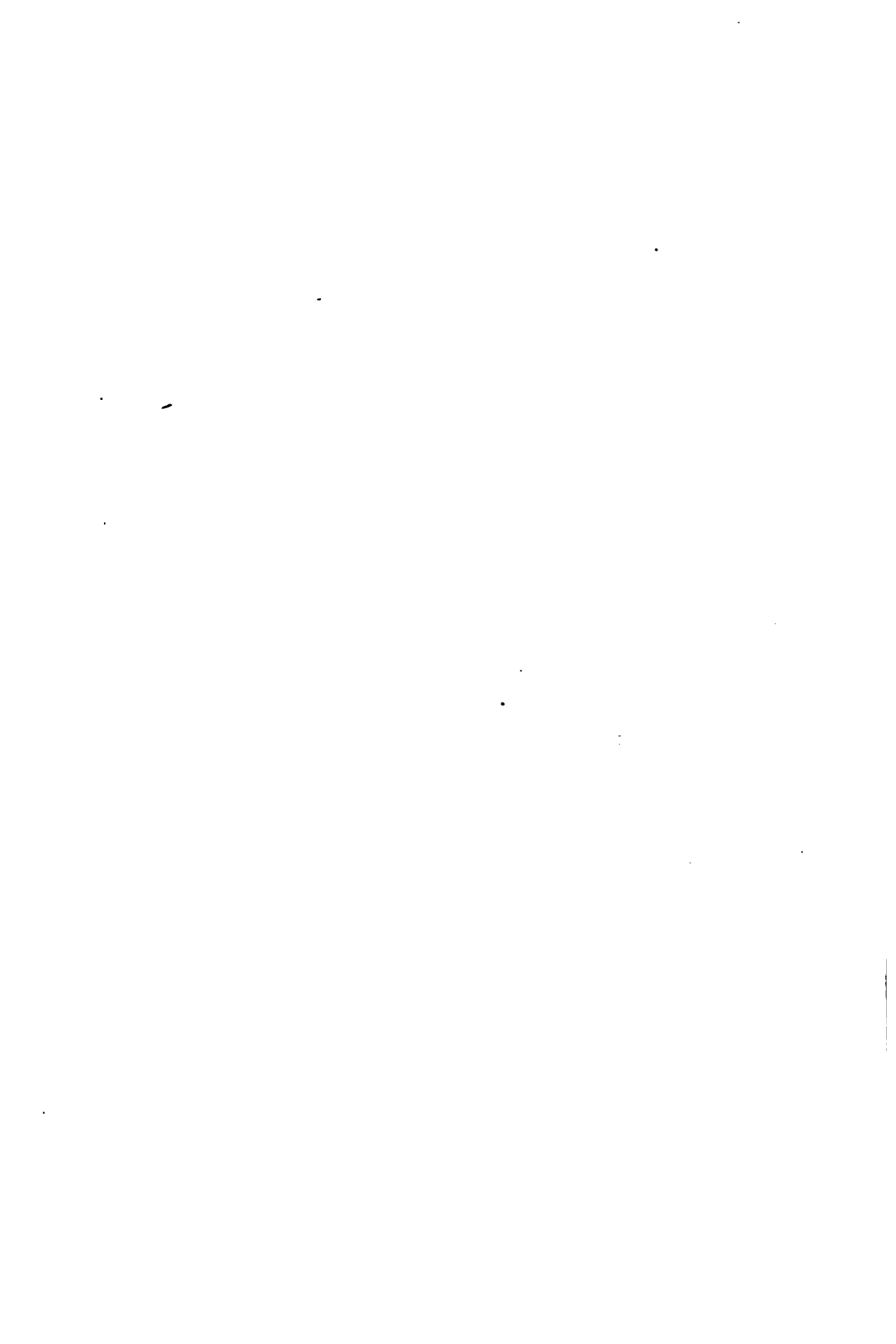
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