for secondary anæmia. From chlorosis a case of secondary anæmia occurring in a young girl may be indistinguishable. The characteristics of the blood are identical, and if the etiology of the case is not clear there may be nothing to set us right.

PROGNOSIS AND COURSE.—The duration of the disease and the severity of the symptoms depend largely upon the nature of the underlying cause. In post-hemorrhagic anæmia, in which less than one per cent. of blood mass is lost, it should be made up in from two to five days; where from one to three per cent. of the blood mass is lost, it should be made up in from five to fourteen days; finally, in the severest hemorrhages, in which over three per cent. of the blood mass is lost, it may be a month or more before regeneration is complete. Young and well-nourished persons are naturally much quicker in making up losses than are feeble or elderly persons. Where the hemorrhage is secondary to such diseases as typhoid, phthisis, or cancer, regeneration after hemorrhage may be very slow, or may not take place at all. Bierfreund found that after operations for mammary cancer the hæmoglobin is much slower in beginning to rise toward normal than after operations for non-malignant diseases (a week later on the average), and he asserts that the hæmoglobin never reaches the point at which it was before. This statement is all the more extraordinary because Bierfreund has specially noted a gain in weight in the same patients on whose blood the above observations were made. In Bierfreund's experience, it is usually from twenty-three to twenty-seven days after operation on malignant tumors of the breast before the hæmoglobin begins to rise.

The improvement of cases of anæmia is likely to be interrupted by periods of relapse. This is not so true of secondary anæmia as it is of pernicious cases, but nevertheless holds to a certain extent.

TREATMENT.—Obviously the first and most important indication is to discover and, if possible, remove the cause to which the anæmia is secondary. Many cases will recover with no further treatment. As a rule, however, recovery is considerably hastened by therapeutic measures, and where the cause is unknown, as not unfrequently happens, we have to devote our attention to the following therapeutic agents.

Nutrition.—There is no especial diet appropriate to the treatment of anæmia; what is needed is a full and varied nutrition, which should certainly include red meat, owing to its relatively large proportion of hæmoglobin and so of iron. The digestion may need attention, but it is important to refrain from giving pepsin and hydrochloric acid in any case before we have made sure that there is not already a hypersecretion such as statistics show to be very frequent in anæmia. The bowels often need treatment either for diarrhœa or constipation, more especially the latter, and relief of this symptom will help the general nutrition, and so the anæmia.

Climatic change is undoubtedly of service in some cases, partly through its psychical and partly through its physical effect. Of late years it has been recommended that we send patients to high altitudes. Experience has shown that patients are very favorably affected by altitude, and the rapid increase in blood corpuscles per cubic millimetre which every person, sound or sick, shows in high altitudes appears to be not entirely transitory.

Medicinal treatment consists largely of proper administration of iron and arsenic. Wide experience in all parts of the world has shown that in the great majority of cases iron is best administered in the form of Blaud's pills. As a rule, they cause no irritation of the gastro-intestinal tract, and do not tend to constipation. I think it is a common mistake to use them in too small doses. To an adult I never give less than six five-grain pills a day, two after each meal, and after a week or ten days I often increase this to nine a day, three after each meal. In the rare cases in which Blaud's pills are not well borne or are not effectual in increasing the amount of hæmoglobin in the blood, it is advisable to try one of the newer organic preparations which contain hæmoglobin as such or some substance nearly allied to it; for example, ferratin. The only objection to these latter remedies is that in order to get sufficient quantity of them into the system to give an equivalent to six of Blaud's pills per day, or one-tenth of a gram of metallic iron, one has to spend a good deal of money. The tincture of chloride of iron should rarely, if ever, be given, on account of its strong tendency to produce constipation, its deleterious effects upon the teeth, and its very disagreeable taste. All preparations of iron should be given after meals, never upon an empty stomach. Occasionally arsenic is useful, especially in the severer grades of anæmia. It is best given in the form of Fowler's solution, two drops after meals, well diluted, and increasing one drop daily until the physiological limit is reached, as shown by the occurrence of itching or burning of the eyelids, nausea, or vomiting. *Richard C. Cabot.*

ANÆMIA, SPLENIC. See *Hodgkin's Disease.*

ANÆSTHESIA AND ANALGESIA.—Definition of terms: *Anæsthesia*, accurately speaking, denotes the loss of sense of touch. The term is often used to indicate the loss of all forms of sensibility—as pain, temperature, muscular location, etc. In this article, when the word is used without qualification, it shall mean the loss of tactile sense. Tactile sensibility is subserved by structures that take cognizance of change of contact, and are stimulated by motion of an external object in contact with the surface.

Analgesia is a term employed to denote the loss of sensibility to painful impressions.

Thermo-anæsthesia is a loss of temperature sense.

Ataxia is a symptom of loss of muscular sensibility.

"Muscular sense" is a complex affair, including several different forms of sensibility. There is the painful sensibility to traumatic impressions, to passive stretching and powerful contractions, as in cramps. The most characteristic "muscular sense," however, is that by which is determined the character of movements and postures due to muscular action, also the character of passive movements and postures of muscles at rest. It also includes the recognition of resistance to contraction, by which is estimated the difference in weight of objects; articular sense is included.

Methods of Testing Sensibility.—The determination of the varying degrees of anæsthesia and analgesia is made difficult by the fact that the physician must depend upon the statement of the patient for his information. The intelligence, attention, and sincere co-operation of the patient are necessary to secure reliable responses. Furthermore, individuals vary, within the limits of what is normal, quite appreciably in their sensibility to external irritation. Finally, in patients suffering from lesions which cause either a slight or perhaps a greater degree of loss of consciousness, sensibility is more or less diminished up to entire loss of sensation, even though the lesion may cause no anæsthesia directly.

In testing sensibility the patient should be blindfolded or in some other way prevented from seeing what is being done, in order that simulation or self-deception may be avoided. It is remarkable how vividly one can feel the prick of a pin or touch of a feather through the medium of sight. When the lesion is unilateral, a comparison of the two sides is very desirable. Various instruments of precision have been devised by neurologists for testing sensibility. These are convenient and desirable for scientific purposes, but for clinical use they are not essential. A much more important element is the cultivation of the judgment of the examiner by constantly using the same method of examination. No amount of paraphernalia will make up for a lack of that cultivation. A feather or camel's-hair pencil or the tip of the finger may be used for testing tactile sensibility. The objection to the finger is the possibility that there may be a difference in temperature between the examiner's finger and the patient's skin, and consequently that contact may be recognized by temperature sense

even when anæsthesia exists. A common pin is a valuable instrument in testing for analgesia. By alternately using the point and head and requiring the patient to distinguish between them by saying "head" or "point," the physician can determine whether his answers are based on pain or tactile sense. When testing for anæsthesia the patient should be instructed to say "yes" each time he is touched; or he may be asked to name the point touched. This gives information as to his power of localization. If more definite information is desired, he may be asked to touch the exact spot that had been touched by the examiner.

On some accounts a better test for analgesia is to pick up a fold of skin and pinch the rounded portion. By practice one is enabled to determine quite satisfactorily the degree of sensibility by the degree of pressure required to produce a painful impression.

Thermo-anæsthesia may be present when tactile and pain sense are normal. To ascertain its existence one may employ two test tubes, one filled with hot and the other with cold water. More accurate means of measurement are needed for scientific record.

In the presence of a localized disturbance of sensibility the characteristics should be noted as accurately as possible. If there is an area of anæsthesia its boundaries should be definitely determined. The task is not difficult when the area is sharply defined, but it becomes more so when it passes gradually into the normal. Anæsthetic areas often exist without the patient's knowledge and will escape notice unless especially sought for. This should always be done in cases presenting obscure abnormal conditions of the nervous system.

For convenience of study the anæsthesias and analgesias may be divided into two great classes: I. Those of functional origin; II. those due to some organic lesion.

Functional Derangements of Sensibility.—I use the word functional advisedly and with a full knowledge and appreciation of the position of those who regard every derangement of function as evidence of organic lesion. I shall not argue this question further than to say that in the manifestations of the nervous system the evidence is convincing that temporary and more or less permanent suspension or derangement of function may and does occur without the existence of organic lesion.

Hysterical anæsthesia may involve all varieties of sensation. In such cases there will be no response to any kind of sensory stimulation—such as touch or pain or heat or cold or muscular action or change of posture or location of a part. Or the anæsthesia may be confined to one variety of sensation while the others may remain normal. Or again, any two or more of them may be involved. Analgesia is the form of anæsthesia most frequently observed in hysteria. Then follow, in order of frequency, loss of tactile sense, temperature sense, muscular sense, and articular sense. The last is quite rare as an hysterical manifestation, but has been noted by several observers. The physician should not assume that a case of ataxia is hysterical until he has discovered other stigmata and has excluded all other probable sources of ataxia. For further discussion of the stigmata of hysteria, see under *Hysteria*.

The anatomical distribution of anæsthesia, in hysteria, is extremely variable. No part of the body is free from the liability of a loss of sensibility from this cause. But it may conveniently be considered under three types: I. Hemianæsthesia; II. segmental; III. disseminated.

Hemianæsthesia is the most common type, and when present without motor disturbance it is most suggestive of hysteria. It involves exactly one-half the body vertically, the middle line, anteriorly and posteriorly, forming a distinct and abrupt line of demarcation between the normal and anæsthetic portions of the skin. The mucous membrane of the same side is also involved. Among the cases of hemianæsthesia from lesion of the posterior portion of the posterior limb of the internal capsule, there have been reported some which resembled those of hemianæsthesia of hysterical origin. These cases are so rare, however, as to be a curiosity.

In the segmental type of anæsthesia a hand and more or less of the arm, or a foot with more or less of the leg is anæsthetic—sometimes called the glove or stocking form of anæsthesia; or a part of the face or head may be involved.

In the disseminated type anæsthetic patches, irregular in size, shape, and distribution, occur. Any conceivable part of the surface may be the site of anæsthesia. I wish to call attention to three characteristic features of these anæsthetic areas, that should always be borne in mind when making a differential diagnosis: (1) The areas do not correspond to the distribution of nerves; (2) the borders are sharply outlined, the change to normal sensibility being abrupt, there being no gradual fading of one into the other; (3) the borders are not constant, but are subject to sudden changes. This feature has been especially emphasized by Dr. Patrick, of Chicago. This shiftiness of the borders is so pathognomonic that it should always be looked for in testing a case. A very soft pencil is needed to mark the outline so that no irritation of the skin is produced whereby the patient's subsequent replies may be influenced. I do not care to discuss the treatment of this condition, as it doubtless will receive proper consideration under *Hysteria*. But I may say in passing that the suggestiveness of the treatment is a most potent factor. Therefore the application of electricity to the anæsthetic area in the form of a powerful static spark or a strong galvanic current is among the most efficient of agents.

Any of the special senses may be involved in hysterical anæsthesia. We may thus have impairment or loss of sight, hearing, taste, or smell. Hysterical amblyopia most often consists in a concentric constriction of the visual field. Besides this there may be a disturbance of the color field, either a total loss of color perception or, what is more common, a reversal of the color fields; the most common form being that in which the field for red is larger than that for blue.

Pharyngeal anæsthesia is commonly due to hysterical disturbance of the function of the glosso-pharyngeal and vagus nerves, of which "globus" is another manifestation, and ageusia or loss of taste still another. Laryngeal anæsthesia is not an uncommon stigma of hysteria. The well-known tolerance of examination of the pharynx and larynx on the part of hysterical patients is due to anæsthesia of these parts.

Anæsthesia and Analgesia of Organic Origin.—In studying the organic lesions of the nervous system with their consequent impairment or loss of sensation, we cannot do better than to adopt an anatomical classification. We shall consider: 1. Lesions of peripheral nerves; 2. lesions of the cord; 3. intracranial lesions.

Trigeminal anæsthesia, more or less complete, results from a destructive lesion in any portion of the nerve from its central origin to its peripheral terminations. The location of the lesion may be determined by the extent and distribution of the anæsthesia, and—in the case of a lesion located at the base of the brain—by noting the disordered function of other nerves involved in this lesion. Peripheral lesions are indicated by the small portion of the nerve involved. If a portion of the face with a corresponding mucous surface is involved, one branch of the nerve is affected at or near its exit from the cranium. If the anæsthetic area comprises the distribution of an entire nerve and is complicated by trophic disturbances, the lesion is in the Gasserian ganglion or its immediate vicinity. A lesion in the posterior portion of the posterior limb of the internal capsule will produce anæsthesia of one side of the face and of the same side of the body, resembling hysterical hemianæsthesia (to which the reader is referred). If one side of the face and the opposite side of the body are anæsthetic, the lesion is probably pontile.

The pathological diagnosis is made by considering the history and development of the abnormal condition. Among the more important factors to be considered are

neuritis from syphilitic, rheumatic, toxæmic, alcoholic, or other origin; tumors at the base of the brain; basal meningitis; traumatism. either peripheral or central. Trigeminal anæsthesia may be the initial symptom of some chronic degenerative disease, such as tabes, chronic muscular atrophy, syringomyelia, etc. In such cases, however, if the attention has been called to that possibility, upon closer examination there will be found other symptoms that will lead to a correct diagnosis. A destructive lesion of the tubercle of Rolando of one side causes a complete loss of all forms of sensibility of the trigeminus of the same side as the lesion, with anæsthesia of the body and limbs of the same side and analgesia of the opposite side. There are motor disturbances accompanying this lesion to which attention will be called farther on, under *Hemianæsthesia*.

Glosso-Pharyngeal Anæsthesia. — In focal destructive lesions of the glosso-pharyngeal nerve, anæsthesia is produced in the region of distribution of its fibres of common sensibility, viz., in the upper part of the pharynx and in the upper portion of the palate. This occurs most frequently in connection with paralysis following infectious diseases, such as diphtheria, but the anæsthesia is seldom limited to the parts supposed to be supplied by the sensory portion of the glosso-pharyngeal nerve.

Pneumogastric Anæsthesia.—The branches of the vagi in which destructive focal lesions give rise to the most noticeable anæsthetic conditions, are the superior laryngeal and the gastric. Laryngeal anæsthesia as an independent condition is caused by focal lesions in the sensory branches of the superior laryngeal nerve. It may be one of the symptoms of degeneration of the laryngeal portion of the vagus nucleus, as in tabes. In post-diphtheritic conditions laryngeal anæsthesia is due, most probably, to the action of toxins upon the nerve in its course, terminations, or centres.

The symptoms of laryngeal anæsthesia are such as result from the anæsthesia. The absence of reflex coughing and the consequent retention of mucus and other foreign matter give rise to inflammatory conditions and consequences, and upon examination abnormal tolerance of manipulation will be found to exist.

Gastric Anæsthesia.—This results from some lesion in the gastric branches of the vagus, on account of which sensory impulses are not transmitted from the stomach to the cerebrum. In this condition immoderate quantities of food are required to appease hunger, and in total anæsthesia the feeling of repletion is never experienced.

The treatment of the anæsthesia of the vagus is best accomplished by the use of electricity, to be applied to the seat of the anæsthesia if within reach. Tonics, alteratives, and eliminatives, as indicated by the nature of the malady upon which the anæsthesia depends, should also be administered. Among the causative agents may be mentioned syphilis, alcoholism, arsenic, lead, various toxæmias, auto-intoxication, and degenerative conditions, such as tabes. If a tumor presses upon the nerve, of course the condition will be relieved only by removal of the pressure.

While anæsthesia and analgesia may occur in the distribution of the sensory branches of any of the spinal nerves, it will not be profitable to consider each in detail. I shall confine my attention to two regions: the region supplied by the brachial plexus and that supplied by the lumbar and sacral plexuses. Disturbance of the function of the nerves in these two regions is more conspicuous than that of any other region supplied by spinal nerves, by reason of the importance of the parts involved. Furthermore, their exposed position and constant use render them more liable to attacks of disease and to traumatic injuries. This remark has reference only to peripheral lesions. To determine whether the lesion is peripheral or central requires close attention to the distribution of the anæsthesia, to the history of the case, and to the mode of development of the attack.

Anæsthesia or analgesia, or both, will not infrequently be found among the symptoms of peripheral neuritis, both multiple and single. Hence, in searching for a pathological diagnosis in a given case of anæsthesia, the same pathological factors should be taken into account as in peripheral neuritis and motor palsy. Anæsthesia over the scapula is a result of disease of the suprascapular branch of the brachial plexus. The circumflex supplies the deltoid and the skin over the muscle. A lesion of this nerve may cause anæsthesia over the lower part of the deltoid. Anæsthesia of the radial side of the forearm points to a lesion of the musculo-cutaneous nerve. Lesion of the musculo-spiral nerve is very common, but the anæsthesia is very inconstant, and may involve the radial side of the hand, the back of the thumb, the index finger, and one-half of the middle finger.

Median nerve disease may cause loss of sensation on the radial side of the palm and front of the thumb, of the first two fingers and of one-half of the third finger. The backs of the distal phalanges of the thumb and first two front fingers may also be anæsthetic. The ulnar nerve subserves sensation on the ulnar side of the hand, back and front, two and one-half fingers on the back, and one and one-half in front. In lesions of the nerve anæsthesia may be present in those areas. Loss of sensation of the entire brachial plexus would point to a cord lesion, except in brachial neuritis, when other symptoms would lead to a correct diagnosis.

Sciatic neuritis, while usually a very painful affection, may give rise to loss of sensation in the cutaneous distribution of the sciatic nerve. To illustrate: a lady sixty years old came to my office complaining of a dead feeling in her right lower limb. Examination showed cutaneous analgesia in the entire distribution of the sciatic nerve, also thermo-anæsthesia in the same region. Tactile sense normal, reflexes subnormal; muscular and articular sense normal, co-ordination normal; muscle tension exaggerated. The history showed that three weeks previously the patient had suffered from tingling, cramping, burning pain which prevented her from using the limb. Putting the muscles on a sudden stretch still caused muscular pain. The sallow, muddy complexion, vile breath, swollen, coated tongue, tympanitic and constipated bowels led me to make a diagnosis of sciatic neuritis from gastro-intestinal auto-intoxication. Free elimination and correction of the gastro-intestinal fermentation caused rapid improvement in the condition of the limb. I am convinced from this and many other similar cases that a degenerative neuritis may involve one or more kinds of sensory fibres of a nerve, while the other fibres remain practically intact. The causative factors are a general poison with local vulnerability.

Anæsthesia of the outer lower part of the back of the leg is caused by a lesion of the internal popliteal. With lesions of the external popliteal there is anæsthesia on the outer half of the front of the leg, and on the dorsum of the foot.

Plantar anæsthesia is occasionally caused by plantar sciatica. If the internal plantar nerve is involved, the anæsthesia will be on the inner part of the sole and plantar surface of the three inner toes and one-half the fourth. If the external plantar is the nerve involved there will be anæsthesia of the remaining outer part of the plantar surface.

In Raynaud's Disease.—Slight anæsthesia and numbness occur in the beginning of this disease, and in mild cases it is more or less constant. In severe cases the anæsthesia is replaced by severe pain. It begins in one or more fingers of each hand and spreads. The toes are similarly affected, and so also are sometimes the tip of the nose and the ears.

The pathological conditions which give rise to loss of sensibility in peripheral nerves are numerous and varied, and include systemic or blood states as well as local conditions. Among the former may be mentioned various toxæmic conditions, such as malarial intoxication, uræmia, auto-intoxication from gastro-intestinal fermentation, and the different toxinæmias induced by the infectious diseases—diphtheria and typhoid or typhus fever. Drug intoxication also plays a part. Among

the drugs to be thought of, alcohol, arsenic, and lead are most prominent. Among city patients, especially females, excessive tea drinking is not an uncommon factor. In fact any condition that is capable of producing deterioration of structure or derangement of function is liable to cause disturbance of peripheral sensibility in the form of the various anæsthesiæ. Among the local causes may be mentioned various forms of traumatism, as blows that suddenly interrupt the conducting power of the nerve, or persistent pressure, or prolonged stretching, as occurs in the ulner nerve when sleeping with the elbow sharply flexed. Neuromata in the course of the nerve, neoplasms in the immediate vicinity of the nerve trunk, enlarged glands pressing upon it, exostoses, inflammatory adhesions or cicatricial bands constricting or binding it down, may impair or abolish its function.

Lesions Involving the Spinal Cord.—Loss of sensation as a symptom has a greater importance in disease of the spinal cord than in any other relation. It is a very common symptom of spinal-cord lesion, and may result from disease of any part of the sensory path or from a lesion of some contiguous structure by which pressure may be produced upon the part of the cord whose function it is to transmit sensory impressions.

The loss of sensation may be total or partial; it may involve all forms of sensibility, or may affect some forms and not others. This depends chiefly upon the fact that different parts of the sensory path serve for the transmission of different forms of sensibility. It may be due less often to a difference in the vulnerability of the different kinds of fibres. Loss of different forms of sensibility may be of more value in the future, as a means of localizing the seat of the disease, than it now is; for then we may have ascertained more accurately the path for each form of sensibility. At present our knowledge is too uncertain to base positive opinions upon. Furthermore, it is not improbable that the paths for sensory impulses are not as constant in their location nor as compact in their formation as are the motor tracts. There is very strong evidence, however, that pain and temperature sensation are transmitted by the antero-lateral tracts. In syringomyelia involving these tracts we are likely to have analgesia and thermo-anæsthesia, while tactile sense remains unimpaired.

It is sometimes difficult to determine whether the loss of sensation in a given case is due to cord disease or disease of the posterior nerve roots. If the lesion be in the nerve roots, the reflexes in the anæsthetic area will be abolished. If the cord alone be involved in the lesion, the reflex arc will not be broken and reflexes will remain intact. It may happen that a lesion of the cord is so situated as to involve the posterior roots within the cord. In such a case the reflexes would be abolished at the level of the lesion, but would remain intact below that level. This makes it necessary to test at the level of the lesion as well as below it. That level may be on the trunk or limbs. In trying to determine whether a lesion is peripheral or in the cord it is well to remember that as a rule cord lesions are bilateral, while peripheral lesions are unilateral. Multiple neuritis is an exception to the rule, and exceptions to the former will occur. Disease of the nerve roots outside the cord usually involves all forms of sensibility, unless the damage is very slight, when tactile impressions may be arrested and not the more energetic pain sense. Damage to the cord is more likely to impair one form without the others. Temperature sense is not impaired without the pain sense.

Among the lesions in which loss of sensation is a prominent symptom, we may mention meningeal hemorrhage, locomoter ataxia, myelitis, syringomyelia, etc.

By the courtesy of Dr. J. V. Lesnet, of Montpelier, Ohio, I was called to see Mr. S., a teamster by vocation, a strong, muscular, thick-set man about forty years of age. Early in the afternoon, while on his way to the woods for logs, he stopped by the roadside to heed a "call of nature." While in the act of defecation he suddenly gave a cry of pain, and fell over unconscious. He was picked up by his fellow-workmen and brought to his home in the village, and the doctor was called. He soon regained consciousness, when it was found that total anæsthesia and analgesia existed from the lower part of the neck, on a level with the clavicle, down. Motor power and muscle sense were not impaired. He complained of pain in the back of the neck; otherwise he felt well. A diagnosis of meningeal hemorrhage of the posterior portion of the cervical cord was ventured. Aconite was exhibited internally. A saline cathartic was administered and cold applications were made to the back of the neck. There was no interference with the normal action of the rectum or bladder. The patient improved rapidly and recovered completely; in a few weeks he was able to resume his work.

In degenerative diseases of the cord, involving the sensory tracts, some one form of sensation is likely to be impaired earlier and more completely than the others. As I have intimated before, this is probably owing to a greater vulnerability of the parts involved, for some local reason.

In locomotor ataxia anæsthesia of the soles of the feet is often more obtrusive and is noticed earlier by the patient than the ataxy. A patient complaining of this symptom should be examined as to his myotatic irritability, co-ordination, pupillary reflex, and other signs of tabes. An earlier diagnosis than is usual may thus be made.

Anæsthesia occurs in the course of spinal meningitis, but it is usually preceded by hyperalgesia. The anæsthesia is only of importance when considered in connection with other symptoms.

Sensory disturbances are among the more obtrusive symptoms in transverse myelitis. Anæsthesia may come on before, or at the same time as, the motor disturbance. All forms of sensation are impaired to a greater or less degree. Vesical and rectal anæsthesia exist, on account of which retention of urine and constipation occur. These symptoms being observed will call attention to other features by which a diagnosis will be made.

Tumors of the cord or its envelope will cause loss of sensation if they are located in the sensory tract or encroach upon it so as to interfere with its function. Aside from traumatic injuries tumors are the most frequent cause of unilateral anæsthesia. In any case of unilateral anæsthesia of obscure origin the possibility of a tumor should be thought of. The form of anæsthesia will depend upon the portion of the sensory tract involved. In this connection the word tumor is used not in its pathological sense, but in its etymological sense of swelling. Thus, the tumor may be an aneurism, a tuberculous deposit, etc.

The sensory fibres cross to the opposite side of the cord soon after their entrance into the cord. A unilateral injury to the cord will consequently give rise to a loss of sensation in the side of the body opposite the lesion. A brakeman on a Lake Shore train was knocked from his train while passing under a viaduct in the city of Detroit. He was brought to Emergency Hospital in an unconscious condition and placed under Dr. Hal C. Wyman's care. Examination showed crushing of the right side of the fifth cervical vertebra. The neck was extended and suitably supported in position. When the patient regained consciousness, anæsthesia and analgesia of the left side of the body and palsy of the right side were found to exist from the neck down. Exaggerated knee jerk and ankle clonus were found on the right side. Skin reflexes were exaggerated on the left side. The patient recovered with anchylosis of the injured vertebra. He gradually progressed toward the normal, so that in about two years he was able to resume his occupation.

Anæsthesia from Intracranial Lesion.—In discussing the sensory pathway in the spinal cord reference was made to the somewhat uncertain condition of our knowledge of its boundaries. In a general way the posterior columns are concerned in the transmission of sensory impressions, but the antero-lateral columns are also concerned in the transmission of certain varieties of sensation. Our knowledge of the intracranial sensory pathway is

still more uncertain. Between the upper end of the spinal cord and the internal capsule the path has not been definitely located. It probably passes up in the posterior half of the medulla and pons, beneath the corpora quadrigemina, through the tegmentum of the crus cerebri, and passes into the internal capsule, where its position has been accurately determined. As may have been inferred from the remarks on the loss of sensation in the fifth nerve with anæsthesia on the same side of the body caused by a lesion in the internal capsule, the sensory path occupies the posterior third of the posterior limb of the capsule. As the path from the fifth nerve joins it in the upper part of the pons, the posterior part of the capsule transmits sensation from the entire opposite half of the body and head, skin, and mucous membranes. Furthermore, the path of special sensibility from the organs of special sense—vision, hearing, taste, and smell—here lie contiguous to the path of cutaneous sensibility. In the case of vision we must remember that there is not a complete decussation of fibres at the optic chiasm; consequently the half of the field of vision of each eye corresponding to the side from which the other sensory impressions come, is represented in the sensory path. This is of diagnostic importance and will be referred to again.

The final distribution of the sensory path in the cortex is also a matter of some doubt. The sensory fibres pass into the white substance of the central hemisphere and go toward the region covered by the parietal bone and to the quadrate lobe and gyrus fornicatus of the mesial surface of the cerebrum. Much discussion has been had and is still going on as to whether the central (motor) area of the cortex is also a sensory area. A destructive lesion in the motor area causing paralysis also causes more or less anæsthesia of the palsied side. The loss of sensation, however, is not co-extensive with the palsy; neither is it permanent nor so persistent. This, with other facts, leads to the opinion that the motor area subserves sensation not directly from projection of the fibres from the path for cutaneous sensibility, but by commissural fibres.

Hemiplegia may exist without any sensory loss or with every degree of it. Hemianæsthesia may exist alone or in connection with every degree of paralysis up to complete hemiplegia. It is unusual for both to exist in a high degree.

Hemianæsthesia may involve all forms of sensibility, or some more than others. In its complete form it involves one vertical half of the body, including mucous membranes. It is always the result of a lesion in the path; for a cortical lesion, to produce hemianæsthesia, would need to involve so much of the cortex that the disturbance of other functions would overshadow the anæsthesia. If the lesion is in the pons, the parts supplied by the fifth nerve escape. Hence the anæsthesia does not involve the face and head. The most frequent location of a lesion causing hemianæsthesia is in the posterior part of the internal capsule. As was said before, a lesion in this locality causes complete hemianæsthesia and involves at the same time the nerves of special sense. This bears a strong resemblance to hysterical hemianæsthesia. In the latter, however, one-sided amblyopia is most likely to occur, while in the former hemianopsia will result; that is, one-half of each field of vision corresponding to the anæsthetic side will be interrupted. When discussing trigeminal anæsthesia I said that the destruction of the tubercle of Rolando causes loss of all forms of sensibility in the distribution of the fifth nerve, and loss of tactile sense in the body and limbs of the side of the lesion and analgesia of the opposite side. The motor disturbances comprise changes in the pupil, narrowing of the palpebral fissure, lessened prominence of the eyeball on the same side, and paresis of the arm and leg on the opposite side.

Cortical lesions can produce hemianæsthesia only when they are very extensive. The special senses may be involved, but instead of hemianopsia there will be loss of sight in the eye on the anæsthetic side.

Hemianæsthesia with hemiplegia and third-nerve palsy of the same side as the lesion is evidence of lesion of the crus.

Tumors in the cerebral hemispheres are likely to cause more or less loss of sensation, in combination with other symptoms, according to what portion of the cerebrum is involved.

Hemianæsthesia involving all forms of sensation may occur in connection with motor disturbance if the tumor is located in the central area of the cortex. Tumors of the parietal region produce disturbance of the muscular sense as their most characteristic symptom, together with hemianæsthesia. Motor disturbances will occur if the tumor encroaches upon the motor area. In the occipital lobes tumors produce hemianæsthesia if they encroach upon the parietal lobes. Disturbances of special sense, particularly sight and hearing, will also occur.

The study of the sensory, as well as the motor disturbances, is of value simply because it enables one to localize the causes of the symptoms. This is more useful from a surgical than from a medical standpoint. For a pathological diagnosis we must rely upon the history of the case, its mode of development, and concurrent conditions. Any destructive lesion involving the sensory path or cortical distribution will cause a greater or less degree of anæsthesia. Among these may be mentioned tumors, gummata, aneurisms, embolism, thrombosis, hemorrhage, and various degenerative and inflammatory processes. Consideration of these will be found under the appropriate heads. *Joseph A. Weitz.*

ANÆSTHESIA, LOCAL (SURGICAL).—Local anæsthesia, or better, local *analgesia*, became possible when the properties of cocaine were discovered by Koller in 1884. Previous to that time it was known that an area of the skin could be benumbed by cold or by depriving it for a time of its blood supply. But the anæsthetic effect of local anæmia could be obtained only in an extremity, while the chilling or even the freezing of the skin by means of a spray of ether had only a limited application. Koller discovered that a strong solution of cocaine, if applied to a mucous membrane for a few minutes, will make it insensitive to pain. By experiments he proved that a solution of cocaine injected into the tissues has the same effect. This discovery opened a wide field for the surgeon, as many trivial operations could now be painlessly and easily performed without the expense, discomfort, and danger attending the use of a general anæsthetic.

Fifteen years' experience with cocaine has fully justified the claims of its discoverer for its analgesic powers. Experience has shown, however, that it is by no means the harmless drug which its early advocates supposed it to be. Medical literature has recorded a long list of accidents from its use, many of them followed by a fatal result; while, far more frequently, alarming symptoms have developed, which fortunately have subsided after prompt action on the part of the surgeon. There is probably no surgeon of experience who has not met with one or more accidents of this character.

The idea uppermost in the mind of those who early employed cocaine to minimize the pain in operations, was to use a solution strong enough to accomplish this end with certainty. Hence solutions containing five per cent., ten per cent., or even twenty per cent. of the drug were swabbed or sprayed upon mucous surfaces or injected into the tissues. The appearance of toxic symptoms in certain patients impressed upon the minds of careful men the necessity for a change in the method of administration in vogue. As a result, some experimenters began to employ weaker and weaker solutions of cocaine, while others hunted through chemical laboratories for some substance less poisonous than cocaine, with equal analgesic powers, and still others attempted to develop the possibilities of analgesia by cold.

A suitable fluid was found in ethyl chloride. For convenience it is put up in tubes having at either end a minute opening closed with a screw cap. If the tube is held in the hand, a portion of its contents is vaporized

and exerts a pressure within the tube. Hence, if the lower cap is removed, a fine jet of fluid is forced out of the tube and may be sprayed upon the skin. In a few moments whitish spots will appear wherever the cold produced by evaporation is sufficiently intense to freeze the water contained in the skin. This method of obtaining analgesia has been employed in France more than elsewhere. It is most serviceable in benumbing the skin previous to inserting a needle for aspiration, or for tapping hydrocele, or in opening an abscess. From the nature of the case it is unsatisfactory in surgical operations requiring dissection of the tissue. The power of ethyl chloride is not sufficiently great to penetrate deeply, and even if it were, the risk of injury would deter the surgeon from keeping a tissue frozen for any length of time. Moreover, the reaction, when the blood again courses through the part, is often an extremely painful one.

Still other surgeons have followed up the effect of local anæmia in reducing sensitiveness. This method is especially applicable to the hand and forearm. They found that if the blood is pressed from the hand and arm, and the tourniquet applied with sufficient force to prevent any fresh blood from entering, sensation is pretty nearly suspended after a lapse of ten or fifteen minutes. This method of operating deserves wider notice than it has received. It has proved a valuable adjunct to a chemically produced analgesia, since the amount of the reagent needed to deaden pain is far less if the circulation of blood is controlled in this manner. The limb is first stripped of its contained blood by the application of Esmarch's bandage from the finger tips to the middle of the upper arm, each turn of the spiral overlapping the turn below by about half an inch. This enables the surgeon to unwind the bandage from the fingers up, and before the turns above the elbow are removed, the tourniquet should be applied, or the upper turns themselves may be left to act as a tourniquet. Attempts have also been made to render bloodless a part of the lower extremity, or an area of the scalp, or of the cheek, etc., by pressure exerted through variously shaped rings. Anæmia in the regions mentioned is more difficult to obtain, and is, on the whole, less satisfactory than that obtained in the extremities, as above described.

The efforts of other investigators to improve chemical analgesia have been very successful. It was early discovered that a solution of cocaine, even though far less concentrated than those originally employed, is still entirely satisfactory. The credit of enforcing this fact upon the medical world is due especially to a French surgeon, Reclus, and a German surgeon, Schleich.

Reclus advocated the use of a one-per-cent. solution of cocaine, or, in certain cases, of a two-per-cent. solution. Solutions of a greater strength he never employs, claiming that they are unnecessary and dangerous. As long ago as 1893 he published a report of two thousand operations performed in complete analgesia brought about by these weak solutions of cocaine. In no instance was there a fatal accident, nor even any bad symptoms.

Schleich performed a great number of experiments to determine exactly how weak a cocaine solution can be without losing its analgesic powers. His experiments led him to several important conclusions. In the first place, they showed that a solution of cocaine as dilute as 1:5,000 is possessed of analgesic power, although the quantity of fluid injected under such circumstances must be far greater than that injected if the solution contains a high percentage of cocaine. The question now raised in his mind was this: Does not the water, by distention of the tissues, reduce the sensitiveness of the nerves, either by pressure upon them or secondarily through a local anæmia? Further experiments showed that this supposition was partially true, and that pure water injected in considerable quantity has the power of reducing the sensitiveness of the parts. The injection of pure water is, however, very painful. He next tried the effects of the injection of normal salt solution, 0.6 per cent. This causes no pain, but its analgesic effect is practically *nil*. A weaker solution of salt, 0.2 per cent., proved more serviceable. The injection of this solution produces little pain and brings about a slight analgesia. Using this, then, as a vehicle, he dissolved cocaine in sufficient quantity to make a solution of one part in a thousand. To this mixture he added a minute quantity of morphine, believing that the analgesic effect of the cocaine was thereby prolonged. Since the injection of large quantities of fluid in an inflamed area causes great pain, Schleich employs under such conditions a somewhat stronger solution of cocaine, so that a less quantity of fluid may be injected. Indeed, he recommends the preparation of solutions of three different strengths, the formulæ for which are as follows:

	Sol. I.	Sol. II.	Sol. III.
Cocaini hydrochlorici	0.2	0.1	0.01
Morphinæ hydrochlorici	0.025	0.025	0.005
Natr. chlorat. sterilisat	0.2	0.2	0.2
Aquæ destill. sterilisat	ad 100.0	100.0	100.0
Adde acid. carbol. (five per cent.)	gtt. 2	gtt. 2	gtt. 2

Solution I. for hyperæsthetic areas (inflammation, suppuration, neuralgia).
Solution II. for moderately hyperæsthetic areas.
Solution III., for extensive operations, to be used alternately with the more concentrated solutions.
For general work Schleich advises the use of Solution II., or the "normal" solution as he calls it.

Schleich also insisted upon a particular method of injection. To render the skin insensitive, the hypodermic needle should be thrust into it nearly parallel to the surface, and not through it. Slow pressure upon the piston will force the fluid into the meshes of the skin, distending them and causing a white wheal to appear. The needle should then be withdrawn and reinserted in the edge of this insensitive wheal, and a second injection made in the same manner as the first. A second wheal is thus produced beyond the first one, in the farther edge of which the needle is again inserted for a third injection. This process is repeated until the benumbed area extends throughout the line of the proposed incision (Fig. 195).

If an abscess is to be opened, or any operation performed which requires cutting beneath the level of the skin, the series of infiltrated areas is made to extend not only across the skin surface, but also in a semicircle beneath the abscess or tumor (Fig. 196). For this purpose a long slim needle is required, and each succeeding injection is made by pushing the point of the needle a little farther under the abscess or tumor. A curved hypodermic needle answers admirably for this purpose. When half

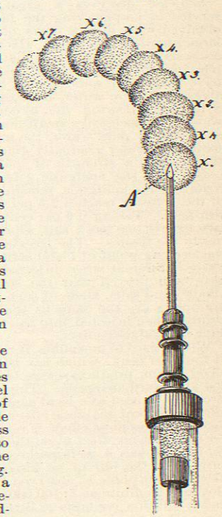

FIG. 195.—Showing Injection Along a Line of Incision in Skin. X, X¹, X², etc., first, second, third, etc., points of injection. After the first puncture, *A*, the needle is always inserted in the edge of the area last anæsthetized. (From Schleich.)