contractures, sensory disturbances, muscular atrophies, and other trophic changes, corresponding to the manner and extent in which the cords of the plexus are involved.

In division or other causes producing paralysis of the *musculo-spiral nerve*, there is paralysis of all the muscles on the posterior aspect of the forearm and the radial group of muscles, so that the wrist and proximal phalanges of the fingers cannot be extended, and the hand falls limply; this constitutes the condition of "wrist drop" which is a characteristic phenomenon in lead poisoning and other nervous affections. The middle and distal phalanges remain capable of extension from the action of the interossei and lumbricales muscles, which are innervated by the ulnar nerve. The paralyzed muscles may atrophy. Sensation may be lost on the radial portion of the dorsum of the hand, usually over the area corresponding to the thumb, index and middle fingers, and radial half of the ring finger; individual variations in the distribution of the nerves of cutaneous sensation in the hand are, however, frequent.

The *median nerve* furnishes cutaneous sensation to the palmar aspect of the thumb, index, middle, and radial half of ring finger, and innervates the pronator muscles, flexor carpi radialis, flexor longus pollicis, flexor sublimis digitorum, radial half of flexor profundus digitorum, abductor pollicis, opponens pollicis, outer head of flexor brevis pollicis, and the two outer lumbricales. Paralysis of the median nerve produced by section of it above the elbow or other cause results in loss of sensation over the area mentioned, atrophic changes in the muscles of the forearm and the thenar eminence, loss of power of abduction and opposition of the thumb, loss of flexion of last phalanx of the thumb, diminished power of flexion of the proximal phalanx of the thumb, and impairment of flexion especially of the index and middle fingers. The power of pronation is lost and the wrist is flexed only by the flexor carpi ulnaris.

Division of the median nerve at the wrist, below the separation of the branches to the muscles of the forearm, results in loss of power of abduction and opposition of the thumb.

Paralysis of the *ulnar nerve* causes loss of sensation over the ulnar third of the hand and over the little and ulnar half of the ring finger, anteriorly and posteriorly, loss of motor power of the muscles supplied by it (flexor carpi ulnaris, ulnar half of flexor profundus digitorum, the muscles of the little finger, the two ulnar lumbricales, all the dorsal and palmar interossei, adductor pollicis, and inner half of flexor brevis pollicis), together sometimes with atrophic changes, at times extreme, in the muscles affected. Adduction of the thumb and lateral movements of the other fingers are abolished; flexion of the proximal phalanges is interfered with, and these phalanges are held in extension or superextension. From paralysis of the interossei and two lumbricales extension of the middle and distal phalanges is lost or impaired, and these phalanges, especially in the little and ring fingers, are held strongly flexed. The action of the flexor carpi ulnaris is lost. In closing the fist, the distal and middle phalanges are first flexed by the common flexors, and then the proximal phalanges are bent by the continued action of these muscles.

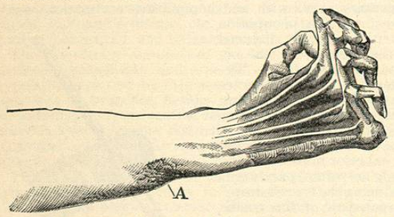

FIG. 2514.—Extreme Atrophy and Contractures from Paralysis of Ulnar Nerve (Caused by Wound at A); an Extreme Instance of "Claw-hand." (Duchenne.)

When the injury or lesion involves the distal portion of the ulnar nerve, near the wrist, beyond the branches given off to the flexor profundus digitorum and flexor carpi ulnaris, these muscles will escape paralysis.

The deformity known as "claw-hand" (main en griffe) is produced by paralysis of the interossei and lumbricales, the common flexors and extensors being at the same time unparalyzed. As these muscles are (with the exception of the two radial lumbricales) supplied by the ulnar nerve, claw hand is a characteristic consequence of paralysis of the ulnar nerve, and occurs in injuries of that nerve (Fig. 2514), and sometimes in progressive muscular atrophy (Fig. 2517), amyotrophic lateral sclerosis, syringomyelia, leprous neuritis, and other conditions. The action of the interossei and lumbricales is to flex the proximal phalanges and extend the middle and distal phalanges, besides acting as abductors and adductors. Paralysis of these muscles results in a superextended position of the proximal phalanges (from the unopposed action of the extensors) and strong flexion of the middle and distal phalanges (from the action of the common flexors); this position of the hand is the one to which the term claw-hand is applied. Along with this paralytic and contractured condition, extreme atrophy of the paralyzed muscles is often present in claw-hand, the palm being hollowed out, and the interosseous spaces on the dorsum of the hand being sunken so as to form deep grooves.

Combined paralysis of the ulnar and median nerves, the musculo-spiral nerve being normal, results in the deformity known as the "preacher's hand" (main du prédicateur emphatique), from its supposed resemblance to the emphatic gestures of public speakers (Fig. 2515). The unopposed action of the extensor muscles causes the hand and proximal phalanges to be habitually held in a position of marked extension and superextension. The "preacher's hand" occurs especially in hypertrophic cervical pachymeningitis, though it occasionally appears in other nervous diseases.

Glossy skin is a rare trophic change sometimes resulting from wounds or other lesions of nerves, which affects the fingers especially. The digits, or one or two of them, are smooth, shining, and glossy, devoid of hair, pinkish or blotched as if by chilblains, and the surface of the skin lacks its natural linear markings. Trophic changes in the nails also occur. The lesions are the seat of burning pain and neuralgia.

Vaso-neuroses.—There are some allied conditions which along with prominent vascular phenomena present pronounced neuropathic features, and hence may be classed as vaso-neuroses. These are Raynaud's disease, erythromelalgia, chilblains, and the condition of vascular spasm described under the name "dead fingers." The hand, along with the foot, is a favorite seat for these affections, which are considered in full elsewhere and can be only briefly touched upon here.

Raynaud's disease (peripheral gangrene, symmetrical gangrene) is a rare condition characterized by small circumscribed areas of vascular disturbance or ischæmia, running on to gangrene, associated with severe neuralgic pains. The lesions are usually several in number, situated on the fingers or toes, sometimes the face; almost always they are bilateral and symmetrical, but the writer has seen a case involving one hand only. In the milder cases or earlier stages the lesions consist of small local areas of anæmia ("local syncope") or of passive congestion ("local asphyxia"). In the severer cases circumscribed moist black gangrenous patches develop; after the slough separates an ulcer is left that heals very slowly. The course of the disease is very slow and protracted, the lesions requiring weeks or months for their evolution and repair. The necrotic process has been known to cause complete spontaneous amputation of the ends of the fingers. In treatment, analgesics are required for the relief of pain, and tonics or other measures

for improving the general condition. Local treatment aims at promoting the separation of the slough and stimulating the healing process; this is accomplished by poultices, caustics (silver nitrate, copper sulphate), excision of the sloughs, antisepsis, etc.

Erythromelalgia is an uncommon condition affecting usually the feet, but also the hands and rarely other regions. The disease is manifested by recurring paroxysms, though sometimes the trouble is almost continuous. The attacks consist in the development of areas of intense burning, pain, and tenderness on the feet or hands, associated usually with transient redness or congestion of the hyperæsthetic area. The attacks are brought on or aggravated by warmth, dependent position, and exertion. The pain is frequently so excruciating as to cause complete disability of the extremity affected. Erythromelalgia is usually classed with nervous diseases, though it can perhaps be equally well ranked as a circulatory disorder—a vaso-motor neurosis or vascular hyperæsthesia. Distance from the heart is a factor in causing, and determining the location of, the lesions; and gravity is another factor contributing to ischæmia which probably accounts for the preference for the feet which the disease exhibits. The disease is obstinate and persistent and no effective treatment is known. During the paroxysms relief is usually afforded by elevation of the part, the application of cold (immersion in ice water), and rest.

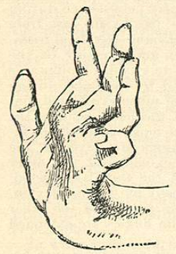

FIG. 2515.—Characteristic Position of the Hand in Hypertrophic Cervical Pachymengitis—the "Preacher's Hand." (Meillet and Richer.)

Chilblains (pernio) are often regarded as related to frostbite, but in some respects they resemble Raynaud's disease and erythromelalgia, and are probably a form of vaso-neurosis. While they sometimes originate after exposure to cold, this is not always the case; anæmic and chlorotic individuals are especially subject. Chilblains are commonest on the feet, but sometimes occur on the hands. The disease is obstinate and the attacks persistently recur, especially in winter. The attack consists in a severe itching or burning pain and tenderness in the areas affected, which are red and erythematous. The pain is aroused or aggravated by warmth, especially by warmth following exposure to cold. In severe cases the affected areas may become œdematous and bullous, and undergo ulceration. For relief of the pain, very hot or very cold water may be applied; also astringent or sedative ointments or lotions, etc. Constitutional treatment should be directed against any anæmic, chlorotic, gouty, or rheumatic conditions.

Vascular Spasm.—In the rare condition sometimes termed "dead finger" one or more fingers undergo sudden, repeated, and transient vascular spasm, so that they become white, bloodless, and cold. The paroxysms last a few minutes, hours, or even days. At times the blanching is preceded by lividity, and is occasionally accompanied by dull pain. The affection was first described by Allan McLane Hamilton in 1874, and since then a few cases have been reported. The treatment is by galvanism, nitroglycerin, or other vaso-dilators.

Acrodynia is a disease of the Orient, occasionally occurring in Europe, characterized by pains in the hands and other extremities, with erythema, thickening and exfoliation of the epidermis, pigmentation, and other changes in the skin.

Hypertrophic Cervical Pachymeningitis.—In this affection the upper extremities are especially involved, usually one becoming affected after the other. In the period of development of the disease there are pains and altered sensation in one or both hands. After the cervical lesions are fully established marked paralytic and atrophic changes develop. The particular distribution of these lesions varies in different cases, but the commonest and most characteristic condition is a paralysis and atrophy of the muscles supplied by the ulnar and median

FIG. 2516.—Characteristic Appearance of the Hand ("Ape Hand") in Progressive Muscular Atrophy. (Meillet and Richer.)

nerves, leaving the musculo-spiral group less involved. The flexors and pronators and the muscles in the palm are paralyzed and atrophied. The unopposed action of the extensors brings the hand and fingers (especially the proximal phalanges) in a position of superextension, forming the so-called "preacher's hand," already referred to; this position is quite characteristic of cervical pachymeningitis, though it may occur in other affections (Fig. 2515). At first the hand can be flexed passively, but later the extensor muscles may undergo contracture. Sensation may be lost or impaired in the affected areas.

Cervical Paraplegia.—In injuries or myelitis of the upper part of the spinal cord the upper extremities may be more or less completely paralyzed, with extensive muscular atrophy.

Progressive Muscular Atrophy.—The hands suffer early, characteristically, and severely in this disease, either successively or simultaneously. The muscles of the thenar eminence are usually the first to be affected; they gradually become atrophied and paralyzed, producing a peculiar flatness of this region. The hypothenar muscles soon become similarly involved. At this stage the hand appears long, thin, and flat, and the thumb lies parallel and in the same plane with the other fingers; the hand in this condition has been likened in appearance to that of the ape (Fig. 2516).

Later the interossei and lumbricales atrophy and become paralyzed, resulting in corresponding loss of the power of abduction and adduction of the digits, flexion of the proximal phalanges, and extension of the middle and distal phalanges. If the flexor and extensor muscles in the forearm are at this stage unaffected, "claw hand" will result (Fig. 2517), though, as the muscles of the forearm usually become involved early, this deformity does not very often occur in progressive muscular atrophy.

Fibrillary contractions occur in the affected muscles. Contractures are not usually present to a marked degree.

Anterior Poliomyelitis.—In infantile paralysis the upper extremity is sometimes involved, but much less frequently, especially permanently, than the lower. Paralysis of irregular and varying distribution occurs, with atrophy of the affected muscles and of bony and other tissues, contractures of the opposing muscles, and retardation of growth. The most injurious and the most characteristic consequences of the disease in infants are the deformities, produced by arrested and irregular development of the parts, that make their appearance as the growth of the child proceeds. In this way, from contractures and irregular development at the wrist, various forms of club hand may be produced.

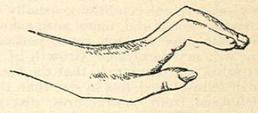

FIG. 2517.—Claw Hand of Moderate Degree in Progressive Muscular Atrophy. (Meillet and Richer.)

In the adult form of the disease, permanent paralyses, atrophies, and contractures may develop, but as full growth has been attained the ultimate deformity is less than in infants.

Locomotor Ataxia.—In this disease the hands often suffer from want of co-ordination and inability to perform

delicate movements, like picking up a pin or buttoning the clothing. Rarely trophic changes, as of the nails, occur in the hand. Charcot's arthropathy occurs rarely in the wrist or joints of the fingers; in this condition an enlarged phalanx may present an appearance similar to that of syphilitic dactylitis. Hyperæsthesia sometimes occurs about the fingers.

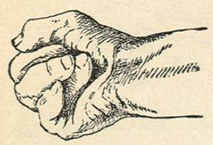

FIG. 2518.—Hemiplegic Contracture of the Fingers. (Meillet and Richer.)

Lateral Sclerosis.—In this condition the upper extremities are usually affected much less and much later than the lower, though rarely the disease begins in the upper extremities. There are present paresis, muscular tension, and exaggerated tendon reflexes; the wrist and fingers are usually strongly flexed and the arm is adducted.

Amyotrophic Lateral Sclerosis usually begins in the upper extremity, with paralysis, muscular atrophy, fibrillar contractions, pain, and paræsthesia, followed at a later stage by muscular rigidity and contractures. Sometimes the fingers are bent into the palm and the wrist is flexed; sometimes there is atrophy of the interossei and claw hand.

Multiple Sclerosis.—The most conspicuous symptom exhibited by the hand in this condition is the intention tremor, or rapid rhythmic tremor when voluntary movements are attempted. The wrist jerk is exaggerated, and paresis and muscular rigidity may be present. Trophic changes in the hand occasionally occur, as swelling of the small joints of the fingers, atrophy of the small muscles, blebs, onychia, sweating, lowered temperature.

Syringomyelia (Morvan's disease) involves especially the upper extremities, and is manifested by paralysis and atrophy of muscle groups, varying in situation, paræsthesiæ and anæsthesia (especially to temperature and pain) in irregularly distributed patches, and trophic changes. Some cases of syringomyelia simulate progressive muscular atrophy, beginning with atrophy and paralysis of the thenar, hypothenar, and interosseous muscles of the hand, producing claw hand; the paralysis later proceeds up the forearm. Enlargement of joints (frequently the wrist) occurs, similar to Charcot's tabetic arthropathy. Œdema, vesicles, bullæ, ulcers, onychias, recurring painless whitlows, and even extensive gangrene and mutilation about the fingers and hand may occur. In a few instances general hypertrophy of the hand has been observed, and in a few others Dupuytren's contraction has been present.

Hemiplegia.—In this affection the primary condition manifested in the hand is paralysis. Later, especially following secondary descending degeneration in the spinal cord, contractures may develop, usually of the flexor muscles (Fig. 2518), though the extensors may be shortened. The muscles are only exceptionally atrophied, aside from decrease in size caused by disuse.

Infantile cerebral palsies and *infantile hemiplegia*, occurring especially during the first two years of life and arising from labor traumatisms (birth palsies) or pathological cerebral conditions, usually affect the upper extremity worse and more permanently than the lower. Trophic effects which cause permanent damage follow the primary paralysis. Growth of the parts involved is arrested or irregular, so that the hand and arm are small and undeveloped, less in size than their fellow, and often deformed from contractures, disproportionate development of different parts, or secondary joint changes. The fingers, wrist, and forearm are usually flexed, and forms of club hand may be produced. Frequently the affected member remains the seat of ataxia, chorea, tremor, or the peculiar motor disorder called athetosis (see below). About ten per cent. of the cases of infantile hemiplegia are followed by athetosis, which is a sequela of this condition rather more frequently than of birth palsy and much more frequently than of adult hemiplegia.

Friedrich's Ataxia is a rare hereditary condition, occurring chiefly in children, in which the hands become involved by extension of the disease from the lower extremities. The hand exhibits an ataxic condition, delicate movements like buttoning the clothes being interfered with. "Manus cavus" often occurs, the palm being arched; the proximal phalanges may be superextended and the middle and distal phalanges somewhat flexed, producing some tendency to claw hand.

In *general paresis* the hands may exhibit anæsthesia, paralysis, tremor, and lack of co-ordination, shown especially by impaired ability to execute delicate movements, as writing.

In *tetanus* the hand participates in the tonic and clonic spasms. As the flexors are stronger than the extensors, in this as in many other spastic conditions the position of the fingers and hand is usually that of firm flexion.

Tetany affects the hands conspicuously. Intermittent paroxysms of tonic muscular spasms occur, associated with pain and paræsthesia. The paroxysms last for from a few minutes to a few days and may persist even during sleep; the intervals between the paroxysms last from hours to months. The mechanical and electrical irritability of the muscles is increased, and pressure on the nerve trunks and arteries excites an attack (Trousseau's symptom). The position assumed by the hand during the spasm depends on the group of muscles affected, but is usually one of flexion. Often the hand assumes the conical shape of the accoucheur's hand about to be introduced into the vagina; the fingers are flexed at the metacarpophalangeal joints and extended at the other joints, the hand is narrowed and the thumb adducted. Sometimes the fist is forcibly closed by general flexion, the thumb being pressed into the palm and the other fingers flexed upon it. Rarely the fingers are extended and separated.

Thomsen's Disease (congenital myotonia) is a rare hereditary affection, manifested by the occurrence of tonic spasms on attempting voluntary movements. The hand may be involved with other parts of the body. On closing the hand firmly, for instance, cramp occurs and the grip cannot be relaxed.

Hysteria.—In this condition the hand, like other parts of the body, may be involved in a variety of ways, by

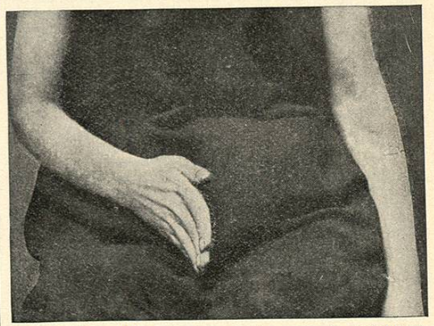

FIG. 2519.—Hysterical Contracture of Extensor Muscles of Hand, of Six Months' Duration. (Dana.)

hyperæsthesias, anæsthesias (often dissociated), slight wasting, vascular phenomena (as flushing, pallor, coldness, ordinary œdema, cyanotic or "blue" œdema), paralyses, sudden temporary loss of power in the muscles, tremor (simple or intentional), contractures, etc. Hysterical contractures of the hand may be temporary or persistent, and usually involve the flexor muscles,

though sometimes the extensors are affected (Fig. 2519); sometimes the contractures are extreme and very firmly fixed, not yielding to sleep or a mild degree of general anæsthesia; they may continue for months, and cause permanent damage by setting up secondary joint changes.

In *epilepsy* the hand may take part in the spasms. In *chorea* the fingers and hand usually participate actively in the irregular movements and inco-ordination. In the *tics* and *habit chorea* the hand may be involved, though the face is the commonest seat of these disorders.

Paralysis agitans is usually manifested in the hand in a very characteristic fashion. In typical cases the fingers are flexed at the metacarpophalangeal joints and the pulp of the thumb is opposed to that of the index finger; by the constant tremor the opposed thumb and index finger are kept continually rolling over each other, producing the movement described as "pill-rolling." The tremor is usually less during voluntary movements. Muscular rigidity of the digits and hand is often present.

Athetosis, or post-hemiplegic chorea, is a peculiar motor affection of the fingers and toes that occurs most frequently as a sequela of infantile hemiplegia and infantile palsies, less frequently after hemiplegia in adults. It is manifested by slow and deliberate forcible involuntary movements of the digits, in extension, flexion, abduction, and adduction, which take place successively and incessantly, even during sleep. The movements may be complicated and peculiar, and may lead to distorted positions of the hand; they can be only partially and for a short time controlled by the will, and the fingers cannot be permanently kept in any fixed position.

The *treatment* of nervous affections of the hand is in general that of the cause or of the general condition producing the local trouble, together with measures to improve the local condition when no general amelioration is possible.

In wounds in which nerves leading to the hand are divided, the ends of the severed nerve should be carefully sutured together with catgut. If this is not done at the time of the injury, secondary suture, even after months or years, may restore the function of the nerve. If a portion of a nerve is destroyed and the ends cannot be approximated by stretching, plastic procedures or transplantation may be tried.

Developing or impending paralysis and atrophy of muscles and the resulting contractures and deformity may sometimes be arrested, retarded, or diminished by the use of electricity, massage, exercise, passive movements, etc. When deformity is fully developed there is usually little possibility of accomplishing any material improvement, though sometimes the local condition can be somewhat bettered. Thus, division or lengthening of the tendons of contractured muscles sometimes improves deformity and motion. In some cases shortening of the tendons of partially paralyzed muscles, as the extensors, may improve their action. Tendon transplantation, that is, the transference and joining of tendons of non-paralyzed muscles to those of paralyzed muscles, has been tried in the hand in a few cases, in some with good results; thus, in extensor paralysis, some of the tendons of flexor muscles may be cut off and the tendons passed subcutaneously or through the interosseous space to the dorsum of the wrist, where they are sutured to the tendons of the paralyzed extensor muscles. In some cases the use of mechanical apparatus is beneficial. Local trophic changes of inflammatory or necrotic character demand appropriate treatment.

Senile Changes in the Hand.

In old age the skin and subcutaneous tissues often become atrophied and thinned, diminishing the size of the hand and fingers. Joint changes are often present, and have been referred to above; they comprise chiefly enlargements (relative or absolute), ulnar deflections, changes in the thumb joint, and other lesions which merge into conditions of rheumatoid character.

Occasionally general palmar induration (as already described) is observed. Trophic changes in the nails—longitudinal ridges ("reedy nail")—sometimes occur. Senile warts (verruca senilis) may develop on the hands as elsewhere; they may be flattish or elevated, pigmented or non-pigmented, sometimes fatty. The back of the hand is a favorite seat for keratosis senilis, which is manifested by warty projections in the form of small papules or larger flattish plates, greasy plates or patches, branny scales, pigmented spots, or in some cases thickening of the entire skin; sometimes the skin of the back of the hand is converted into a dense horny plate. This condition may run into epithelioma. Tremor of the hand, merging into paralysis agitans, is a common senile condition.

Condition of the Hand in General Diseases.

The changes exhibited by the hand in a large number of general diseases have been already detailed, so that there is little to be added on this subject. In anæmic conditions the hand is pale, cold, dry, and the nails are pale. In conditions of vascular relaxation and atony, weak circulation, or lowered blood pressure, the skin is clammy, cold, purplish, or mottled. In cardiac disease the hands may be congested, cold, clammy, or œdematous, and the fingers may be clubbed. In nephritis the hand is dry, pale, œdematous. In tuberculosis the hand may be emaciated, hot, dry, or sometimes clammy, and the fingers are occasionally clubbed or blunt. Clubbed fingers may occur in other forms of pulmonary disease. The hand is dry and shrivelled in diabetes. Onychias may follow severe acute diseases. In typhoid fever the palms of the hands (and soles of the feet) are usually dry, parchment-like, of a yellow to brownish color, and during convalescence are the seat of active desquamation. In certain forms of idiocy the skin of the hands is loose, wrinkled like a washerwoman's, and looking too large for the hand, while the finger tips are tapering and conical. *John Benjamin Nichols.*

HARBIN HOT SULPHUR SPRINGS.—Lake County, California.

Post-Office.—Harbin Springs. Hotel.

Access.—Take boat at Oakland Ferry from San Francisco. At Vallejo change for Napa Valley branch to Calistoga; thence a twenty-mile stage ride brings one to the springs. Time from San Francisco: seven and one-half hours. The location is at the base of a spur of the Coast Range of mountains, 2,000 feet above tide water. Lake County has been justly named the Switzerland of America, and it would be difficult to find a more delightful and picturesque location than that of the Harbin Springs. The mountain air is very invigorating and not subject to extremes of heat or cold, the mean temperature being 70° F. The waters are sulphurous and saline, the principal spring flowing 1,500 gallons per hour. There is also a small chalybeate fount yielding only sixty gallons per hour. The sulphur spring has a temperature of 122° F., and is used for bathing, for which excellent facilities have been provided. Following is an analysis of this water:

One United States Gallon Contains:

Solids.	Grains.
Sodium chloride	23.05
Sodium carbonate	5.42
Sodium sulphate	10.19
Potassium carbonate	1.74
Magnesium carbonate	6.18
Magnesium sulphate	11.94
Calcium carbonate	9.10
Calcium sulphate	14.63
Ferrous sulphate	1.75
Arsenious salts	.07
Alumina	1.60
Silica	2.76
Organic matter	Trace.
Total	88.43
Gases.	**Cu. in.**
Carbonic acid gas	4.26
Free sulphureted hydrogen	11.74