

## JOINT AFFECTIONS IN NERVOUS DISEASE.\*

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America has the honor of having first seriously directed the attention of the medical world to the intimate relation between disease of the joints and of the nervous system. Since Dr. John Keasley Mitchell<sup>1</sup> wrote his suggestive articles in 1831 and 1833 our knowledge of this relation has made remarkable progress.

If we leave out of consideration the atrophic joints and limbs of the cerebral and spinal palsies of children and the joint changes in acromegaly the most important joint affections in nervous disease fall into the following groups:

1. The intermittent joint effusions (*hydrops articu-lorum intermittens*).
2. The arthropathies of tabes and dementia paralytica (*arthropathia tabetica*).
3. The syringomyelic arthropathies (*arthropathia syringomyelica*).
4. The painful joints of the psychoneurotics (*arthral-gia psychoneurotica*).

THE REGULARLY INTERMITTENT JOINT EFFUSIONS  
(*Hydrops Articulorum Intermittens*).

This remarkable affection early described by Moore<sup>2</sup> has been carefully studied in this country by Kennedy,<sup>3</sup> Barnes,<sup>4</sup> Brackett and Cotton<sup>5</sup>; in England by Marsh,<sup>6</sup> in France by Féré,<sup>7</sup> Crepin, Rejou,<sup>8</sup> and Panas<sup>9</sup>; in Germany and Austria by Seeligmüller,<sup>10</sup> Pierson,<sup>11</sup> Kapper,<sup>12</sup> Linberger,<sup>13</sup> and especially by Schlesinger,<sup>14</sup> who has been able to collect fifty-five cases from the literature.

In this disease there is an acute swelling of a joint which occurs periodically. The intervals vary; usually the attacks occur every fourteenth day, but in some instances they occur every third or fourth day, every ninth or sixteenth day, or even every thirtieth day. In one case the swelling occurred at the menstrual period. The periodicity is often so regular that, as in malarial affections, the patient will be able to foretell the day when the joint will be attacked. The joint may or may

not be painless. There is, as a rule, no fever, nor is there local redness or heat. The knee is the joint most frequently attacked, usually on one side only; sometimes both knees are simultaneously involved. Other joints may be the seat of the affection; even, it is asserted, the mandibular articulation and the joints of the spine.

The duration of the attacks is also variable; usually the swelling lasts only three or four days, but it may continue for a week or longer.

The disease has nothing to do with infection (pyogenic, tubercular, syphilitic, malarial or rheumatic). It is almost certainly angioneurotic in origin and is probably closely related to the angioneurotic edema which affects the skin and mucous membranes. Not infrequently an attack is accompanied by other neural manifestations, or, instead of an attack of the joint swelling, there may be an "equivalent" in the form of polyuria, profuse sweating and reddening of the face.

The diagnosis is the most important in order that the mistake of treating by surgical methods may be avoided. A surgeon, if unfamiliar with the disease, may be tempted to suspect an "irritable synovial fringe" or a loose semilunar cartilage and advise operation. Unluckily, too, the cases are sometimes mistakenly supposed to be instances of tubercular arthritis and are treated by fixation and prolonged rest.

The sudden onset, the absence of fever, the short duration of the attack and the periodic recurrence make the diagnosis, in a majority of cases, really easy. Tuberculosis is not difficult to exclude, especially if the tuberculin test be employed in doubtful cases.

The treatment of the individual attacks consists of rest, encouragement and the application of a flannel bandage. Aspiration of the joint or injections are wholly unnecessary. The attacks will often cease if proper general hygienic measures are followed. Most individuals suffering from the disease require antineurotic measures—psychotherapy, hydrotherapy, occupation-therapy and the like. Arsenic in small doses, long continued, appears to have been beneficial in some cases. Now and then a case will resist all attempts at cure; the disease has been known to persist through a large part of a lifetime. In view of what we now know of the relation of a slowed coagulation time for the blood in connection with serous effusions, it might be worth while to test the time in cases of intermittent hydrops and perhaps by the therapeutic effect of calcium lactate.

II. THE ARTHROPATHIES OF TABES AND DEMENTIA PARALYTICA (*Arthropathia Tabetica*).

Since Charcot,<sup>15</sup> in 1868, published his careful clinical study of the joint lesions which occur in the course of tabes many writers have dealt with the subject, and a large number of cases have been placed on record. In late years the topic has been dealt with in a number of important monographs and collective reviews. Among these the articles of Rotter,<sup>16</sup> Pansini<sup>17</sup> and Henderson<sup>18</sup> may be especially mentioned. Full references to the literature are to be found in these articles. Nearly 400 cases are now on record, and the analyses begin to be of value. In America Drs. S. Weir Mitchell, H. M. Thomas and others have made reports on the condition.

15. Charcot: "Sur quelques arthropathies qui paraissent dépendre d'une lésion de cerveau ou de la moelle épinière," Arch. de Physiol. Norm. et Path., Paris, 1868, No. 1, pp. 161, 379, 1 pl.

16. Rotter: "Die Arthropathien bei Tabiden," Arch. f. klin. Chir., 1887, vol. xxxvi, p. 1-71, 2 pl.

17. Pansini: "Sull'artropatia tabetica," Naples, 1896.

18. Henderson: "Joint Affections in Tabes Dorsalis," Jour. Pathol. and Bact., Edin. and Lond., 1905, vol. x, p. 211-264.

\* Read in the Section on Practice of Medicine of the American Medical Association, at the Fifty-seventh Annual Session, June, 1906.

1. Mitchell: "A New Practice in Acute and Chronic Rheumatism," Amer. Jour. Med. Sc., 1831, No. viii; "Further Cases and Observations Relative to Rheumatism," Ibid., 1833, vol. xii.

2. Moore: "Periodical Inflammation of the Knee Joint," Lancet, 1864, No. 1, p. 485; "Two Cases of Periodical Inflammation of the Right Knee Joint," Med.-Chir. Trans., Lond., vol. L, p. 21-38.

3. Kennedy: "Hydrops articu-lorum intermittens," THE JOURNAL A. M. A., 1894, p. 900.

4. Barnes: Ref. Handbook, Med. Sc. (Wood's) 1895, vol. xi, No. 7, p. 484.

5. Brackett and Cotton: Boston Med. and Surg. Jour., 1901, vol. cxlv, p. 484.

6. Marsh: "Cases of Intermittent Hydrops of the Joints," Trans. Clin. Soc., Lond., 1905, vol. xxxviii, p. 147-149.

7. Féré: "Contribution à l'histoire de hydrarthroses intermittentes," Rev. neurol., Paris, 1893; also: "Notes sur quelques de l'hydrarthrose intermittente neuropathique," Rev. de chir., Paris, 1893, p. 616.

8. Rejou: "De l'hydrarthrose intermittente," Paris, 1877.

9. Panas: Communication sur l'hydrarthrose intermittente. Bull. et mem. Soc. de Chir. de Paris, 1878, vol. iv, p. 401-405.

10. Seeligmüller: "Hydrops articu-lorum intermittens," Deutsche med. Wochenschr., 1880, vol. vi, No. 52, p. 61.

11. Pierson: "Zur Kenntniss der Hydrops articu-lorum intermittens," Deutsche med. Wochenschr., Berlin, 1881, vii, 169.

12. Kapper: "Zur Therapie des Hydrops articu-lorum intermittens," Allg. Wien med. Ztschr., 1885, vol. xxx, p. 362-382.

13. Linberger: "Ueber intermittirenden Gelenkhydrops," Beitr. z. klin. Chir., vol. xxx.

14. Schlesinger: "Die intermittirenden Gelenkschwellungen," Nothnagel's Spec. Pathol. u. Ther., Wien, 1903, p. 1-27.

In Charcot's original description the main clinical features of the tabetic arthropathy were pointed out—the sudden appearance of a firm, painless swelling of a joint, extending to the surrounding soft parts, occurring often independently of traumatism, and followed by rapid changes in the joint surfaces, the latter leading to dislocations or subluxations and to false positions of the bones in a very short time.

Pain, while usually absent, is sometimes present. Its rarity, however, is shown by Henderson's analysis; in his statistics the presence of pain, other than the frequently occurring tabetic pains, was noted in only 20 out of 333 cases. The joint is rarely red, though in some instances slight redness appears and lasts for a few days.

The sudden firm swelling is very characteristic. It does not pit on pressure and is quite different from an ordinary edema. It extends, too, with great rapidity, often reaching its height in a few hours, and involves structures beyond the capsule and bursæ of the joint. More rarely the swelling comes on gradually. Occasionally crepitation can be made out very similar to that met in ordinary arthritis deformans.

After the full development of the swelling, the joint may rapidly grow smaller again, the swelling often entirely disappearing within a couple of weeks. Most authors distinguish a benign and a malignant form, the latter, unfortunately, being that most frequently met. In the benign form the swelling may entirely disappear and the joint return almost to its normal state, except, perhaps, for slight crepitation. In the malignant form there is rapid loosening of the ligaments, alteration in the bones, subluxation or dislocation often following within a few days or weeks. Not infrequently free bony masses appear in or about the joint. If the knee be involved, a genu-recurvatum may rapidly be formed. Flail joints are common sequels of tabetic arthropathies.

The tabetic arthropathies may occur at any stage of development of the disease. They may even be among the premonitory symptoms, though this is unusual. The majority of the cases appear to have been observed first in the ataxic period. It was Charcot's opinion that the joint affections usually appeared in the transitional period; that is to say, just before the onset of the ataxia, and he thought that if they occurred in the ataxic period the arms were usually involved rather than the legs; that is, joints in limbs in which the disease was not so far advanced. Henderson's statistics indicate a somewhat different incidence. In a total of 246 patients analyzed by him the first arthropathy occurred in the pre-ataxic stage in 54 cases, in the transitional in 36 cases, in the ataxic in 156. It is rare to have an arthropathy appearing first in the paralytic stage.

If the joint be tapped in the stage of acute swelling, a clear yellow fluid is usually obtained; sometimes it is blood-stained. In the joints which have been incised a slightly reddened synovial membrane has been found, with some thickening of the fringes. In later stages the fringes are lengthened, have bulbous extremities, and may contain nodules of bone or cartilage, or areas of necrotic tissue.

In the milder cases the capsule of the joint and the periarticular ligaments may suffer but little, but in the severe arthropathies these fibrous structures become thinned and fuse with neighboring structures to form a general fibrous mass in which small bony or cartilaginous nodules frequently appear. An arthropathy which might have remained benign had the joint been kept at rest is often converted into a malignant arthropathy

by neglect and overuse. The painless character of the affection tends to lead patients to use the joint, unless they are strictly warned against this by the medical attendant.

The changes in the bone and cartilage of the joints themselves have attracted the attention of many investigators. In the benign cases there may be no changes whatever, though it is rare that erosion of cartilage is entirely missed. Most often, and especially in the malignant cases, changes in the bones and cartilage occur very similar to those which are found in arthritis deformans; indeed, a number of pathologists class tabetic arthropathy as one form of arthritis deformans. As in arthritis deformans, atrophic and hypertrophic lesions are described, the former being most often met in the hip and shoulder. Subclavicular dislocation of the shoulder and dorsal iliac dislocation of the hip are common deformities in these cases. Sometimes the head, neck and great trochanter of the femur entirely disappear, with formation of the so-called "drum-stick femur."

Hypertrophic changes are more common in the knee and ankle. The ends of the bones taking part in the formation of the joint become enlarged and numerous osteophytes appear in and about the joint. The joint surfaces become eroded, the tibia suffering more than the femur at the knee. The tibia is often dislocated backward.

Enlargement of the lower ends of the tibia and fibula is very common when the ankle is affected by tabetic arthropathy. This is frequently referred to in the bibliography, and is very evident from the *x-ray* pictures which Dr. Baetjer has taken in the Johns Hopkins Hospital.

Almost any joint in the body may be affected, though the small joints appear to be less often involved than the large. Even the maxillary joint may become affected.

Two very interesting special types of tabetic arthropathy are occasionally met: (1) The tabetic foot (*piéd tabétique* of the French) and (2) the tabetic spine.

In the tabetic foot the bones of the arch are especially affected. I mean those taking part in the formation of the intertarsal and tarsometatarsal articulations. The bones, the joint cavities, the ligaments and the adjacent soft parts may all be involved. Henderson describes and illustrates two characteristic displacements of the metatarsal bones; one lateralward, the other dorsalward. The term tabetic foot should not be applied to a tabetic arthropathy of the ankle; in the tabetic foot proper it is not the talocrural articulation which is involved.

The bony lesions in the tabetic spine resemble very closely those of other varieties of spondylitis deformans, but the sudden onset and the extensive destruction of the parts, along with the existence of other tabetic signs and symptoms help to distinguish it.

### III. THE JOINT AFFECTIONS IN SYRINGOMYELIA

#### (*Arthropathia syringomyelica*).

The joint affections in syringomyelia resemble very closely those that occur in tabes. The cases have been collected and analyzed by Sokoloff<sup>19</sup> and later by Graf.<sup>20</sup>

19. Sokoloff: "Die Erkrankungen der Gelenke bei Gliomatose des Rückenmarks (Syringomyelie)," *Deutsche Ztschr. f. Chir.*, vol. xxiv, Festschr., C. Thiersch, Leipzig, 1892, p. 505-548.

20. Graf: "Ueber die Gelenkerkrankungen bei Syringomyelie," *Beitr. z. klin. Chir.*, Tübingen, 1893, No. 10, p. 517-550, 1 pl.

Sokoloff had compiled 20 cases of the joint affections, including 6 in Morvan's disease. Graf added 13 more to the list. The arthropathies of syringomyelia are also well described in Schlesinger's<sup>21</sup> monograph. It has been estimated that about 10 per cent. of syringomyelic cases suffer from joint involvement; men are about twice as often affected by syringomyelia as are women, and of 34 cases of syringomyelic arthropathy 26 were in males and 8 in females. The average time of onset of the joint affection is the fortieth year, but it may occur in childhood. Usually the arthropathies precede the muscular atrophies and the muscular disturbances, but this is not a constant relation; occasionally the reverse is seen. The joints on one side of the body are as prone to involvement as those on the other. The joints of the upper extremities, and especially the shoulders and elbows, are most often affected (80 per cent. of the cases). Even the wrist appears to be twice as often attacked as either the hip or ankle. As we have seen, this is in marked contrast with the arthropathia tabetica, which is most often located in the joints of the lower extremities (80 per cent. of the cases). The reason for this may lie in the fact that the gliosis spinalis most frequently affects the intumescencia cervicalis, the tabetic degeneration most often attacking first the intramedullary axones of the peripheral sensory neurones which innervate the lower extremities. Trauma frequently precedes the arthropathy. The swelling is usually sudden, as in the tabetic joint lesion. Unlike the latter, the joints are not wholly painless as a rule. After a few days the swelling subsides, but some crepitation remains in the joint. In the course of time this subsidence of swelling is followed in turn by a gradual increase of swelling, now entirely painless. It may be years before this leads to marked enlargement and deformity of the joint. The patients finally apply for treatment, less on account of the disease of the joints as such than for the progressive atrophy of the limb and the corresponding loss of power.

On examination of an advanced case of syringomyelic arthropathy, the hypertrophic enlargement of the extremities of the bones entering into the formation of the joint is usually a striking feature; the capsule is thickened and often ossified in places; distinct crepitation can be elicited on movement of the joint owing to erosion of the cartilages or to changes in the synovial membranes. In other cases atrophy of bone is seen instead of hypertrophy; the whole end of a bone may have been absorbed, the passive hypermobility of the joint is extreme, the capsula articularis is thinned and expanded, and spontaneous dislocation frequently occurs. Exostoses develop in and near the joint; spontaneous fracture is not rare. The diagnosis is made certain by finding the muscular atrophy, the syringomyelic dissociation of sensation (analgesia and thermanesthesia with retention of tactile and muscle sense), or, in Morvan's type, the panaritium and mutilation of the digits. Occasionally a syringomyelic arthropathy suppurates, but this, as in the suppurative tabetic arthropathy, is an accident, due to secondary infection with pyogenic micro-organisms.

The frequent occurrence of habitual dislocation of the shoulder in syringomyelia has been emphasized by Schrader (13 cases in the literature). Scoliosis and kyphoscoliosis are also commonly met. The recent literature contains references to several rare cases in which

the joints of the lower extremities have been involved. In Merton's patient, studied in Trendelenburg's clinic, the joints in both feet were affected; the exact changes in this and in a number of other cases have been studied in x-ray photographs.

The course of the syringomyelic arthropathy is usually longer than that of the tabetic. There are on record cases which developed very gradually, one over a period of twenty, another of thirty-five years (Sokoloff). In the gliomatous arthropathies it is rare, too, to see such large exudations as are met in tabes.

The treatment of the disease is limited to rest, orthopedic measures and the avoidance of trauma. Operative interference is rarely desirable.

Two main theories have been advanced to explain the origin of the tabetic and syringomyelic arthropathies. According to the older theory, they are directly dependent either on the disease in the spinal cord or on a disease of the peripheral nerves accompanying these maladies. Charcot and Joffroy assumed the existence of a trophic center for the joints in the anterior horns, but many facts speak against this view. The neuritic explanation seems plausible for tabes, but there is no evidence in favor of it in syringomyelia.

According to the second theory, that held by Virchow, v. Volkmann and Rotter, the relation of the arthropathies in tabes and syringomyelia is totally other than that assumed in the first theory. These authors maintain that these arthropathies are really cases of arthritis deformans; they have their rapid course and are painless, or relatively painless, on account of the analgesia, the ataxia, and the unnoticed traumatism which occurs. But (1) there is rarely any ataxia in syringomyelia or in the cases of arthropathia which occur in incipient tabes; (2) analgesia, though frequent, is not constant; (3) the joint disintegration often advances in spite of absolute rest; (4) the periarticular processes are too extensive to be thus explained (Graf), and (5) the frequent simultaneous involvement of several joints speaks against the conception that the connection between the diseases of the cord and the diseases of the joints is simply indirect (Sonnenburg). A brief but interesting review of the theories will be found in Joachimsthal's article<sup>22</sup> and in the article of Henderson<sup>23</sup> on tabetic arthropathy.

#### IV. THE PAINFUL JOINTS OF THE PSYCHONEUROTICS

##### (*Arthralgia Psychoneurotica*).

Under this heading I include the arthralgias of hysteria (Brodie's joints), of traumatic neurosis, of neurasthenia and psychasthenia. Good accounts of the hysterical joint are to be found in Brodie,<sup>23</sup> Briquet,<sup>24</sup> Charcot,<sup>25</sup> and Binswanger.<sup>26</sup> In the surgical textbooks of Tillmann and Da Costa the condition is adequately recognized.

The knee is most often affected (gonalgia), the hip next (coxalgia), the shoulder frequently, the talocrural and the intertarsal joints occasionally. The cervical spine may be the seat of symptoms and the condition be

22. Joachimsthal: "Knochen- und Gelenkveränderungen bei Nervenaffektionen," Handbuch der pathol. anat. des Nervensystems, Hrsg. von Flatau, Jacobsohn u. Minor, Berlin, 1904, p. 1397-1417.

23. Brodie: "Pathologic and Surgical Observations on Diseases of the Joints," from the 4th London edition, with the author's alterations and additions, Philadelphia, 1843.

24. Briquet: "Traite clinique et therapeutique de l'hysterie," Paris, 1859.

25. Charcot: "Lectures on Hysterical Contraction of Traumatic Origin," Med. Press and Cir., London, 1883, vol. xxxv, p. 417; 439.

26. Binswanger (O): "Die Hysterie," Wien, 1904, p. 283-293.

21. Schlesinger: "Die Syringomyelie," Ein Monograph, 2 Aufl., Wien, 1902.

mistaken for cervical caries. One joint is usually affected at a time, though in rare instances two or more are concerned. Redness, heat and swelling are rarely present; pain and disturbance of function are the two prominent symptoms. Spasm (contracture) of the muscles proximal and distal to the joint frequently exists. The muscular atrophy is generally slight in amount, but in long-standing cases may be profound. The position assumed by the limb may or may not simulate that found in organic disease.

Many of the cases follow trauma of some sort (Charcot). The trauma may be followed immediately by the joint neurosis; more often there is an incubation period of "psychic meditation." In some cases no preceding physical trauma can be made out, the malady then developing after an emotional shock, after a convulsive seizure, or by imitation after seeing an organic joint affection. The arthralgia is sometimes the first symptom of the psychoneurosis; as a rule, however, the stigmata of hysteria, of psychasthenia or of neurasthenia have been recognizable, in cases carefully studied, for some time preceding the joint trouble.

The great importance of the differential diagnosis of these arthralgias from organic disease, especially from tubercular gonitis and coxitis, is obvious. The nocturnal exacerbations of the pain, which frequently occur in sleep and awaken the patient in tubercular coxitis, are absent in psychoneurotic coxalgia. On making passive or active movement of the joints in cases of joint neurosis, the patients complain of "horrible, unbearable pain." Sympathy only increases the pain, while if the attention can be diverted temporarily the movements can often be carried out without severe pain. It is often found, further, that the pain is more intense in the skin and soft parts than in the joints themselves. Careful esthesiometric tests nearly always show a distinct hyperalgesia of the skin over the joints between the attacks of pain. In hysterical coxalgia, for example, there exists frequently an area of cutaneous hyperalgesia, triangular in shape, the apex of the triangle being at the lower margin of the symphysis pubis, the base at the middle of the sacrum. When the knee, elbow or wrist are complained of, the hyperalgesia of the skin is usually cuff-like in form, the area surrounding the whole joint. During the severer neuralgiform seizures the hyperalgesia may change to a total hyperalgesia of one-half of the body. Analgesias are sometimes demonstrable in hysterical cases.

In psychoneurotic coxalgia the attitude of the lower extremity may resemble most closely that met in organic disease of the hip joint; there may be apparent shortening, abduction, lateral rotation, or, later on, adduction and medial rotation. The limping gait, accompanied by lumbodorsal pseudoscoliosis, may strikingly simulate that of organic hip disease. Some of these patients refuse after a time to make any attempts to move their joints, and lie in bed for months or even for years.

A few cases of psychoneurotic arthralgia are associated with a higher grade of muscular atrophy than is commonly seen from simple inactivity, and these may be puzzling. According to Gilles de la Tourette, the atrophy differs from that of organic disease, being more general in the extremity with the psychoneurotic joint, while with the joint of organic disease it is localized chiefly in the muscles which extend the limb.

With x-ray examinations and tuberculin reactions organic arthropathies are now less likely than formerly to be mistaken for joint neuroses, but there is still dan-

ger that the psychoneurotic joint will be looked on as an organic disorder. Very skilled surgeons and physicians have been deceived before now; even to-day it is the neurologist who often saves the psychoneurotic joint from the knife and saw or plaster-of-Paris fixation. In doubtful cases the deep chloroform narcosis recommended by Charcot should be resorted to for diagnostic purposes. Not only do the contractures disappear when the patient is anesthetized, but a careful physical examination of the joint can be made and the physician can assure himself of objective negativity. In addition the phenomena observable during recovery from anesthesia are helpful in differential diagnosis. It is the sensitiveness of the skin which returns first in the psychoneurotic joint, the tenderness and pain in the deeper parts, elicited by tapping the trochanter or the heel, coming back later. It is only after the patient has rather fully recovered from the anesthesia, say in the course of from twenty to thirty minutes, that the deep pain and contractures return. It is just the opposite with the joints of organic disease.

The treatment of the psychoneurotic arthralgias should be mainly directed toward the general psychoneurosis which underlies the symptom. Nothing is more harmful than a predominantly local therapy. Isolation and psychotherapy are the sovereign remedies in these cases. After a thorough examination has been made and the absence of organic disease has been determined, the patient should be told that the joint trouble is nervous in origin, and that, in the physician's opinion, there is no reason why it should not speedily get well. After a few days of complete separation from the family and friends, and when "medical obedience" has been fairly well established (frequently easily obtainable by encouragement and by keeping the patient for a short time in bed on a diet consisting exclusively of milk), the patient's intellect and will are to be appealed to by "persuasion."<sup>27</sup> Passive movements of the joints are to be begun and gradually increased; hydrotherapy and electrotherapy may be used as adjuvants. After a few days the patient may be induced voluntarily to move the joints a little, and very soon normal motility may be regained. The patient, through occupation therapy and will-gymnastics, should be taught gradually to improve in self-control.

It is surprising to see the "wonderful" transformations of which psychoneurotics are capable when simple measures of the kind mentioned are employed. The length of time the symptom has persisted need not make one skeptical of recovery. The miracles of St. Anne de Beauprès and of Lourdes, of osteopathy and of Christian Science amaze the laity. Just as marvelous cures, but more lasting ones, attend the efforts of the physician who knows how to recognize quickly and to treat rationally the psychoneurotic manifestations.

27. Barker: "Some Experiences with the Simpler Methods of Psychotherapy and Re-education," *Trans. Assoc. Amer. Phys.*, 1906.

**Sterilization of Sewage Filter Effluent.**—At the meeting of the Society of American Bacteriologists, held in New York, Dec. 27-28, 1906, E. B. Phelps, of the sanitary research laboratory of the Massachusetts Institute of Technology, reported the failure of the sprinkling or contract method to remove the pathogenic forms of bacteria. He stated that he has found that the addition of bleaching powder in the proportion of 5 parts chlorin to 1,000,000 gallons of sewage is a thoroughly reliable method. Mr. Phelps has found copper sulphate to be fairly effective in the proportion of 2 parts of the sulphate to 1,000,000 gallons of sewage.