Original Articles.

PRINCIPLES UNDERLYING THE STUDY AND TREATMENT OF CHRONIC ARTHRITIS.

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THE term "chronic arthritis" brings to mind confused classifications, obscure etiologies and unsatisfactory treatments which justly make it unpopular with practitioners, but joint affections are not rare and patients demand treatment notwithstanding the unattractiveness of their troubles. Definite and, as far as possible, scientific conceptions of chronic arthritis are, therefore, particularly needed concerning the rationale of causes and cures.

With these needs in view the writer has devoted himself almost exclusively for several years to the study of arthritic patients and examination of the writings of past generations of physicians who have struggled with the problem. As a result he believes that he has gained a little better understanding of the subject and one which may perhaps be of interest to those who, while they are confronted with its difficulties and obscurities, have had less time or opportunity for its careful consideration. The present paper deals mainly with the fundamental principles involved, and extended discussions of special methods, examples of actual cases and results of treatment are reserved for future communications.

In his work the author has had the great advantage of the frequent advice and counsel of many physicians and other friends, to all of whom he desires to express his obligations and thanks, and in the preparation of this paper especially to Dr. Theobald Smith, Dr. Wm. H. Howell and Prof. W. T. Sedgwick.

Patients may be grouped for convenience into the following clinical classes. (1) Incipient Cases; (2) Moderately Severe Cases without Joint Destruction; (3) Acute Exacerbations of Chronic Disease; (4) Very Severe Cases with Joint Destruction and Disability.

Well-known and fundamental principles naturally governing the treatment of all of these classes are so easily forgotten or neglected that a brief summary of them at the outset may be useful, for proper treatment can only be secured by thorough comprehension of those normal anatomical and physiological features which control the health and ordinary activity of joints and by clear appreciation of the various diseases that may be accompanied or followed by arthritic phenomena. The Etiology of Chronic Arthritis has already been discussed by the author in a previous paper, to which the reader is referred.¹

NORMAL PHYSIOLOGICAL CONDITIONS WHICH CONTROL THE HEALTH AND ORDINARY ACTIVITY OF JOINTS.

All healthy joints are constantly being subjected to normal physical, chemical and nervous stimuli through mechanical movements, strains

due to body weight, external physical agencies, physical and chemical conditions of the blood, and also to nervous impulses transmitted to and from joints and articular blood vessels through trophic and sensory nerves; and all pathological conditions must arise from departures from these normal relations. Moreover, joints cannot be influenced by any other means than by those just enumerated. The health of all organs and tissues depends upon normal physiological processes going on within tissue cells by which living material is built up from food substances of the blood, energy set free, and waste products eliminated. It varies in degree according to variable combinations of these physical, chemical and nervous stimuli, and it depends also upon the inherent properties of the protoplasms themselves, as protoplasms vary greatly in different tissues and with different individuals.

Individuals may be considered to be "robust" or "delicate" according as the sum total of their various tissue resistances is respectively great or small. Moreover, the interaction of different tissues, each upon the other, which doubtless influences this sum total of cellular tissue resistance and eventually determines to a large extent the general health of the individual, sometimes affords an opportunity for the study of individual organs by observing the effect of the conditions of other organs upon the one selected for study. With joints it is possible to estimate to some extent the various degrees of arthritic resistance and normal activity by observing the pathological conditions in organs that are contributing deleterious substances to the blood stream and thus are affecting articular structures, either directly through chemical and physical stimulation of joint tissues, or indirectly through chemical and physical stimulation of nerve cells in the cord which, in turn, react by transmitting unusual and perhaps undesirable stimuli to joints and articular blood vessels.

We are met at the outset by a significant fact, namely, that with diseases of other organs arthritic phenomena are comparatively infrequent, a fact which must be interpreted to mean that joint resistance is generally sufficient to withstand those abnormal blood states to which joints are frequently exposed. The small percentage of cases of this kind which do display arthritic phenomena must apparently either represent joint tissues of poor resistance or exceptionally abnormal conditions of blood and lymph, or else abnormal conditions in controlling nerve cells. It is a familiar fact that severe infections often occur without any arthritic phenomena, while at other times even mild infections of the same kind may have associated with them severe joint complications. It seems reasonable, therefore, to conclude that, while the joints, as a rule, are peculiarly healthy and resistant, they may occasionally be weakened or non-resistant even to an extreme degree.

As will appear later, this idea of variable resistances in the cell protoplasms of various tissues or organs, including, of course, the joints, coupled

¹ *Etiology of Chronic Arthritis*, Johns Hopkins Hosp. Bull., July, 1910.

with the idea of variability in stimuli from without, is of fundamental importance in scientific diagnosis as well as in prognosis and rational treatment. Again, it must not be forgotten that the former, cell resistances, are particularly obscure and are dependent upon the stimuli from without and upon congenital peculiarities of the protoplasm.

DISEASES ACCOMPANYING OR ASSOCIATED WITH JOINT LESIONS.

Diseases which occasionally may influence the health and behavior of joints comprise a long list that includes nervous, infectious and constitutional affections, the more important of which will now be mentioned, because they must not be forgotten or overlooked when seeking for the causes involved in any given case.

Acute articular rheumatism, gout, rheumatoid arthritis, osteo-arthritis, influenza, scarlet fever, typhoid fever, bacillary dysentery, amebic dysentery, malaria, pneumonia, septicemia, tuberculosis, gonorrhea, syphilis, tonsillitis, oral and nasal sepsis, otorrhea, pulmonary abscess, gastro-intestinal disturbances, diseases of thyroid gland, spleen, lymph nodes, infections of the gall bladder, kidneys, male and female genito-urinary tracts, hemophilia, scurvy, anemias, lead poisoning, syringomyelia, tabes dorsalis, paralysis agitans, congenital heart disease, puberty, pregnancy, menopause, erysipelas, furunculosis, psoriasis, osteomyelitis and chronic suppurative conditions.

(See Arthritis Deformans, R. Lewellyn Jones; and Bulletin of the Committee for the Study of Special Diseases, T. S. P. Strangeways, for statistics of relative frequency of associated diseases.)

Sometimes only one focus of infection contributes its products to the blood stream, but sometimes several foci may exist. At times one cause may initiate the arthritis and other causes perpetuate it. Sequence in time of development of several questionable factors, therefore, should be considered, as the oldest lesions may be primary causes and others be merely accompaniments that are cured with removal of the primary trouble; but these secondary accompaniments contribute their pathological products to the blood also and may thus exert an influence upon the joints. Gastro-intestinal toxemias resulting from the inactive life of patients often seem to be grafted on to the original process, and perhaps sometimes perpetuate it.

As might be expected, common diseases appear more likely to be common causes of joint disease than rare disturbances of internal organs which some investigators would invoke to explain obscurities associated with arthritis. According to the writer's experience, while the latter may indeed be very rarely contributing factors, the commonest causes are apparently bacterial infections, digestive disturbances, abnormalities in metabolism associated with puberty, pregnancy and the menopause, and unstable conditions in nerve cells controlling the joints.

METHODS OF TREATMENT OF CHRONIC ARTHRITIS.

Methods of treatment consist in application of appropriate remedies, and in attempts to restore physiological relations in joints; to repair defects due to strains, traumata and excessive mechanical irritation; to overcome abnormalities of the blood and do away with harmful exposure to climatic influences; to rectify, as far as possible, derangements of the nervous control and to thus increase health and resistance of the joint tissues.

Some remedial measures act locally, others are employed in treatment of diseases of organs when these stand in causal relationship with joint disease; and there are also general hygienic measures to be applied.

Local treatments are applied to lessen excessive mechanical irritation, increase or diminish blood supply, alleviate pain, prevent and correct deformities, restore mobility and remove pathological tissue, hypertrophied villi, joint mice, loose cartilages, etc. These objects are attained by orthopedic apparatus, plaster casts, splints, bandages and strappings; by hot and cold applications, bakings, Bier's passive hyperemia, massage exercises, electricity and operations of various kinds.

Diseases of other organs standing in causal relationship to joint diseases can exert their influence directly upon joints only through the blood, and indirectly through the action of blood upon nerve cells with production of unusual nervous stimuli, as already explained. Blood presumably owes any irritating qualities to the presence of particular toxins, to undue accumulations or deficiencies of normal products of metabolism of tissue cells, and probably also to its mere physical properties. Nervous stimuli depend upon the state of the blood and upon inherent peculiarities of nervous tissues, just as joint conditions depend upon these states of the blood and inherent peculiarities of joint tissues; and when nerve cells are robust and healthy the nervous element in joint disease is at a minimum; when they are weak or diseased, the nervous factor becomes of greatest importance. Irritants circulating in the blood stream are most obscure in their nature and are called toxins, metabolic products and internal secretions, but comparatively little is known of the chemical constitution or molecular grouping by which they exert their influence upon joint structures. Bacterial toxins, which are among the best recognized of these complex organic bodies, can be identified only by their therapeutic effect upon animals, although it is possible to cultivate them outside the body *in vitro*. The precise chemical nature of metabolic products of organ activities are quite as poorly understood. In gout it is known that sodium mono-urate circulating in the blood is somehow concerned with the pathological process, but physiologists are still discussing whether gout represents defective diminished elimination by the kidneys, excessive production by the body tissues or faulty processes in liver associated with conversion of purin bodies of the food, or whether various factors are combined. Variability in vital resistance of joint tissues has

to be considered in gout as in other types of arthritis, but the exact chemical reaction upon joint tissues of the soluble urates in the blood is not well understood.²

In lead poisoning the metallic element gets into the circulation presumably as some organic combination of the proteid molecule and exerts its selective action especially upon nervous tissues whereby arthritic pains are occasionally an accompaniment of this disease, but here again the exact chemical substance which reacts upon nervous tissues is unknown.

Products of bacterial activity in the intestinal tract are absorbed into the blood and in cases of acute ptomaine poisoning make their influence very evident; also there is absorption of products from bacteria habitually present in the intestinal tract which may accumulate in the blood from over-production, or possibly through diminished elimination by the kidneys, and these are capable, apparently, of producing joint changes much as excess of uric acid derivatives in the blood may produce arthritis when patients have susceptible joints; but the exact chemical nature of these bacterial products has not been determined.

Relations between joint diseases and lesions of uterus, thyroid gland, spleen, lymph nodes, lungs, heart, kidneys and formed elements of the blood itself undoubtedly exist, yet it is not well understood whether such joint lesions are induced by bacterial infections, disturbances in metabolism of tissue cells, reflex nervous derangements or combinations of these; for blood conditions always are obscure, and although it may contain irritants, yet routine blood examinations offer little aid in explaining the existing states.

Control of the properties of blood which are so vital to health of joints, therefore, must be made by search for, and treatment of, different organic diseases and infections; and while it is not possible to enter into details of treatment for all derangements of organs, fevers and foci of infection, yet it is necessary to understand and remember their existence in order to accurately interpret and treat any given case.

General hygienic methods of treatment increase metabolic functions of tissues generally and help to restore depleted conditions such as are frequently observed at the onset of arthritis. Through the action of these general measures the blood becomes altered and contains different proportions of food substances and metabolic products from all tissues, while foci of infection, if they exist, are more successfully resisted, as the protective functions of the tissues against foreign substances are stimulated and blood flowing through joints exerts healthier action. Nervous stimuli presumably also are changed by this altered blood condition and joints are able to perform their physiological functions more perfectly and consequently slowly begin to improve.

General hygienic methods consist in the regulation of personal habits, administration of medicinal tonics and physical therapeutic measures.

Personal habits should be carefully investigated, occupations inquired into and changed when necessary; diet, sleep, rest and exercise regulated; and mental disturbances and drug habits ascertained.

Medicinal tonics comprise such drugs as strychnine, quinine, iron, arsenic, iodides, phosphates and others which exert their influence more or less upon the protoplasm of all tissues and help to repair defects that each is subject to.

Physical therapeutic measures consist in application of heat, light, mechanical and electrical stimuli in various forms of baths and massage for the sake of their tonic effects. For the various forms of special treatment reference must be made to the voluminous literature upon the subject, as they include sun and air baths; artificial radiant heat baths; hot, neutral and cold water baths, and these are often combined with mechanical friction or electricity and chemical substances in most confusing combinations. The importance of general hygienic measures in treatment of arthritis is here especially referred to as these measures will be frequently mentioned in what follows.

The writer uses for routine treatments at hospital clinics the pharmacopeial preparations, tincture of nux vomica, and elixir of iron, quinine and strychnine phosphates for general tonics, and calomel, magnesium sulphate, sodium phosphate, fluid extract of cascara sagrada, and rectal lavage with warm water at frequent regular intervals to clear the intestinal tract and regulate digestive functions. Usually treatment begins by purging with calomel and magnesium sulphate, and this is followed for several weeks with daily rectal irrigations. Finally the irrigations are given less frequently, and fluid extract of cascara sagrada and sodium phosphate are prescribed to assist evacuation upon days on which irrigations are not used.

Diets have to be regulated in order to prevent reaccumulation of foods in the digestive tract and to avoid continuance in formation and absorption of bacterial irritants from the intestine that injure joint tissues. Diets also must be so regulated as to supply sufficiently large amounts of food materials to maintain the health of other body tissues and to keep up the individual's general resistance and vigor. Accurate rational directions for diet regulation in arthritic disease the writer is unable to give at present, but reliance can be placed upon simple modifications in quality and amount of food until the right diet is experimentally discovered. This important subject of diets in arthritic diseases the writer now has under consideration, and which it is hoped may furnish the basis of a future paper.

Strong hydrotherapeutic measures should not be prescribed for arthritis because this class of patients do not respond well to the more vigorous methods, and the writer is informed by Dr. J. H. Kellogg that he uses only mild ones at Battle Creek Sanitarium, where he has found from his extensive experience that arthritic

² A. Magnus-Levy: Uric Acid in Gout. Am. Jour. Med. Sci., vol. cxi, November, 1910, pp. 625-643.

patients will not bear strong, continuous stimulations. Sun baths and changes in climatic environment seem especially adapted to arthritic and rheumatic states. Mild irritants that have acted for long periods of time in producing joint lesions should, therefore, be combatted by mild remedies for long periods in order to restore normal functions, and more stimulating measures should be reserved for occasional use to upset recurring lapses into chronic pathological states.

When occupations and circumstances have produced very unhygienic modes of living, simple regulations of personal habits sometimes are sufficient to start patients towards recovery. Inquiry into personal habits is too often overlooked, and not infrequently failures of treatment may be traced to neglect in ascertaining and rectifying simple yet most important errors in habits. Sanatoria and health resorts scattered throughout the country furnish interesting and convincing evidence of the frequent efficacy of simple hygienic measures in cure of diseases. These establishments prosper because they cure patients by correcting defective habits while patients are kept entertained and occupied with a routine which constitutes each particular "cure." These methods are often scornfully regarded on account of their simplicity, yet it is just as well to admit their importance as very many persons are benefited, and the fact that some patients are made worse and that recurrences occur after these simple measures are stopped should not lead us to overlook the fact that many improvements undoubtedly do take place. Instead of underestimating the efficiency of simple methods, it is safer to consider that regulations insisted upon at sanatoria if permanently adopted would very often result in permanent improvements.

INCIPIENT CASES OF ARTHRITIS

Patients frequently seek medical advice for slight pains and stiffness in various joints, and for swellings which make their appearance upon the fingers, in order to learn whether severe arthritis is likely to develop, and what should be done to arrest its progress. It is often impossible to say whether or not there will be serious trouble later, but the best estimate generally depends upon application of such ideas and physiological principles as have been explained, and although diagnosis and prognosis is often impossible at the outset, yet our methods of treatment are sufficiently definite and may result in cure in spite of our ignorance of precise underlying causes.

It is the writer's custom with incipient cases to obtain accurate ideas of patients' past diseases, their inherited and acquired tendencies, occupations and habits of life; and from a complete but rather superficial physical examination to locate gross abnormalities in organs and active infective foci; also to observe at the time the state of the general health as well as mental and nervous conditions. When active pathological processes are discovered, these are immediately

treated, but when only indefinite, mildly suspicious conditions are found, as is often the case with this class, then reliance is placed upon general hygienic methods to correct all irregularities, and if cures do not result, further treatment is then instituted as explained under the next section upon moderately severe types of arthritis.

General hygienic measures have been described, and those applicable to incipient cases consist in administering tonic medicines, as *nux vomica*, combinations of iron, quinine and strychnia; or iron, arsenic and strychnia; and in correction of personal habits. The latter are not too greatly restricted in these mild cases, but diets are simply modified when they are obviously defective and the digestive tract is emptied and kept cleared by means already described. It should be remembered that digestive disturbances are numbered among the commonest of maladies and are starting points for deviations from the normal processes concerned with elaboration of food materials for the tissues and that, therefore, treatment of digestive abnormalities is a very important means of changing the quality of the blood and of influencing all organs. Gross errors in habits of sleeping and taking exercise are also rectified. Local treatments are of less importance and when needed consist in mild stimulation with radiant heat, high-frequency electrical applications and warm dry protective coverings for the affected joints. Salicylates are also indicated in small doses at times when pain interferes with sleep.

Patients who do not improve are then treated as outlined under moderately severe types of arthritis, but the dividing line between these two types is an arbitrary one and transitional stages occur. This classification is simply convenient for descriptive purposes.

Summary.—Diagnosis in incipient arthritis depends mainly upon personal histories of patients and superficial general examinations; prognosis is very often impossible to determine at the outset; treatment is directed towards undoubted pathological conditions when these exist, and otherwise consists in general hygienic measures.

MODERATELY SEVERE TYPES.

These are most typically represented by chronic, well-developed polyarticular joint diseases in which joint destruction is slight and changes have not gone on that require manipulations or local operations. Monarticular types of moderate severity, however, have also to be considered in this class.

Preferably these patients should be kept in a hospital under observation for a few weeks until all suspicious circumstances revealed by histories and the unusual states found in examinations have been carefully considered, and until interpretation of these data is accomplished and an idea is gained of the relative importance of mechanical and nervous factors, of external influences and influences acting through the blood, after which subsequent treatments may be outlined as seems best.

Questions often arise with regard to what shall be done with patients who have only suspicious conditions in various organs but no well-defined, active lesions. Shall all these suspicious foci be radically treated like well-defined ones on the assumption that they really are the causes, although obscure, and that the arthritic process is likely to continue until they are removed? Concerning this question observation shows that there are occasional patients with obstinate arthritis who have been subjected in turn to many radical operative treatments without relief. Treatment to them has meant unnecessary discomfort and a series of expensive experiences in addition to their arthritic disease; moreover, such examples seem difficult to avoid when patients are plucky and willing to try all remedies, and their arthritis is obstinate, because there is such diversity of opinion among the medical profession regarding causes and treatments. Better understanding of joint diseases is needed, therefore, to avoid injury from attempted treatment of incurable cases as well as to restore health in those who do respond to treatment.

It is well in our present stage of enlightenment to recognize that some patients cannot be cured, although theoretically they should be, because it is a fact that some are not relieved and failures seem due in part to lack of recognition of underlying causes when the disease is in its early stages and can be most advantageously attacked.

Methods of treatment in moderately severe cases of chronic arthritis.—Patients are put to bed and kept out of doors as much as possible; diets are reduced to meet the requirements of the inactive life, and modified as tests indicate. Stomach and intestines are cleared of food accumulations to prevent possible bacterial toxemias; and general medicinal tonics and drugs for relief of pain are used sparingly, the latter only to insure sleep and comfort. Passive movements must be given daily or patients allowed to arise from bed a few hours each day if joints show tendencies toward stiffening, and gentle massage may be used to supplement passive movements. Pathological processes in other organs, if unquestionably active, are treated immediately.

Within a few weeks a considerable proportion of cases will show distinct improvement; others will show very little change; and the remainder will grow worse. Those showing improvement should continue to receive the same treatment, and if suspicious foci have been located in other organs, these should be observed until doubts are dispelled or confirmed. Sometimes these foci disappear under hygienic treatment and at other times they become more definite and localized, requiring attention before complete cure is effected. Cases which show no improvement in the first few weeks should, nevertheless, have their treatment continued unchanged, as general hygienic measures act slowly, while the advantage of removing merely questionable foci cannot be told until the focus is removed, and experience demonstrates that such operations

frequently have little effect upon the joints. When the disease does not begin to improve within a few months, or grows steadily worse, decisions have to be made which depend upon the particular circumstances presented by each individual case. The safety, comforts and dangers of neglect of conservative methods; the risks, discomforts, benefits and disappointing results of operative procedures; the rate at which arthritic disease is progressing; the confidence and mental attitude of the patient; the degree of definiteness of suspicious lesions, have all to be considered.

At this stage before radical treatments are instituted upon uncertain grounds attention is urgently directed once more to the nervous control of joints, as it is the writer's belief that many cases are primarily of neuropathic origin, and at the risk of repetition reasons for this opinion will be given.

It should be remembered that the nervous system controls every important organ and co-ordinates all activities as is shown by the general health of the individual; and the influence of nervous control of joints may readily be observed in the very destructive joint changes following spinal cord lesions, as in syringomyelia and tabes dorsalis.

In the more severe cases of rheumatoid arthritis (atrophic arthritis) there have also occasionally been found appreciable pathological changes in spinal cord and meninges when they have happened to be examined.

The physiological relationships between nervous tissues, joint tissues and body tissues may be recalled to make clearer the ideas which follow:

Nerve cells continually influence body tissues (including joints), directly through trophic and vasomotor nerves, and also, by modifying metabolic activities of different tissues in varying degrees, indirectly influence all tissues through interactions among the latter. Conditions of the blood stream are changed and proportions of metabolic products from each tissue vary as the result of nervous stimulation and activity.

Nerve cells are continually affected by sensory nervous impulses, by the metabolic products of organ activities and food products, and occasionally by the metabolic products of bacterial activity in the blood when infective foci are present.

Joint tissues and all body tissues, as explained, may be influenced through trophic nerves, metabolic products of organ activities, food products and occasionally bacterial products in the blood.

Nerve cells, joint tissue cells and all body tissue cells exhibit variable degrees of vitality, all may be robust or delicate, and many theoretical combinations are possible. For example, lung tissues may be delicate and other tissues vigorous in one individual; kidneys alone be defective in another; liver and gastro-intestinal tract exhibit abnormalities in a third; and delicate joint and nerve tissues be the most pronounced defects of a fourth. The latter theoretical

cal possibility is the one to which attention will be directed, and evidences for its existence sought in pathological changes which can be anatomically demonstrated as well as suggested by functional abnormalities that may be clinically observed.

Evidence to be readily accepted must rest upon a visible or recognized basis; biological principles and physiological laws are more likely to be stigmatized as too theoretical; but so many conditions depend upon invisible physical and chemical processes going on within tissue cells that it is unwise to ignore these biological and physiological principles as they constitute the only adequate means of interpreting invisible metabolic disturbances of cell activities. Neuroses belong especially to this class of disturbance having no visible anatomical basis, and lesions in rheumatoid arthritis seem to be just at the transition line between visible and invisible processes, as some of the severest cases exhibit visible changes in spinal cord substance, peripheral nerves and diffuse patches of spinal meningitis while mild cases do not show any visible lesions.

(Reference should be made to the chapter on morbid anatomy of rheumatoid arthritis in R. Lewellyn Jones' book, "Arthritis Deformans," for an admirable presentation of anatomical changes observed in that disease.)

Gross pathological evidence will be disregarded in this article and attention directed to those functional disturbances in various organs which may possibly signify abnormal metabolic processes taking place in their controlling nerve cells. In rheumatoid arthritis (atrophic arthritis) muscular atrophy often occurs so rapidly and to such extreme degree that it cannot be satisfactorily explained by atrophy from disuse; moreover, special muscle groups are usually affected; cutaneous pathological changes include pigmentation, sweating and, in later stages, dryness and harshness, with desquamation and thinning of the skin; local circulatory disturbances are seen in the waxy white fingers and cyanotic appearance of the extremities. Sensory disturbances are observed in premonitory sensations of tingling and numbness, stinging and burning feelings, soreness, streams of pins and needles and muscular cramps. Tendon reflexes are increased. Visceral disturbances are represented rarely by gastric crises, and frequently by light or severe abnormalities in digestive functions.

The following case typically illustrates many of these points.

Single woman, thirty-seven years of age. Arthritis developed at three years of age; five severe acute attacks up to eighteen years of age with complete restoration in function after the first ones. Continuation of attacks of greater severity involving all joints with permanent impairment in joint function until patient became confined to wheel chair or bed. This disabled condition she has now been in for several years. She was a delicate child and had scarlatina, measles, pleurisy, influenza, carbuncles and tonsillitis,

also a nervous collapse which lasted two years; and further injured her health from study when at college. She is a small, slightly built woman with lively tendon reflexes and wonderfully good mental development, and her readiness to try new remedies has resulted in operations upon tonsils, nose, mastoid, joints and gall bladder, besides various physical therapeutic treatments. No very definite infective foci have been discovered by any of the competent physicians who have treated her, and she has progressively grown worse. Remedies which have temporarily arrested the disease have been a quiet life out of doors with attention to simple hygienic measures, and these restored her health from a bedridden state to one in which she could walk again, although with difficulty. Continued over-exertions brought on another acute attack from which recovery was very slow until she was again sent to a quiet country place and kept out of doors with only sufficient entertainment to insure contentment; and again the joint pains lessened, muscular spasm relaxed and joint motion appreciably improved.

With each attack there has been excruciating pain, fever, extremely rapid muscle atrophy, cutaneous disturbances and periods of indigestion, and each recovery has been characterized by restoration of muscles, return of normal digestion and subsidence of muscle spasm, articular pains and cutaneous disturbances. When the patient had an acute mastoid infection of great severity, there was marked diminution in arthritic pains and increased mobility of the joints which persisted for a month or so afterward. The bacterial toxins of the mastoid infection did not increase joint symptoms, as might be imagined they would do if articular structures were susceptible to bacterial poisons. Their toxins, however, produced fever and accelerated tissue metabolism, so that the blood temporarily was changed and presumably acted in different manner upon all tissues, including joints and nerve cells controlling the affected joints.

Similarly there has been noticed in this patient very abrupt cessation of articular pains and increased mobility of joints following ether anesthesia. The effect was very striking and transformed excruciatingly painful joints immediately into much more comfortable ones as soon as recovery was made from the anesthetic. Relief from symptoms in this instance lasted nearly two weeks before pains and spasm slowly returned. Ether anesthesia is known to increase metabolism of the tissues, also exerts profound influence upon nerve cells, and while nothing can be proved by these observations, yet the unusual response of nervous tissues may indicate pathological processes in them.

Another point in favor of nervous instability in this patient is shown by gastric disturbances noticed when arthritic pains are worst; and these visceral manifestations have caused so much discomfort that cholecystotomy was performed, but only an inflammatory state was discovered. Bacteriological examination of stools and chemical examination of the urine have shown exceptional freedom from intestinal putrefactions. Relief afforded by salicylates, tonic hydrotherapeutic baths and electrical treatment harmonizes with the idea that the nervous element is a very important one in this instance, and absence of any definite focus of infection after prolonged search and failures of radical treatments strongly help to confirm it, as does also the long course of arthritic disease beginning in early childhood.

These data probably will not seem convincing as they are read for the first time, but deliberation and attempts at other explanations of these clinical facts strengthen the plausibility of the neuropathic theory,

which has very many adherents among those who are best informed.

The writer wishes to point out that many elements enter into the etiology of each case of arthritis and that nervous influences are constantly at work, sometimes in a normal, unobtrusive manner and sometimes in obvious pathological ways; and that when the degree of nervous derangement is great, arthritis may properly be considered of neuropathic origin.

Summary. — It is always impossible to understand exactly the complex relations that exist between body tissues, the endless series of influences that are exerted to and fro continually between every organ upon every other one, by means of nervous stimuli and shifting states of the blood. Such interactions, however, obviously do exist, and it seems reasonable to suppose that when nerve centers which control joint structures directly or when nerve centers which control other organs indirectly influence joints through the blood, if these nerve centers are seriously defective, then prognosis for joints is poor, irrespective of the question whether such nerve cells are congenitally weak or have acquired defects from injuries sustained in severe infectious fevers, because normal metabolic function of nerve cells can be restored with difficulty when they are once seriously injured.

Estimation of the nervous factor in the etiology of any given case of arthritis can be made only imperfectly by the personal history and suggestive physiological manifestations in various organs, and the practical effect upon treatment is simply to delay radical measures still further and to encourage continuance of general hygienic treatments which are often efficient means of restoring the health of nerve tissues as well as of all other tissues. But if improvement does not occur, operations will probably be resorted to sooner or later whether they are beneficial or not, on account of the doubts and differences of opinion which must necessarily arise.

Vaccine treatment should be given a trial while conducting hygienic treatments and before operative procedures are instituted, because injection of bacterial cultures after the living organisms have been artificially destroyed has frequently been tried upon infectious arthritis with some temporary improvement of arthritic conditions.

Such bacterial products undoubtedly cause a general reaction in the tissues and there are temporary improvements corresponding to temporary altered states of the blood whereby local infections are more successfully resisted for the time, but joint conditions which have come on and become chronic from long residence in the tissues of resistant bacteria are much less favorably influenced by inoculations of bacterial products than acute infections which have already been successfully resisted and localized by the individual. In the latter conditions injection of bacterial products is frequently followed by rapid clearing up of infective foci, and the inoculation reaction appreciably accelerates the mastery over the parasitic micro-organisms.

In the writer's limited experience there have not been very many permanent benefits observed that can be definitely attributed to vaccine treatment, but investigators who have had more experience are confident that considerable benefit

is derived not infrequently, and it is conceivable that bacteria in the tissues in chronic as well as acute states occasionally exhibit sufficiently low degree of resistance to enable the general tissue reaction from inoculations to just turn the balance in favor of the individual and to overcome the parasitic bacteria.

Operations upon other organs include removal of tonsils and teeth; operations upon nasal bones and sinuses; curettage and drainage of osteomyelitic foci in many localities, curettage of uterus; salpingectomies, hysterectomies, colostomies, cholecystotomies and operations for suppurative conditions in various organs. Special indications cannot be given, as each depends upon the special circumstances which exist in each individual case, and some of them, as, for example, hysterectomies, have not been done for arthritis alone, but because local disease of the uterus demanded its removal, yet in these cases severe arthritic disease which existed simultaneously has been permanently cured.

Local treatment in moderately severe types which show no serious joint destruction consists of protective or stimulating measures. Normal muscle balance tends to be destroyed by atrophies, also by spasms in various muscle groups, and joint contractures consequently tend to occur and may be treated by local stimulation of affected muscles, massage and electricity. Normal position may be retained with aid of orthopedic apparatus and plaster casts. Synovial membrane hypertrophies due to excessive mechanical irritation require measures to restrict and minimize motion, by bandages, adhesive strappings and plaster casts.

Local measures include bakings, hot and cold applications, dry and moist applications, chemical counter-irritants, massage, passive motions, Bier's passive hyperemia, various forms of electricity and radiant heat; and all are rather indiscriminately used to combat pain and swelling. Some cases are benefited temporarily and others are not influenced, but prediction cannot be made what the effect will be in many instances until trial is made. High-frequency electrical treatment relieves arthritic pain often in atrophic arthritis and gout. The physiological action of local measures usually is a double one through direct stimulation of joint tissue cells and by modifications of blood and lymph supply to the parts. When there is reason to suppose the blood is at fault, caution should be exercised not to wear out the tissues that are already struggling with unfavorable conditions by over-stimulating them with therapeutic agents. Protective methods used for various joints will not be described in detail, — the strappings and supports for feet; strappings, bandages, casts, iron braces for knees, hips and spinal column; plaster jackets, corsets, collars, shoulder braces, cuffs, gloves and other appliances used by orthopedic surgeons.

From what has already been said concerning normal physiological factors that control health of joints it will be evident that local measures are of secondary importance and palliative in cases

not produced by mechanical and external agencies, but nevertheless are useful. Mild treatments should be tried first and their results closely watched, as mild irritants have acted for long periods of time to produce the pathological conditions, and restoration can be brought about best through similar mild prolonged treatments.

ACUTE EXACERBATIONS OF CHRONIC ARTHRITIS.

These are treated by the same principles that are used in chronic processes, but require modifications on account of their severity. Acute exacerbations of chronic rheumatoid arthritis (atrophic arthritis), acute onsets of arthritis due to bacterial infections, acute gouty attacks and acute rheumatic fever are confused because they are often much alike in their arthritic manifestations and require similar local treatments. Underlying immediate causes of acute attacks are obscure, perhaps being due to sudden entrance into blood stream of irritating substances in unusual amounts or of unusual toxicity; or perhaps are caused by the sudden breaking down of cell resistances in joint or nerve tissues. These suppositions are supported by recognized facts. Showers of uric acid in the urine accompany acute exacerbations of gout; rapid development of bacterial infections are followed by abrupt onset of arthritic symptoms as soon as joint resistances are overcome. Joint and nerve tissues react variably according to the severity of stimuli which are acting upon them and according to the resistance of their cell protoplasm; and premonitory symptoms and abrupt onsets of arthritis so often observed can be easily understood upon this biological basis. When irritants in the blood are of moderate severity and joint cell resistances are of moderate degree, slight premonitory symptoms occur and subside as the tissues react successfully at first before they finally break down in their normal function, but when weak tissues are overwhelmed with irritants of greatest toxicity, they succumb with surprising abruptness. Abrupt onsets of nervous symptoms, as, for example, delirium and mania, probably are manifestations of similar overwhelming conditions that suddenly destroy the physiological balance in nerve cells, and nerve cells which control joints and articular blood vessels show pathological conditions suddenly arising in them by suddenly producing arthritic lesions. The actual case cited in this article is an example which the writer believes to have an important neuropathic element and exhibits at times sudden onsets of arthritis with extreme symptoms of prostration, fever, sweats and involvements of all joints in an exquisitely painful process.

Underlying causes of acute cases must be sought by methods which have already been described, and methods for local treatments also remain unchanged, but are applied with greater vigor. Inflamed joints are kept perfectly quiet by means of splints or plaster casts, thus entirely removing mechanical irritation; gouty attacks in which subsidence can soon be expected may properly be treated by active local stimulation of the joint

tissues with electricity to temporarily increase cell resistance and metabolism, and some gouty patients find they are thus able to avert milder attacks if such electrical treatment is taken immediately when first symptoms become evident. With other patients such active local stimulation seems inadvisable when the blood is likely to contain irritants for a considerable time, and stimulation then may aggravate instead of ameliorate local joint conditions.

Variations in external physical influences should be prevented by dry protective coverings applied to the affected joints. Increasing the blood supply sometimes means increasing the amount of toxic influence, while decreasing the blood supply means diminution in necessary food products of the blood and perhaps an inadequate removal of waste products. The best circumstances in each instance can only be determined experimentally, and in practice thermal measures of heat and cold may be tried cautiously, and if improvement occurs they are persisted with, but abandoned if no relief is afforded.

Drugs are almost always given to control pain and are justifiable on account of the important influence pain has upon the resistance and total metabolism of the individual.

VERY SEVERE TYPES OF ARTHRITIS.

These fall into three groups; those in which mild irritants have acted for a long period and caused slow disintegration of joint structures; those in which severe bacterial irritants cause more rapid destruction of the joints, and those due to mechanical and traumatic causes. Conditions seen in gout, certain cases of rheumatoid arthritis (atrophic arthritis) and osteo-arthritis (hypertrophic arthritis) represent the first group, and bacterial infections with organisms themselves growing in joint tissues are examples of the second class.

Treatment of the first class consists principally in correction of deformities and in restoration of joint motion. Attitudes habitually assumed during acute stages of the disease often result in permanent deformities, as, for example, the forward bending of the cervical spine due to propping the head up with pillows, and the stooping attitude of such patients from fixation of the vertebræ by bony overgrowths when in improper positions in bed. Faulty attitudes lead to faulty physiological functions, and bony overgrowths in joints of the extremities often require operative measures to remove obstructing bony tissue and to restore motion. Osteotomy of the femur is a familiar operation in treatment of ankylosis of hip with deformed position, and this procedure helps to restore the normal attitude and muscle balance, thus preventing secondary deformities, and consequently assists in maintenance of the individual's normal physiological functions.

The second class, tuberculous, gonorrheal, pyogenic and other infections of the joints, require aspirations, arthrotomies for washing out joint cavities and for removing necrotic material. Various injections have been employed; for

example, oils to prevent post-operative adhesions and oxygen to inhibit growth of anaerobic micro-organisms. Frequently arthrotomies are performed for other reasons, to remove hypertrophied synovial membranes and loose cartilages, but none of these methods will be discussed and are simply mentioned to complete the outline of clinical classes proposed at the beginning of the paper.

RÉSUMÉ.

An attempt has now been made to describe as exactly as possible how joints may be influenced by normal physiological factors; mechanical, nervous and external stimuli; and by physical and chemical properties of the blood; and to enumerate the different diseases that may alter normal nervous control of joints and normal states of the blood.

Physiological pictures of metabolic activities going on in all living tissues, and the ways by which different ones react upon each other, have been described, because normal states of the blood and of nervous tissues depend upon normal functions and reactions of every individual organ.

Attention has been called to the fact that vital processes going on within tissue cells cannot be accurately measured at present by chemical or physical means, and in early stages of many diseases intracellular pathological processes leave no visible anatomical evidence of their abnormal action, notably in nerve cells which produce abundant physiological evidence of deranged function but only meager visible proofs of it, so that physiological effects produced upon other organs furnish the only adequate means of recognizing and estimating the intensity of these invisible, intracellular pathological processes that act through nerves and blood.

All manifestations of arthritic disease, including joint defects, lesions of other organs and all clinical symptoms can be more readily understood upon this physiological basis as representing departures from normal conditions that exist in healthy states.

Description of methods of examination and special methods of treatment have purposely been avoided as much as possible, and confusing nomenclatures have also been kept in the background in order to make clearer the importance of these principles; yet it should be recognized that adequate examinations and skill in application of special methods contribute as much as general conceptions to success in treatment. The latter, however, are so easily forgotten or neglected, and their neglect is responsible for so many failures, that they are here emphasized. Application of these principles will establish their value in determining why some patients are curable and others are non-curable.

Permanent cures of arthritis depend upon permanently removing the causes which are producing the disease, and this is possible, first, when infective foci are present which may be completely removed by surgical means; secondly, when arthritis is produced by acute infectious fevers which subside and no longer exert their influence;

thirdly, when defective metabolic processes in tissue cells can be permanently altered into healthy activity, and, finally, when defective personal habits and unhygienic occupations are recognized and may be regulated.

Infective foci may be permanently removed when they occur in tonsils and teeth, and when chronic suppurative conditions elsewhere can be radically treated or removed. Obstinate cases of fecal impaction may cause severe arthritis, and permanent cures are possible when such unsuspected intestinal conditions exist that may readily be prevented from recurring. Operations upon the gastro-intestinal tract which restore normal relations in it and prevent bacterial toxemias theoretically also may permanently cure arthritis.

Defective metabolic processes in tissue cells that are independent of bacterial action often are difficult to permanently restore to a normal state, and success in treatment here depends at present mainly upon early applications of simple hygienic measures before metabolic abnormalities have become too extensive or too chronic.

Regulation of defective personal habits and unhygienic occupations are the simplest, also one of the most important and most efficient, means of increasing the number of cures of all types of arthritis.

Incurable cases of arthritis are represented by bacterial infections of vital organs that cannot be operated upon and which are resistant to general hygienic measures. Examples are also seen in nervous maladies in which there are serious defects of nerve cells that cannot be reached; and as already mentioned, also in patients whose unhygienic occupations and faulty habits must be continued for financial reasons. Some patients are born with such non-resistant joints that they are almost certain to become impaired in spite of treatment, by repeated attacks of arthritis in acute fevers and infections, and these patients also are likely to become incurable.

Paul Ehrlich's apparently successful treatment of syphilis by means of an arsenical chemical compound which destroys the spirochetes of that disease in the tissues without injuring the tissue cells of the host arouses the hope that he may be able to prepare other chemical substances in the same purposeful manner that he has done with syphilis, that will be specific for other parasitic cells, common pyogenic micro-organisms and others. Such specific chemical substances would be of inestimable value in combatting bacterial diseases of inoperable vital organs, and would appreciably lessen the numbers of incurable arthritic patients. Theoretically, such chemical substances exerting their toxic effect directly upon foreign parasitic cells in the tissues seem much more likely to be efficacious than injections of bacterial toxins that produce a general protective reaction of the body tissues and indirectly exert greater inhibiting influence upon local foci of infection through temporary changed conditions of the blood.

Conception of arthritic disease as being either self-limited or incurable is erroneous and unjustifiable upon theoretical grounds and also is unsupported by actual evidence furnished by patients who have been permanently cured. All degrees of acuteness and chronicity of arthritis can be observed, and anatomical changes range from perfectly normal to completely disintegrated pathological states.

Statistics of cures may always be questioned when many influences are acting, but prompt restoration of normal health and function of diseased joints occurs so frequently as soon as rational treatments are instituted that no reasonable doubts exist of their important influence, although absolutely incontrovertible proof seems likely to be an impossibility for an indefinite time to come.

The writer's experience with arthritic patients for several years, therefore, has led him to the following inferences:

(1) The causes of chronic arthritis are many, and arthritis must be considered a symptom of many diseases rather than an entity that is produced always by the same specific cause.

(2) Causes generally are common diseases of other organs, common infections and ordinary defects of personal hygiene rather than obscure and rare diseases.

(3) The most severe deforming types of arthritis that stubbornly resist treatment and the mildest kinds that are easily controlled and permanently cured have similar origins. They differ only in the degree of severity with which the underlying causes act.

(4) Arthritic disease in every stage may often be modified by treatment, sometimes only slightly, and sometimes to a great degree, permitting permanent cures not infrequently.

(5) The best period to initiate treatment is in the incipient and early stages before chronicity is established, although the later stages also must be attended to when the disease has progressed to that degree.

(6) Diagnosis and treatment of incipient and early arthritis depend upon thorough knowledge of physiological conditions that control health and normal activity of joints, and cures result when defects in these conditions can be recognized and remedied.

(7) Proper application of simple hygienic measures and correction of defective personal habits are the most adequate means of treatment in the early stages.

(8) Increased efficiency in treatment depends upon greater clearness in understanding of normal physiological conditions that control health of joints, and also upon increased skill in treating diseases of other organs and infections that act as causes; and such knowledge of physiology and increased skill in treatment should be strongly advocated as well as search for new methods and new causes, for obscure conditions generally may be explained more satisfactorily as confusing combinations of common causes than by assumption of unknown rare pathological processes.

(9) New methods for treatment of chronic arthritis are likely to consist of very dissimilar ones, special drugs, organ extracts, vaccines and physical therapy applied to diseases of different organs and to infections; and better comprehension of physiological conditions governing the health of all organs may also be advantageously emphasized.

(10) Future advances in treatment of arthritis, as in pulmonary tuberculosis, appendicitis and some other diseases, probably will be towards prevention of extensive pathological changes by early recognition of the disease, and treatments will tend to become comparatively simple ones that prove themselves to be efficacious in these incipient stages.

RADIUM THERAPY.*

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CHARACTERISTICS OF RADIUM.

RADIUM emits three kinds of rays, the so-called alpha, beta and gamma. The alpha and part of the beta (the soft) forms have but slight penetrative power, while certain of the beta and all of the gamma are capable of exerting influence deep within the tissues. In therapeutic work the alpha and the soft beta rays are employed where superficial results are wanted, as in diseases of epidermis and upper corium, or again where caustic action is needed, but as a rule other modes of destruction can be employed which are cheaper and more rapid in their effects. It is the deeply penetrative action of the hard beta rays and of the gamma rays as a whole which gives radium its most practical value.

The power of penetration of these rays is indeed extremely great, but the depth at which these rays act therapeutically depends not only on this penetrative power alone, but also on the number of the rays which attack a given point and on the susceptibility of the given tissue.

This really great penetrative power is illustrated by a recent experiment in which a cancer of the breast $15\frac{1}{2}$ cm. in width was treated for forty-eight consecutive hours with the enormous dose of 19 cgm. of pure radium sulphate spread on shields 28 cm. square. During this exposure an electroscope and a screen of platino-cyanide of barium were held on the opposite side of the breast, and both instruments showed the influence of radium emanations, the former in eight to nine seconds.

Before this exposure the breast was a hard, bosselated, homogeneous mass, but sixteen days later it had shrunk 1 cm. in width, and palpation revealed a series of nodules. The breast was then amputated, and on section one could see that the portion of the tumor lying directly in the path of the rays differed totally from the remoter zones.

* The salient points of a lecture delivered at the Boston Medical Library at the request of the Surgical Section of the Suffolk District Medical Society. This paper is compiled by Dr. Charles J. White, from data left in his hands by Dr. Wickham.