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## Treatment of osteoarthritis

Lloyd Donald Bridenbaugh  
*University of Nebraska Medical Center*

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THE TREATMENT OF  
OSTEOARTHRITIS

BY

DONALD BRIDENBAUGH

SENIOR THESIS PRESENTED TO THE COLLEGE OF MEDICINE,  
UNIVERSITY OF NEBRASKA  
OMAHA, NEBRASKA

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## INTRODUCTION

I have chosen the treatment of osteoarthritis as the topic for my senior thesis. How could a topic, which has been known since the beginning of history, be fascinating enough to the senior medical student to compete with some of the modern wonder drugs as a topic for senior research? The reason probably was that my first contact with clinical medicine was a chronic arthritic patient. It was then that I suffered the rude awakening that medicine isn't the exact science I had believed it to be. A small amount of research at that time impressed me with the importance of the condition and with the value of further research.

In this paper I shall attempt to point out the importance of this disease by giving a brief summary of the history, incidence, pathology and symptomatology of the condition. The various phases of treatment will be reviewed in more or less detail.

One of the first lessons to be learned in treating this disease is the importance of maintaining a broad-minded attitude. Numerous individual procedures have resulted in benefit to the arthritic. The beneficial removal of a tooth or a pair of tonsils in some cases has led operators and patients alike to feel that such a measure will offer relief in all cases. There has grown up undue enthusiasm in many instances for this or that procedure. The use of a given medicine or the injection of some vaccine after occasional successes has often been carried to extremes with resulting disappointment to both patient and physician.



Any attempt to confine treatment to such a single line of procedure is, therefore, doomed to failure in all but a small proportion of the cases.

## HISTORY

Chronic arthritis is a very ancient disease; probably the most ancient of known diseases. Through the ages it has been no respecter of animals or men. It is prevalent today and is dreaded, even by the courageous, nearly as much as cancer is dreaded. Almost since life has existed in such a form as to leave recognizable fossils, chronic arthritis has existed also. The period involved has been estimated by Moody to be quite beyond our comprehension of time, perhaps six hundred million years. The changes found in some of the vertebrae of these remains, closely resemble the changes found in the spine of human beings at the necropsy table of a modern hospital. The pathology has been essentially the same for about a hundred million years. In the Museum of the University of Kansas is the skeleton of a large mosasaurus (platecarpus). The foot bones, especially the first metatarsal and phalanges of this prehistoric swimming reptile, show the articular changes characteristic of chronic arthritis. This is the first-known example of multiple arthritis in a fossil vertebrate.

The evidence runs through various dinosaurs of the Comanchean period (110,000,000 years); the primitive ungulates of the Eocene (50,000,000 years); the Egyptian crocodile of Miocene (15,000,000 years); the camel of the Pliocene (1,800,000 years); the cave bear and sabre-tooth cat of Pleistocene Age (500,000 years). The "Ape Man" of the Pliocene Age (1,800,000 years) suffered from "spondylitis deformans". The "Java Man" of the Pleistocene Age

(500,000 years) showed exostoses of the femur, the earliest human pathological lesion. The Neolithic man (75,000 years); the pre-dynastic Nubians and ancient Egyptians (8,000 years); and the pre-Columbian Indians of America all show typical changes of chronic arthritis. Parker noted typical lesions of chronic arthritis in the lumbar vertebra, the hip joint, the knee joint, and the head of the first metatarsal bone of the "Lansing Man" (antiquity not settled, probably Pleistocene, 500,000 years). Smith and Jones, from their study of the skeleton of pre-dynastic Nubians (circa 8,000 B.C.) gained the impression that almost all of the adult population had experienced some of the effects of chronic arthritis. The disease was never found before the epiphyses had united and the joints of adults most exposed to injury were most frequently affected. Sir Marc Armand Ruffer, bringing to a study of ancient Egyptian mummies and skeletons the trained, careful habits of a pathologist, describes examples of both rheumatoid and osteo-arthritis. The skeletons covered a period of over three thousand years and the changes which he describes and illustrates by photographs are typical of the same kinds of chronic arthritis as those which we are writing about today.

We are faced with the discussion of a disease older than history, common to animals and man and distributed over the whole face of the densely populated portion of the earth. No specific has been discovered for its cure; its prevalence is alarming, the economic waste of its inroads is huge; the physical and mental

suffering caused by it is distressing. Its basic causes are being understood, but this understanding is not so widely distributed as the disease. Its prevention is usually possible, but it is not usually prevented. Its arrest under proper therapy may be hastened, but it runs its course in too many cases. When its fires are burnt out, resultant handicaps may then be lessened, but the bedridden cripple is still far too common. All existing knowledge concerning the disease should be made available and all the light of clinical and laboratory study should be focused upon it.

Perhaps the first organized attempt to study the syndrome began in England with the Cambridge Committee for the Study of Special Diseases. Unfortunately, this effort was curtailed by the outbreak of the first world war. The next step in development was the establishment in 1920 of the Ligue Internationale contre le Rhumatisme. This organization, then composed chiefly of European representatives, encouraged the formation in a number of countries of groups interested in the problem and qualified to study it. This movement extended to the United States, where there was formed in 1928, the American Committee for the Control of Rheumatism. This Committee entered on active efforts to arouse the interest of the profession in the magnitude of the sociologic problem presented and to extend knowledge concerning it by means of publications and, especially, of extensive exhibits in connection with the Scientific Exhibit of the American Medical Association. In 1930 the desirability became apparent of organizing a national society for the study

and control of rheumatic disorders and the American Rheumatism Association was, therefore, founded. It consisted of a larger group of physicians interested in and qualified to study the syndrome of arthritis and allied topics. This society holds yearly meetings for the presentation of scientific papers and discussions, sponsors an extensive review of English and American literature, and in various other ways promotes wider interest and more extensive interchange of information concerning the problem.

Among the various lines of progress in the field of rheumatic disease, one of the most encouraging is the greater attention now paid to the problem in the medical schools of the United States. There is a growing number of special clinics, research units and hospitals devoted to the care and study of patients with rheumatic diseases. Better evaluation of methods of treatment and a fuller understanding of the basic nature of the disease are being realized in these centers, but much still remains to be accomplished. Great significance attaches to arousing in the public mind appreciation of the disease as a social problem, the value of adequate treatment in the early stages and the importance of providing adequate institutional care for sufferers from it, not only in the late stages but throughout the disease.

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## INCIDENCE

Rheumatoid diseases present serious problems both socially and medically. The prevalence of rheumatoid diseases and the economic cost occasioned by them are not widely recognized. The data presented by the survey conducted by the United States Department of Public Health regarding the incidence of various chronic diseases in the United States revealing that this group of diseases afflicts 6,800,000 persons or approximately one out of every nineteen persons in the entire population yearly—a number greater than that involving any other group of chronic disease—will come as a surprise to many. Of these, 147,000 are regarded as permanently invalided. These disturbances of the locomotor system affect not only a greater number of persons than more widely appreciated chronic diseases such as arteriosclerosis, tuberculosis and diabetes, but are also responsible for a greater total loss of days of productive work than are any of the latter. It is estimated that rheumatic disorders are responsible for the loss of 97,000,000 days of work annually.

The significance of these several factors in terms of national economy cannot be overestimated. By a simple calculation it means that an equivalent of over 320,000 otherwise able persons in the United States are rendered unemployable for an entire year by these disorders. The total loss of "manpower" presents a challenge quite apart from the factor of human suffering occasioned by the disease. The greatest incidence of these disorders occurs among

persons subjected to the conditions imposed by submaintenance incomes; namely, among families receiving less than \$1,000 annually. What factors are involved in the large incidence among this group, whether inadequate nutrition or exposure from poor housing, are not yet evident. It should be added, lest improper conclusions be reached, that the disorders do occur with lesser frequency among the more fortunate economic classes, wherein the chances for better hygiene, housing and nutrition are available.

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**Primer on Arthritis, J.A.M.A. 119: 1089-1104 1942**

## CLASSIFICATION OF ARTHRITIS

Arthritis occurs in a number of different forms depending on various etiologic agents. Some of the groups are characterized by certain pathologic and clinical features which make their differentiation comparatively easy. In other instances only the most careful study will determine the identity of the articular disorder.

Arthritis may occur in either an acute or chronic form. However, almost any type of acute arthritis may pass into a subacute or chronic form, and many cases of chronic arthritis are subject to acute exacerbations.

The classification of arthritis would be much simplified if one knew the etiology of all the various types. Unfortunately this is not the case. Indeed, in the majority of cases the etiology of the particular disease cannot be definitely established.

Roughly speaking, the great majority of the cases of arthritis fall into one or another of five groups:

1. The frankly infectious cases caused by a specific microorganism;
2. Cases that are probably infectious but of unproved etiology;
3. The degenerative forms of joint disease, which in Europe are often spoken of as arthroses;
4. Arthritis resulting from physical injury to the joint due to trauma;



5. Gouty arthritis.

These are the five common divisions of arthritis, and under these main groups there are certain subdivisions. In addition to these prevalent varieties, however, there are certain rare forms of arthritis, such as the tabetic joint and intermittent hydrarthrosis, which should be included.

1. Infectious arthritis of proved etiology.—This general heading includes all cases of arthritis due to infection which can be proved due to a specific microbe. The individual arthritides are named according to the particular micro-organism and joints concerned: e.g. pneumococcic arthritis of the left shoulder, tuberculous arthritis of the right knee, gonococcic arthritis of the left knee, etc.

2. Probably infectious arthritis, etiology unknown.—Two of the main divisions of arthritis come under this heading: the arthritis of rheumatic fever and rheumatoid arthritis. Under rheumatoid arthritis one may include such clinical variants as Still's Disease and the ankylosing arthritis of Marie-Strumpell.

Rheumatic fever is still classified as a disease of unknown origin. However, authorities are pretty well agreed that the disease is due to infection, and many students are convinced that it is closely associated with hemolytic streptococcus infection.

Rheumatoid arthritis is probably a chronic infectious disease, but the specific agent has not yet been determined. Under this heading are included a majority of the cases of Chronic progressive

arthritis for which a specific cause cannot be discovered. The disease is characterized at its early stages by transitory pain, stiffness, and swelling of the joints and in its later stages by deformities and ankylosis.

3. Degenerative Joint Disease or Osteoarthritis.—Osteoarthritis represents a degenerative process which involves both the cartilage and adjacent bone and is entirely different from the arthritis which results from actual infection of the joint. Some authors speak of degenerative arthritis as an arthrosis, and the impression is quite general that the changes which occur in the cartilage and bone often result from prolonged or oft repeated trauma. Osteoarthritis may appear in a generalized or localized form. The disease is much commoner in middle-aged or elderly persons, though occasionally it is encountered (particularly in women) in the thirties.

4. Arthritis Resulting from Physical Injury to the Joint by Trauma.—Injury may occur to the synovial membrane, the cartilage or any one of the ligaments. The ordinary sprained ankle is a good example of the trauma which can lead to this form of arthritis. If the results of trauma are not properly handled, the traumatic arthritis may become chronic, but usually the condition heals rapidly.

5. The Arthritis of Gout.—Gout is a disease of unknown origin, though it is commonly defined as a disturbance in purine metabolism. It is characterized by acute recurrent attacks of arthritis, each of which is followed by a complete remission.

Later on, however, the arthritis may become chronic. In late gout deposits of sodium urate crystals, the so-called tophi, are frequently found in articular, periarticular and subcutaneous tissues. At least 95% of gouty patients are men and in many there is a history of gout in some other member of the family.

6. Other Disturbances of Joints.---

- A. Disturbances of the joints secondary to abnormal postural strain.
- B. Disturbances of the joints secondary to lesions of bone.
- C. Primary neoplasms of the joints (e.g. cyst;xanthoma; hemangioma; giant cell tumors; synovioma)
- D. Disturbances of the joints associated with loose bodies.
- E. Disturbances of the joints secondary to functional or psychogenic causes.

OSTEOARTHRITIS (HYPERTROPHIC, DEGENERATIVE)

Etiology.—

Primary osteoarthritis is essentially a disease of late adult life and is especially prone to occur in weight-bearing joints and in joints in which a considerable amount of motion takes place. It is also prone to occur in the short, heavy, so-called herbivorous type of individual. Observation on post mortem material by various investigators has shown that before the age of 45 degenerative changes are relatively slight but that after the age of 40 they are increasingly common. As a result of these and similar observations on animals there is at present a rather widespread belief that the changes which comprise the pathologic picture of the disease are the result of the normal wear and tear of everyday use and that it is a natural phenomenon for the joints of men and other animals to develop these changes as age advances.

However, there are certain characteristics of the disease which are not explained by this theory. One of these is the fact that occasionally the disease is well developed in patients who are relatively young--that is, in their middle thirties--while other people reach relatively advanced age and yet their joints show only slight osteoarthritic changes on clinical and roentgenographic examination. It is thus evident that, if the disease is due to wear and tear and nothing else, certain persons must be born with an articular joint structure which is definitely subnormal. In support of this theory the disease at times tends to

be relatively frequent in certain families and it may be so frequent that a definite hereditary tendency is suggested. Also, against the pure traumatic theory is the fact that one of the most frequent sites of the development of the disease is the terminal interphalangeal joint of the fingers; that is, the so-called Heberden's nodes. Not only is this a frequent site in which the disease cannot be explained by excessive use, but these Heberden's nodes frequently develop on the fingers of those who have done practically no manual work.

Removal of foci of infection has no influence on uncomplicated degenerative joint disease. Furthermore, the pathologic changes incident to this condition are not similar to those present in various forms of infection of the joints. Consequently, the infectious theory has been almost entirely abandoned. Another theory is that of intoxication, it being believed that certain toxins were absorbed either through the gastrointestinal tract or possibly from foci of infection, and that these toxins exerted a malign influence on the articular structures and caused the degeneration which resulted in the arthritic changes. This theory has been abandoned by most observers because of lack of any evidence to support it. It is now generally believed that arteriosclerosis is not the cause of the arthritic changes but is merely incidental because the disease tends to develop in people who are in the arteriosclerotic age.

Many still believe that there are other causes which tend to precipitate and to accelerate the progress of the disease. Since the primary change is degeneration of the articular cartilage, it

is believed that in some way the nutrition of the cartilage is interfered with and that diet and endocrine factors may be responsible. It is probable that, with advancing years, persons of a stocky type tend to develop the disease more frequently than the tall, slender, so-called carnivorous type of persons.

No adequate explanation has been offered of the fact that a person may have advanced pathologic changes in various joints over a period of years and have no clinical symptoms, and then suddenly and apparently without warning and without any undue injury to the joint the clinical disease may develop in a particular joint and may persist with pain, swelling and disability over a considerable period of time.

Secondary osteoarthritis differs from the primary disease in that it affects single joints or occasionally joints on both sides which have been subjected to similar insults. It results from gross skeletal deformity, fractures and ligamentous injuries which produce abnormal strain or incongruity of the joint surfaces, and from long continued successive trauma to a given joint. The development of the hypertrophic changes is dependent on the continued use of the injured joint.

#### Pathology.---

The disease affects primarily the weight-bearing joints and the first pathologic change is a softening of the articular cartilage. On gross appearance the involved area has lost its bluish white,

shiny, translucent appearance, has become dull, and its surface is finely granular in appearance. Should pressure be made on such an area it will be found that this involved portion is softer than is the normal articular cartilage. It is to be noted that these primary areas of degeneration tend to occur in the central portions of the weight-bearing joints--that is, far from the articular margins where it is believed that the nutrition is better because of the periarticular plexus of vessels--and also at the point where the articular surface receives the maximum amount of pressure.

Microscopically, this soft area of cartilage is beginning to disintegrate. The surface tends to peel off in small flakes and the deeper layers of the cartilage tend to be fibrillated, being split into columns. It is believed that this peeling off and fibrillation of the articular cartilage is due to the lack of or deterioration in the quality of the cement substance which binds together the fibrous bundles which make up the cartilage matrix. When the surface of the cartilage flakes off and when the deeper layers become fibrillated so that the surface resembles the pile of velvet, many of the cartilage cells become necrotic.

In addition to necrosis of the cells which border the clefts in the cartilage and which border the surface, there is a tendency to proliferation of cells in the vicinity if the lacunae are still intact and there results an irregularity in the cellular structure; the dead cells disappear while neighboring living cells proliferate and form cell nests. As a result of the continued function of the

joint with pressure and friction on the soft surface, the disintegrating cartilage is gradually worn away.

The change in the underlying subchondral bone consists of a proliferation of the bone-forming elements so that the haversian canals are narrowed, the trabeculae are thickened and the subcortical bone becomes more dense invading the cartilage to a variable degree. Hence, when the cartilage disappears the joint surface is composed of dense eburnated bone.

Concomitant with the changes in the surface of the articular cartilage and the subchondral bone there also occur changes around the margins of the joints. These changes are proliferative in character, both of the cartilage and of the subchondral and subperiosteal bone. New bone is formed and tends to invade the cartilage over it or to form excrescences around the margins of the cartilage. At the same time there is a tendency to proliferation of the cartilage cells so that cell nests are formed, and there is probably a variable amount of metaplasia into cartilage of the adjacent connective tissue where the synovial and periosteal tissues merge gradually into the articular cartilage.

As a result, new tissue is formed, the surface of which is cartilage and the base and interior of which are cancellous bone. These are the so-called osteophytes, or marginal lipping or hypertrophy, which give to the joints their characteristic roentgen appearance. There also may occur irregularities on the articular surface due to ecchondroses, or thickening of the subchondral bone.



The interarticular fibrocartilages, such as the semilunar cartilages, and the interarticular ligaments, such as the crucial ligaments and certain tendons which are in intimate relation to the joints, also show degenerative changes with lack of cement substance, fibrillation of their structures and necrosis of their cells to a variable degree.

In some instances the synovial membrane becomes thickened and hypertrophied and may exhibit rather extensive villus formation and a considerable increase in vascularity. However, the proliferation of the synovial surface cells and the infiltration of subsynovial areas which are characteristic of rheumatoid arthritis and of arthritides which are due to specific infections of various types do not occur. In certain instances cartilage may be laid down in the synovial membrane, in others there is a fibrosis of parts of this structure and there may be considerable arteriosclerosis of the vessels in the deeper layer of the synovial surface. As a rule, the synovial fluid is normal in amount and in cellular content. However, this fluid may be increased in amount and contain slightly more cells than normal.

Since the exposed area of the subchondral bone is dead and contains no living cells and since there is no formation of granulation tissue, ankylosis between the opposing articular surfaces does not occur except rarely in the spine. However, limitation of motion in joints may occur as a result of the encroachment of formations of new bone around the margins of the articular surfaces. This is particularly true in the hip and spine and also in the ankle and fingers.

At the present time little is known as to the cause of the pain in osteoarthritic joints. Not only is the pain present around the joint but may extend for considerable distances along the bone. This is especially true of the knee and it is not infrequent for the pain and tenderness to extend down along the inner aspect of the tibia for a considerable distance below the attachment of the ligaments of the knee joint. It is to be noted that, in people with osteoarthritis, laboratory examinations of blood and urine reveal nothing abnormal. The sedimentation rate of the erythrocytes is not usually increased, the blood picture and the blood chemistry are normal except that in certain persons the cholesterol content is elevated. In elderly patients arteriosclerosis is common.

#### Clinical Features.--

Onset.--Osteoarthritis may exist entirely without symptoms. As a rule, its onset is gradual and insidious and its course chronic. It is estimated that 97 percent of the people who live beyond middle life develop characteristic joint changes with or without symptoms.

Symptoms.--The early symptoms vary. Locally stiffness of one or more joints may be noticed, especially after rest, with improvement on moderate use during the day, but worse again the next morning; discomfort, even pain, in joints, produced by overuse or trauma and relieved by rest, fixation and heat; numb sensations in the fingers, especially the little fingers and hypersensitivity of the joints to any blow. Easy fatigability on exertion may be one of the general complaints.

Common early signs are slight enlargement of the joints of the fingers, knees and toes. These overgrowths on the margin of the joints, when they occur in terminal phalanges of the fingers, are called Heberden's nodes.

As time goes on, the disalignment of the joints results from the irregular degeneration and loss of cartilage. This is especially noticeable in fingers, knees, hips and toes. Sometimes soft tissue swellings develop, because the chondro-osseous ridges cause joint irritation when used. There is rarely any joint effusion.

Natural History.—The natural history or clinical course of the disease depends on heredity, age, diet, obesity, circulatory disturbances, occupational strain and trauma, accidental injury and probably faulty body mechanics—all factors that basically underlie the disease and cause the remissions and exacerbations. As time goes on without treatment, more joints are involved. Great disability and pain may result if the spine, hips and knees are injured. Ankylosis does not occur except in the spine where exostoses may fuse with one another. Motion decreases as these enlarging painful bone growths impinge.

Late Symptoms.—The changes in the spine may cause irritation and pressure on nerve roots in all parts of the spine (occipital, cervical, brachial, intercostal, inguinal, ant. <sup>?</sup> crural, sciatic). The nerves may be painful but are not usually sensitive to touch, as in neuritis.

Roetgenologic Appearance.—Early in the disease little may be seen in the roentgenograms except sharpening of the margins of the

joints. The hands usually show these minute changes first and are good guides to the nature of the disease process. The toes, knees, and cervical bodies may show early spurring. As the disease progresses, the degenerative process in the articular cartilage increases and the chondro-osseous overgrowth at the joint margins show more clearly. The joint space is narrowed by the degeneration of the articular cartilage. The articular ends of the bone become deformed by the loss of cartilage, and the joint lines are changed by the overgrowths of bone masses. Flattening or mushrooming of the ends of the bones takes place. In the spine, "beaks" grow from the margins of the bodies and may impinge or unite. In the knees these exostoses may break off and form calcified loose bodies in the joint cavity. Sometimes cystlike cavities in the cancellous bone ends appear near the thin ebonized surface. Roentgenograms should always be taken of the hands even if they are symptomless, because they reveal early changes and are easy to interpret.

Laboratory Observations.---There are no characteristic abnormalities which can be determined by laboratory methods. The blood is usually normal. Anemia is unusual. The sedimentation rate is normal except in the mixed types of arthritis. Agglutinins for hemolytic streptococci are absent in contradistinction to rheumatoid arthritis. The metabolic rate is often lowered. The dextrose tolerance curve is not infrequently diabetic in type, as in rheumatoid arthritis.

Differential Diagnosis.---

The diagnosis of osteoarthritis in its early stages is not difficult and is of great importance. The points of significance to remember are:

1. Even without important symptoms the history of a similar type of arthritis in the parents.
2. The age after 40 at about the time of the menopause in women.
3. The frequent history of trauma and the presence of faulty body mechanics.
4. The insidious onset of stiffness and vague joint pains.
5. The well-being of the patient without increased sedimentation rate, anemia, fever or other illness.
6. The involvement of weight-bearing joints and the presence of typical Heberden's nodes.
7. The minute characteristic chondro-osseous growths seen in the roetgenograms.

Later the loss of motions, irregular deformities and actual marginal exostosis leave no doubt as <sup>to</sup> the nature of the type of arthritis with which one is dealing.

The differential diagnosis is sometimes complicated by evidences of mixed rheumatoid arthritis in the same person. The soft tissue swelling in cases of rheumatoid arthritis may obscure the Heberden's nodes and bony exostoses which are seen in the roentgenogram. Osteoarthritis may also be found in conjunction with other conditions of the bones and joints as osteitis deformans, Charcot's joints, osteitis

fibrosa, neoplasms and chronic osteomyelitis. In such cases the osteoarthritis may be considered nature's attempt to repair damage to the margins of the joints.

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## TREATMENT OF OSTEOARTHRITIS

### GENERAL MEDICAL PRINCIPLES.—

Arthritis and the rheumatoid syndrome constitute fundamentally a medical problem. The manifestations of the uncontrolled disease markedly affect certain structures and tissues commonly regarded as within the domain of orthopedic surgery. Sufferers from arthritis have consequently appealed to orthopedic surgeons in great numbers with the aim of undoing and modifying the damage which inadequate therapy has allowed to arise. This damage has sometimes been unpreventable. More often, however, it has been in some part, or even wholly, preventable. The intensive experience which orthopedic surgeons, as a whole, have thus acquired in this disease has led, finally, to the evolution of a viewpoint on the part of some of them, which has been of great value. Many of the considerations advanced by orthopedists along this line, however, have not depended on orthopedic knowledge or equipment and have rested fundamentally upon basic principles which the internist could have developed, had his interest in the subject been sufficiently acute. It is also fair to say that many internists have regarded the human body too much as a collection of organs having separate functions and too little as an entity of which these organs are merely component parts. Furthermore, in the light of our present knowledge of the disease, it is clear that most of the underlying and inciting causes of arthritis lie in fields which are within the domain of the internist and the laboratory men. In short,

"untangling" of the rheumatoid syndrome must, by definition, depend upon that philosophical point of view which internal medicine should be able to bring to bear upon the foundations of disease in general. The idea is all too current that arthritis is a disease of the specialist in some of those fields, surgery in particular, which have to do with regions in which focal infection often occurs. The countless examples of failure among arthritics treated on this basis exemplifies the truth of this statement. Few greater injustices can be done to these unfortunate sufferers than to permit their complicated problem to be envisioned by surgeons or others, be they every so skilful, who hang the whole syndrome upon a single etiologic hook. This point of view is one which has too often plunged arthritics, already in deep water, into a surgical vortex from which they have never escaped.

The internist should approach all patients, but especially the arthritic, with the determination that no phase of the problem, surgical or otherwise, will be allowed to fall outside of his general purview. The surgeon is perhaps justified by results in adopting a more cavalier attitude towards the individual as a whole and in making the assumption that the field of surgical scrutiny alone need be considered. No such attitude, however, is permissible on the part of the internist. More than any other practitioner his examination must be thorough and it should therefore begin with the top of the head and finish with the soles of the feet. It cannot be assumed, however, that the usual routine medical examination will necessarily elicit the data which it is important for the



observer to know. Practitioners thoroughly skilled in examining the subjects of tuberculosis or heart disease may miss the salient and determining features in their survey of the chronic arthritic. For example, many of these sufferers are fatigued because of a toxemia and because of the effort of "carrying on" in the presence of unremitting pain. The mental state then induced may be of great significance to the physician not only in diagnosis, but especially in evaluating the possible success of treatment. The whole morale of the patient and his attitude toward life in general, not to say the disease and his medical advisor in particular, may determine success or failure. The expression of the individual, his reaction time to questions, the level of his mentality, even the extent of his education and those intangible factors which make for determination and character in general, must be definitely evaluated. It may be said at the outset that the physician who approaches the rheumatoid syndrome with hopes of accomplishment must be, or must become, something of a psycho-analyst or psycho-therapist. In perhaps half of all cases little or nothing can be accomplished in treatment unless all circumstances be so visualized and controlled by the physician that the patient is led to subordinate himself fully to the cooperative struggle toward the goal desired. This is true whether the chief emphasis must be placed by the physician upon controlling and guiding a personality accustomed to dominate and dictate; or upon exhortation and encouragement of an individual whose morale is so congenitally poor or so lowered by disease as to make any

serious effort, even in his own behalf, almost impossible. The present writers are convinced that in the treatment of chronic disease too much latitude is accorded, in general, to the mental attitude with which patients attempt to return to health. This process of convalescence is, in fact, usually a most complicated biologic experiment in which the patient must be educated to the point where he can understand and appreciate at least the fundamentals in that field of applied biology which constitutes medicine. Sufferers from arthritis are prone to undergo, much more than are most other sick individuals, distortion of their normal mental vision. The physician must often persuade a patient, who may be prejudiced and opposed to the dictates essential to his recovery, to submit to those dictates notwithstanding, knowing that when they have achieved a betterment of health, cooperation will be assured because of the right mindedness which supervenes. The patient cannot get well until his point of view changes, and his point of view cannot change until he at least begins to get well. This situation obviously constitutes a cycle which it is sometimes difficult or impossible to break. It is therefore, of paramount importance that the patient be made to understand the principles here involved, and it is the hope that the emphasis placed upon this phase of the examination and treatment may help to educate both patient and physician toward enlightenment of that viewpoint which must underlie any sustained therapy.

History taking should be thorough. There may be evidence in the history or physical examination of the hereditary or constitu-

tional background on which the disease often falls. Any of the various medical complications, especially those incidental to the later decades, may appear in the course of arthritis. Rarely does a pronounced arthritic present, in whom a thorough examination does not develop other organic or functional disturbance. The probability of this increases with age. Almost constantly one finds evidences of faulty posture, a prominent abdomen, the intestinal deformations, and possibilities of focal infection in any of the systems of the body.

It is probably superfluous to mention here that a full examination from the standpoint of internal medicine requires the full routine serological blood and urine studies common to any good medical clinic. The kidney function tests by the Mosenthal method is often informing in the elderly and should be correlated with the Phenolsulphathalein determination and, in women especially, with a study of a catheterized specimen of urine. Basal metabolism tests are usually significant in arthritics but the change is probably due to a "mechanical" condition, namely constriction of smaller blood vessels, rather than any basal error of combustion per se.

Upon the completion of a physical examination of the individual the practitioner, unfortunately, cannot rest there. The developments of present day medicine are such that it has become impossible for any one individual to comprehend within his mental equipment or experience all fields of medicine. Nevertheless, the practitioner in remote regions can do much for his patients. Recognition of the

hereditary, constitutional, gastrointestinal, and fatigue factors operating to produce arthritis will enable the general practitioner at once to achieve results which are at least as valuable as those to be derived from removal of infection alone and usually of more lasting significance. It is clear that whatever the immediately exciting causes of an attack of arthritis may be, recognition of the underlying disturbances and causes in the given individual might often have prevented onset of the disease. Prophylaxis of this sort is easily possible in families, for example, in which one case has suggested that familial constitutional make-up of the members as a whole. It is then possible to pick out those individuals who would in all probability get arthritis and to prevent the disease by intelligent control of the liver and medical requirements of such persons.

The various fields which need intensive consideration will now be taken up. The order in which this is done is not to be taken as indicative of their respective importance. It will be well first to consider those fields which assume chief importance in the general medical mind. These fields are of undoubted and great importance; to consider them at the outset has the further advantage of opening the way to other considerations which might otherwise be regarded as prematurely developed.

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FOCAL INFECTION AND ARTHRITIS.—

Focal infection and its relationship to arthritis are seriously considered by some members of the profession, but are minimized by others. Focal infection may play an important role in the rheumatoid syndrome; it may be of secondary consideration, or it may have no relationship whatever. Its relationship as an etiologic factor must be determined by familiarity with the rheumatoid problem, by clinical experience in handling these patients, and by comprehensive evaluation of the analyses of experienced collaborators in the specialties.

There are still some clinicians who regard focal infection as unimportant. This iconoclastic view is based upon the fact that clinical recovery from systemic manifestations does not always follow the eradication of foci. It is assumed that such failures negate the whole principle. This negative attitude is directed toward hypertrophic arthritis, which is regarded as degenerative and hence unrelated to infection. Rheumatologists generally appreciate the fact that removal of foci represents but one link in the chain of therapy. All links are important. Rarely does the removal of a single focus remove the only activator of the arthritis. Treatment of the disease begins, but does not terminate, with the conservative removal of foci of infection.

The viewpoints of outstanding clinicians interested over a period of years in the arthritic problem are presented here as reflecting mature judgment regarding focal infection:

Pemberton:<sup>35</sup> "Except in early and mild cases, focal infection should be removed in arthritis only after optimal physiology has been obtained in the arthritic sufferer, following intelligent rest in bed."

Minot:<sup>1</sup> "The early removal of foci is indicated but the patient should be built up before undertaking debilitating surgical procedures."

Snyder:<sup>46</sup> "In rheumatoid groups in which infection is the outstanding etiologic factor, the most clearly indicated method of attack is the removal of all offending foci of infection as rapidly as the patient's condition permits, the most easily accessible foci being removed first."

Haden:<sup>1</sup> "Focal infection is only an influencing factor, not the one of chief importance. Nevertheless, it is unwise to allow evident focal infections to remain. They should be removed early in mild cases; in more advanced cases, when patients are on the upgrade."

Hench:<sup>1</sup> "In the face of progressive arthritis, when the building-up processes do not otherwise materialize, procrastination in removal of foci seems unwarranted and the risk thereof is justified if foci are removed in conformity with good clinical and surgical judgment."

In the analysis of arthritic cases it is customary to start with a thorough examination of the oral cavity. This region is the most frequent site of infection.

Gingival Infection.—In this study attention is therefore directed not only to the apical portions of the teeth but to the gingiva. Infection in these tissues is likely to be disseminated to other parts of the body because of the unusually rich blood and lymphatic supply in this region. From the therapeutic standpoint, infection in the gingiva is open to control by mechanical and chemotherapeutic measures. When the gingivitis and pocketing are present, the teeth are carefully scaled and calculus and other debris which has collected at the gingival margin are removed. Talbot's iodine may be applied to the pockets for a few seconds and the excess solution rinsed from the pockets with a 0.9% solution of sodium chloride. Following this the gums are massaged by means of a rubber gum "massager." This type of therapy, usually at weekly or biweekly intervals, restores the gums to a healthy condition. Gingivitis may be considered a focus of infection requiring special attention when encountered in arthritis.

Infected Teeth.—There is often a question as to whether a pulpless tooth is free from infection or whether it may become involved at some future time. Pulpless teeth showing apical disease should be removed. The retention of questionable teeth may interfere with treatment, lower the general resistance of the patient and cause disturbance elsewhere in the body, as, for instance, in the prostate. Roentgenograms must be taken from the proper angles and given correct exposure to insure clear definition. The use of transillumination and tests for vitality may be of some help in making a diagnosis. Retained roots, erupted and unerupted third molars, alveolar infection, cysts, questionable crowns and bridges



should be critically appraised in studies for foci in the mouth. In the advanced cases the removal of infection associated with teeth may be equally important in that it improves the patient's general condition, but it is less dramatic since it can have little effect on the already damaged joints. Even in elderly, chronically ill patients the careful removal of infection associated with the teeth is advisable as soon as the patient's condition warrants it. After all known foci are cared for the clinical results still suggest an influence from some focal infection, it is appropriate to conclude that questionable teeth should be sacrificed. Dentures can satisfactorily replace extracted teeth.

According to Okell and Elliott, definite gingival trauma incidental to treatment, or the removal of infected or non-infected teeth may be followed by a shower of organisms into the blood stream. These observations have been corroborated by Fowler and Tapp in studies conducted in the Abington Memorial Hospital. These findings may account in part for joint flare-up, or temporary exacerbation of pain which sometimes occurs in various parts of the body after radical treatment of the gums or teeth.

• Infected Tonsils and Adenoids.—The tonsils are usually regarded as the most important focus of infection in this region. While it is sometimes difficult to determine, until after removal, whether or not a tonsil is infected, it is usually possible to ascertain this before resorting to operative procedures. Inspection of the anterior pillar for congestion, and withdrawal of the pillar

by a retractor, sometimes reveal evidence of underlying infection in the tonsil. Pressure exerted externally to the meridian of the tonsil may yield cheesy masses, liquid, grayish or yellowish pus, or mucopus, as further evidence of the existence of infection. If the infection is deep-seated, it may be necessary to apply a suction cup in order that the contents of the crypts may be expressed and observed. Enlargement of the lymph nodes at the angle of the jaw may be a further important diagnostic point and is believed by many clinicians to be the most accurate method of determining whether infection is present or not.

Adenoidal tissue in the nasopharynx may be as much a focus of infection as diseased tonsils. Before the removal of this tissue it is not unusual to obtain positive cultures of organisms, and then find that pus is present in the removed tissue. The retention of diseased tonsils or adenoidal tissue may be the primary activator of focal infection in other organs of the body viz., the prostate or the intestinal tract. Diseased tonsils should be removed very early in young rheumatoid patients. In elderly persons they may be treated quite successfully and much of their infection reduced by means of local expression of the retained secretion and the local application of antiseptics, such as 2 per cent solution of mercurochrome. Adenoidal tissue may be removed by electro-coagulation. It is to be borne in mind, however, that while dessication by the electric current is not very painful or a major ordeal in any true sense of the word, there is usually left behind a necrotic bed of slough from which absorption takes place.

Many of the so-called "scratchy throats" associated with arthritis are often caused by unrecognized infected lymphoid tissue. Patients who have had previous tonsillectomies and still have active arthritis should be diligently examined for infection in the regrowths, stumps, or tags, and in the small crypts concealed behind the pillars or beneath scar tissue and infected lingual tonsils. The same diligent search should be made for infected lymphoid tissue in the throat.

Sinus Infection.—The nasal accessory sinuses may become acutely and chronically infected and may be a primary cause or activator of arthritis. In many cases, response to therapy for the arthritis is unsatisfactory until local treatment or operative procedures are applied to the sinuses. The ethmoid and maxillary sinuses are the most frequently infected, and paranasitis may be present. The nose should be thoroughly inspected with a nasal speculum or nasoscope, to determine the state of the membrane and the secretions found. The nasal membranes should be shrunk and the sinuses transilluminated. The patient should be placed in Escat's position for twenty minutes and the nose again examined for secretions and the location of drainage.

Inspection of the middle turbinate may reveal some infection in the ethmoids, frontals, and antra. Transillumination is very helpful in the diagnosis of frontal or maxillary disease. The diagnosis of ethmoid and sphenoid sinusitis can best be determined by proper X-ray examination of these regions. Where previous infections have thickened the walls of the antra and roentgenograms

are questionable, needle puncture with lavage may be necessary to complete the diagnostic picture.

Pfahler has found that hyperplastic changes occurring in the membranes of the sinuses which have failed to respond to local treatment will benefit by x-ray treatment. A headache may follow these treatments for a period of six to twelve hours, but usually is not severe enough to interfere with the patients routine.

Surgical measures are indicated in refractory cases in which polypoid degeneration exists, where infected ethmoids do not respond to treatment, and where frontal and antral membranes are thick and diseased. Surgery is also advised in these cases in which headache and a slight elevation of temperature persist, or a purulent discharge continues, or where the patient's postnasal condition does not improve and the arthritis is still active.

The Genito-Urinary Tract.—A careful analysis of the genito-urinary system for possible contributory infection should be considered as a routine procedure. Analyses for infection in the oral cavity and nose and throat are seldom neglected. Unfortunately for the arthritic suffered, the prostate and seminal vesicles have too infrequently been considered as part of the picture.

Prostatic Infection.—Infections in the prostate are rarely primary among the arthritics studied, and are seldom of gonococcal origin. There appears to be a relationship with dental and tonsillar infections. In most cases the dental and tonsillar infections are

primary and the prostatic infection may be closely related to infection in the tonsils. There is particularly close relationship between spondylitis ossificans ligamentosa and infection in the prostate, in that prostatitis is very frequently associated with this condition.

Examination of the prostate of the arthritic must be thoroughly but cautiously conducted. A digital examination is made of the seminal vesicles and prostate for evidence of gross pathology. A drop of the secretion is examined microscopically on a slide, after first covering the drop with a cover slip. The normal secretion never shows more than five leukocytes to the 1/6 inch field, and any number above this should be considered evidence of infection. Clumps of pus cells in the prostatic secretion are evidence of deep-seated infection with poor drainage.

There is a difference between a focally infected prostate and one infected as a result of gonorrhoea. In the prostate infected from previous gonorrhoea, all gland follicles become involved and no normal prostatic secretion is present. Pus is everywhere in the field. In prostatic infection secondary to distant foci, the infection may be so deep-seated that it may take two or three consecutive massages of the gland before pus is found in the secretion. If manipulation of the gland causes an increase in joint symptoms even though no pus has been observed on the first, second, or third microscopic examination, the gland should be treated, since it is infected and pus will appear later when drainage is established. Even with proper massage, mild reactions usually occur within twelve

hours. Usually lesser reactions occur twenty-four to forty-eight hours following prostatic massage. Treatments should not be given more frequently than at three-day intervals. Treatment of the prostate should be properly spaced if other foci are treated; it should not be given on the same day. Prostatic infection cannot be cleared up so long as the causal foci remain.

Urinary Tract Infection.--In addition to the routine examination of the prostate it is sometimes desirable to examine the urinary tract for infection. Catheterized specimens of urine should be taken for culture where urinary tract infections are considered. Treatment of upper urinary tract infection such as pyelitis, should depend upon the offending organism. Urograms are at times used to rule out strictures at the ureteropelvic junctions, or in the ureters, or to reveal disease in the pelvis of the kidney. A cystoscopic examination is another valuable diagnostic procedure if the urogram fails to reveal the complete picture of the pathology present. Cystitis rarely occurs and when confirmed may respond to medication, or may require bladder lavage. It may occur when fluid intake is low and when constipation is marked, especially in elderly bedridden patients remaining in a fixed position for hours at a time.

Nonspecific Pelvic Infection in Women.--It is quite difficult to establish a direct relationship between arthritis and non-specific infection in the female pelvis. In many examinations carefully carried out, such foci when found consist of involvement of cervix

and endocervical glands with cervical erosions, cysts, salpingitis, and parametritis. When a cervix shows infection, a diligent and careful examination must be made by an experienced gynecologist to determine its extent.

Cervical foci in the non-gonorrhoeal group can be treated by medicaments, douches or actual cautery. By removing the cause of profuse leukorrhoea, improvement occurs in the general health of the arthritic. When the cervical glands are chronically involved, conical destruction of the gland-bearing area of the cervix is performed by the electric cautery knife.

The Gastrointestinal Tract.—Careful investigators have shown that, while the gallbladder should be examined in any complete survey of the arthritic patient and any infection eliminated it is not a common focus of infection among arthritic subjects. Of greater importance to most arthritics as a site of toxemia is the remainder of the gastrointestinal tract.

The liver removes toxins and bacteria from the general circulation and acts as a detoxifying organ and bacteriolytic mechanism in infections of the gallbladder. Usually the liver takes care of moderate degrees of gallbladder infection. However, this protective power diminishes with advancing age. Gallbladder disease over a period of years may bring about secondary changes in the heart, kidneys, and occasionally in the pancreas, and may be related to arthritis in the joint. An infected gallbladder should be removed because of the pathology involved in the biliary tract and its

possible interference with the normal physiologic function.

Cholecystitis should be managed, as in any medical case, by gallbladder drainage, adjustment of diet and medicaments. Surgery should be resorted to on the basis of pathology in the gallbladder.

Summary.--The evaluation of the role of focal infection in the treatment of arthritis should be considered from the standpoint of the state of the patient's health, as well as upon the basis of the period of time the infection has been present. Hasty diagnostic conclusions and radical removal of suspected foci of infection, without added careful analysis of all etiologic factors possibly related to such foci, may prevent the patients recovery and further impair his limited recuperative powers.

The removal of foci even in patient whose arthritis is of many years duration may be followed not infrequently by improvement in joints. The early removal of foci may be of great value.

The presence of foci of infection is harmful to the patient no matter what his disease. The relationship of focal infection to systemic disease can best be determined after careful analyses have been made by competent consultants in their specialties. Interpretation of their findings should be reached by the internist and not by the "focal specialist" alone. The most careful diagnosis of focal infections and their treatment or removal afford no panacea in the treatment of arthritis but if the arthritic patient is individualized, such focal infection as may be present will appear in proper perspective in relation to the problem as a whole.



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PHYSICAL THERAPY IN THE TREATMENT OF CHRONIC ARTHRITIS

Physical therapy refers to the treatment of disease or injury by means of physical agents. It is an adjunct to medicine and surgery. The proper application of the physical agents must, of necessity, be known and used by the physician.

An attempt will be made to describe the physical agents most frequently applied in chronic arthritis, beginning with the simplest. The clinical application and limitations of these procedures will then be mentioned and described.

In applying a physical procedure to any patient it is desirable to obtain the patient's responses to the type of physical agent used. Sensory disturbances, circulatory changes and scars should be taken into consideration since any one of these may alter the effect of the treatment. For example, a patient who has lost heat sensation may suffer from over-exposure, or one who has a scar may suffer from blister formation, or one who has impaired circulation may suffer from deep ulceration in the application of heat.

Baking.--The method of applying heat by bakers is perhaps the simplest form of applying heat in the treatment of an arthritic joint. Bakers are constructed in various sizes, depending on the part or parts to be treated. The apparatus is an oven-like affair enclosing electric light bulbs of the incandescent type.

The apparatus is placed over the involved joint or joints. The baker should be covered by a blanket to prevent heat loss. The patient's skin should be free of any bandages or ointments.

The patient should be made to relax comfortably while undergoing this treatment, which should last for a period of twenty minutes. This treatment may be given daily, or a minimum of three treatments a week. Following the heat treatment, the joint should be covered and allowed to cool gradually. One must guard against chilling.

In treating multiple joint involvements, it is advisable to use a large body baker which covers the patient's entire body with the exception of the head. This type of treatment is more severe and there is profuse sweating, with a consequent loss of body salts and water. To take care of these losses the administration of 15 to 30 grains of sodium chloride followed by two glasses of water is recommended.

Infra-Red Irradiation.--This is another form of heat application by means of the infra-red generator. It is best to allow five minutes for the heating of the generator before making application to the skin surface over the affected joint. The distance of the generator from the patient should be such that the patient feels a comfortable heat. This should last for a period of fifteen to twenty minutes.

Luminous Heat Bulbs.--Such bulbs as Thermo lights are used in localized joint involvements. The benefit derived is entirely due to the heating characteristics. The tremendous heat thrown out by these lamps makes them more or less dangerous, and they should be used with care and at a safe distance from the patient's skin surface. This lamp will heat the skin surface quickly and tremendously, and in treating an arthritic joint the slow heat and the prolonged

heat is to be preferred. The amount of heat should never reach the stage of discomfort. By increasing the distance of this lamp from the patient a satisfactory treatment will be given.

Diathermy.—Medican diathermy is the production of heat in the body tissues. This modality is applied by three methods:

1. Long wave or conventional diathermy.
2. Short wave diathermy.
3. Induction coil diathermy.

The relative merits of these procedures are still in the controversial stage and will not be discussed here. It is sufficient to say that all three methods will induce heat in the deep tissues, including the joint structures.

The long wave, or convention, diathermy produces slower temperature rise locally over a longer period of time. The metal electrodes come in direct contact with the skin surface. Care must be taken in the application of the metal electrodes. K-Y jelly or soap may be used to insure good skin contact; otherwise sparking occurs with resultant burns. One or two joints may be treated simultaneously by means of bifurcated cords. Equal-sized electrodes may be used above and below the joint in the form of cuffs. The duration of treatments is varied from thirty to forty-five minutes.

Short wave diathermy is more direct in its action. The body acting as a condenser, the electrodes are spaced about  $\frac{1}{2}$ -inch from the skin surface. Rubber-covered electrodes are used, with felt or towels  $\frac{1}{2}$ -inch thick next to the skin. In place of the latter, glass air-spaced electrodes may be used in contact with the skin surface.

The electrodes are placed either above or below the joints anterior or posterior, or laterally to the joints. The duration of the treatment is dependent on the power of the apparatus and ranges from ten to twenty minutes. Do not treat through the clothes.

Induction Coil Method.—The current is conducted to the patient by means of a very flexible cable which is insulated. The cable is coiled about or wrapped around the joint to be treated. The duration of the treatment varies from twenty to thirty minutes.

In giving any one of these diathermy treatments it is necessary to be careful that no metal comes in contact with the patient or the machinery. Metal chairs, metal beds, or spring mattresses should not be used, for shocking and severe burns may result. There is also a tendency for the metal furniture to draw the current away from the parts or part which is under treatment, thereby making the treatment ineffective.

Diathermy treatments are given on an average of at least three times weekly, although there are no contraindications to daily treatments. One or two treatments weekly produce little or no results.

Hyperpyrexia.—Hyperpyrexia induced by physical agents is a long-drawn-out procedure which is time-consuming, expensive, ~~ex-~~  
~~pensive~~, and which subjects the patient to considerable mental and physical exhaustion. Among the arthritics, particular care must be exercised, especially in the selection of cases as to risks. The cardiorenal mechanism must be in excellent condition. Reports show that the results are good in only a few selected cases, usually

among the early acute cases associated with gonococcal infection.

Paraffin Baths.—Another means of applying heat is with the paraffin bath. The paraffin is melted in a double boiler, care being taken that a piece is left unmelted or, otherwise, burns may result.

If the joints of fingers, hand or wrist are affected, the hand is dipped into the paraffin, keeping the fingers separated. Do not touch side or bottom of boiler. Remove the hands from the boiler and the paraffin is allowed to harden. Again dip and quickly remove. Repeat this process until a thick glove is formed. Allow the paraffin to remain on for one half to one hour; then peel off and put paraffin back into the boiler.

If paraffin is applied to knee joint, elbow joint, spine or ankle joint, a new paint brush is used to apply the paraffin to the affected part. Apply it until you get a thickness of 1/8 inch and allow it to remain on for from one-half to one hour.

The above procedures may be done at least three times weekly; or, if the procedure is carried on at home, it may be done three times daily. The value of the paraffin bath is attributed to the fact that heat is effectively retained for considerable periods.

Mud Baths and Mud Packs.—These are recommended for general and local use in chronic arthritis, especially in the presence of capsular swelling. The essential effect is that of heat; the mud has high heat retention and low heat conductivity, higher temperatures can, therefore, be maintained.

Massage.—Massage is the manipulation of the soft tissues of

the body. It is important that such massage of an arthritic be gentle and purposeful. The heat treatment usually precedes the massage, for the heat prepares the tissues by giving them proper relaxation and a better blood supply.

In a massage, the joint should be completely relaxed and comfortable, clothing and restricting bands being removed. In giving the massage the hand or hands should mold the surface of the tissues and should move smoothly. If necessary, cocoa butter, cold cream or olive oil may be used; or, if the skin is moist or sticky, alcohol or talcum powder can be used. The massage should not cause pain and the hands should be kept in contact with the skin surface at all times. Do not pinch the tissues. A stroking movement should be used. The depth of the stroke depends on the toughness and resistance of the tissues. The heavier stroking should be upward, the lighter stroke downward. Pemberton advocates that massage of an arthritic joint be confined to the regions below and above the joint, for it is at these places that circulation can really be increased. Five minutes of massage to a joint is sufficient; a longer massage often tends to traumatize the already weakened tissues.

Pemberton gives four indications for the use of massage in arthritis:

1. To prevent or delay muscle atrophy and to restore tissue when atrophy has taken place.
2. To improve local and general metabolism.
3. To increase circulation of the local tissues.
4. To promote muscle contraction of the limb, thereby stimulating venous blood flow.

X-Ray Therapy.—Many of the larger arthritic clinics have used the x-ray in the treatment of chronic arthritic cases. The technique was to give 200 or over two to four target areas twice each week for six treatments which comprised a course of treatment. No further treatment is given until two months have elapsed. The results show improvement in 60 to 75 percent of the cases of osteoarthritis.

No better results were noted in those patients with considerable soreness and tenderness or spasm of the muscles. Persistent stiffness and pain in which a decrease in swelling is difficult to measure seemed to be an indication for x-ray therapy the effect of which seems to be chiefly one of analgesia with an increased range of motion at the joint.

Severe deformity or articular derangement, serious chronic disease or systemic infections seem to be contraindications to x-ray therapy.

The duration of symptoms had little effect on the end results. The condition of the joint was the most important factor. Repeated courses of x-ray treatment do not ensure the permanence of the improvement. Unpleasant effects such as a temporary increase in symptoms after the first treatment and nausea and vomiting were occasionally seen but no damage to the skin or articular tissues occurs. Roentgenotherapy should be regarded as a local treatment only—a helpful adjunct to the medical and orthopedic measures that are usually prescribed.



Ultraviolet Irradiation.—Ultraviolet irradiations are contra-indicated in febrile conditions. This limitation is often overlooked. The arthritic patient is frequently in need of ultraviolet and oftentimes shows remarkable results. The local reaction of the skin to the ultraviolet rays is an erythema is associated with an enlargement of the capillary vessels. This vasodilatory reaction is not confined to the irradiated surface but extends deeply into the tissues. Blood regeneration in anemic conditions is often stimulated by this procedure. The erythema-producing rays, in normal doses, evoke a rise in the bactericidal elements of the blood. It cannot be said that the important subject of the full mechanism of the blood reactions is yet satisfactorily understood.

The general systemic effects of the ultraviolet rays on the body which are beneficial to the arthritic include an altered metabolism which is shown in the improved appetite and sleep, increased assimilation and diuresis, mental stimulation through action on the central nervous system, improvement of skin tone, and the formation of vitamins and provitamins. Ultraviolet rays may be obtained from various sources, direct sunlight and ultraviolet lamps of various types.

In preparing the patient for irradiation treatment, either natural or artificial, it is necessary that the skin surface be free from any grease, ointments, powders or other medications and that the skin be exposed directly. In giving sunlight treatments, the patient's eyes should be protected, either by dark glasses or

moistened cotton sponges. If natural sunlight is utilized, the best time for exposure is about 11:00 AM. The nurse or the patient should be advised of the importance of this consideration. The first exposure should not exceed fifteen minutes, which time is increased by fifteen minutes with each subsequent exposure. The patient may be exposed anteriorly and posteriorly the same day or on alternate days. Care must be taken not to overexpose the patient. Some serious complications have resulted as a result of neglect of this precaution.

Galvanic Current.—When considering galvanic currents it is always necessary to consider the effects of polarity. The galvanic current is a direct current possessing actively positive and negative poles.

In the treatment of an arthritic joint, the galvanic current may be used. A painful joint may be given relief from pain by application of the positive pole, because this has a tendency to reduce nerve irritability and to produce vasoconstriction. On the other hand, relief of joint pain may be secured by the application of the negative pole, which acts as a counterirritant by increasing nerve irritability and produces vasodilatation. The effects are purely the result of this reaction.

Iontophoresis.—Iontophoresis is employed for the introduction of drugs with local vasodilating effect by means of the galvanic current. The drugs that are most commonly used at present are histamine and mecholyl in 1 per cent aqueous solutions or in ointment form.

Both of these drugs, when introduced into the tissues through the skin's surface, produce marked vasodilatation at the site of application. This vasodilatation is maintained for a period of from twelve to twenty-four hours. The action is partly one of counterirritation. However, if treatment is prolonged, there will be considerable absorption of the drugs with resultant systemic effects. These drugs should not be used on those patients who are prone to asthmatic attacks or who have cardiac involvement.

Hydrotherapy.—Chronic arthritis is not a disease of certain joints but a constitutional disorder so hydrotherapy is valuable in that it produces increased circulation and metabolism.

The full tub bath, given at a water temperature of 100° F. for a period of twenty minutes, is sometimes indicated in polyarthritis. While the patient is in the water, he should try active movements of all the joints. These patients should be carefully watched and, occasionally, should be assisted in their movements. The room temperature should be 75° or 80° F. to prevent the patient from getting cold.

For those arthritics who are unable to take a full tub bath, Coulter describes the application of the full wet pack; this consists of wrapping the patient in a warm moist sheet with dry blankets over this and allowing him to remain for forty-five minutes. Body bakers, Thermo lights, infra-red irradiations, or hot water bags may be used in conjunction with this application to keep the subject at the desired temperature. These systemic treatments

are given at least twice weekly and not more than three times weekly.

Hydrogymnastics are sometimes desirable and are conducted by immersing the patient in a heated pool at a temperature of 102° F. and allowing him to exercise the painful joints under water. The bath may last thirty minutes, but it should not be given to the weak or debilitated arthritics. The Hubbard tank, improved by Currence, has been devised for hospital use. This enables the arthritic not only to receive the movements necessary under water, but the whirling motion of the water also gives him a gentle massage.

Whirlpool baths are given either to the upper or the lower extremities at a temperature of 110° F. for twenty minutes. The whirling produced by water under air pressure gives an efficient and gentle massage to the painful joint. Joint motion which otherwise could not be tolerated because of pain may be given while in the whirlpool bath.

Nauheim or carbon dioxide baths owe their effects purely to the generalized peripheral vasodilatation and counterirritation. These baths at present can be produced artificially, with the same results as with natural water. The warm, magnesium-sulfate full-tub bath given at a temperature of 100°F. for thirty minutes is a useful household treatment, using proportions of 1 pound of Epsom salts to a tubful of water; this is often sufficient to afford relief from painful joints. These baths should be given at least twice and not over three times weekly. The procedure is contra-

indicated in the case of weak and debilitated patients.

The local application of hot magnesium-sulfate packs is favored by a good many. In applying such packs the temperature should be 103° F. and the packs should be at least 1 inch thick. The solution should consist of 2 teaspoons of magnesium sulfate to 1 quart of water. The joint should be completely wrapped in the pack and the pack should remain on for at least an hour; this should be repeated every three to four hours. Again a baker or Thermo light may be used to maintain heat.

Exercise.—The value of exercise for the maintenance of health is generally known, the resulting increase in circulation benefiting all parts of the body. In the arthritic, exercise must be limited and selected.

Passive exercise, limited in extent, is necessary to prevent adhesions and contractions of the joints. The movements should be gentle and without pain. Never force a joint, for this is very apt to produce a flare-up in the condition.

Active exercise may be employed to restore muscle function. All structures producing motion must be considered part of the joint: the ligaments, muscles, synovial membranes, the nerves and the blood vessels. The active exercise should be limited to the point where the patient begins to feel pain and fatigue. If the patient is too weak, the active movements may be assisted. When the joints are stiff and will not function freely, the patient should be encouraged to move the muscles about the joint actively, i.e., so-called muscle setting. In the presence of pain or inflammation, motion about the joint is contraindicated.

Occupational Therapy.—This form of treatment should be devised to meet individual requirements and should include not only physical, but also mental occupation. Occupational therapy is applicable chiefly to the convalescent and has a very limited place in the regimen for patients who are acutely ill or for whom complete rest is essential.

Posture.—Permitting the chronic arthritic to become deformed is poor treatment. Poor posture is a potential factor in arthritis, and early steps should be taken toward prevention rather than correction. The purpose is to get these muscles in balance so that proper tone will develop. The physician should be the one to demonstrate and give proper postural exercise as indicated to meet the requirements of the patient.

Rest.—Fatigue is almost always present in chronic arthritis and, therefore, general rest, both physical and mental, is essential. Rest in bed should be in a position of good posture. The bed should not sag; the spine is to be kept straight allowing only one pillow under the head. No pillows are to be allowed under the knees. The patient should not be kept in one position for too long a period, frequent changes of position being indicated to prevent pressure sores and stiffness. Mental rest and relaxation is secured by eliminating various mental annoyances, such as visitors and household details.

Local Rest.—The affected joint should be kept at rest. This procedure should be prescribed judiciously and the position of rest should be the position of maximum function. Molded plaster splints

are best utilized for joint rest. Later, braces may prove necessary as a supportive measure. Do not immobilize the joint over too long a period, for this may eventually lead to joint stiffness. Passive motion and massage should be instituted at the earliest possible moment during the course of a splinting procedure.

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### Endocrine Therapy in Arthritis

Estrogenic Substances.---Because of the fact that many women have arthritis for the first time or have an exacerbation of an already existing arthritis at the time of the menopause, and because still more have prominent rheumatic symptoms, especially arthralgia, at the time of the menopause, it was suggested that there was an intimate relationship between gonadal hormones, and perhaps the whole endocrine system, and some forms of rheumatic disease.

One of the first endocrine preparations used to treat menopause arthritis and arthralgia was thyroid substance, for sometimes thyroid deficiency definitely exists. In such cases benefit is derived from the thyroid. However, with the development of our knowledge regarding the nature of the menopause, it became evident that use of estrogenic substance might more often be helpful. Numerous reports indicated that adequate treatment with a potent estrogen will often completely control the arthralgia and even arthritis which develops with the menopause, both natural and artificial.

In those patients who began showing signs of the menopause after arthritis existed, improvement in the arthritis was slight or none at all, although typical symptoms of the menopause were effectively relieved by estrogen therapy. There was no particular difference in the effects of the oral and ingested substances provided sufficient doses were used. Significantly more of the substance was needed when given by mouth.



Thus it would appear that in patients undergoing the menopause in whom rheumatic disease develops at that time adequate treatment with potent estrogenic substance may often have significant benefit on the rheumatism as well as on other menopausal difficulties. Oral preparations seem as effective as injected substance when used in adequate amounts; by either route moderate to large doses may be needed to effect good results. Estrogen therapy had little or no effect on the rheumatic disease in cases of existing arthritis when the menopause began.

Arthritis and Hypothyroidism.—Hypothyroidism, more particularly the severer form of thyroid deficiency, myxedema, frequently has an etiologic role in arthritis. It appears that only in the more advanced forms of thyroid deficiency is the incidence of arthritis significant.

"Hartsock found that there is a seasonal variation in the amount of thyroid extract required, a larger amount being required in cold weather. Hartsock further recommends that thyroid extract be administered early in the day even when the basal metabolic rate is well below normal."

The general concensus of opinion is that thyroid gland therapy was of permanent beneficial effect in 45 to 50 per cent of the cases. Osteoarthritis of the hip, spine, or shoulders did not respond well to the administration of thyroid extract. Obese women exhibited swelling of the arthritic joint and show excellent results from thyroid extract administration.

In determining the indications for thyroid therapy in arthritis it is found that thyroid extract is most effective in the presence of other signs of hypothyroidism. The hypothyroid symptoms are in many cases the so-called "minor" or "atypical" evidences of hypothyroidism: intolerance to cold weather, persistent subnormal temperature, tendency to recurrence of acute and subacute catarrhal symptoms, minor gastro-intestinal symptoms, mental and physical lassitude, increased perspiration, dryness of the skin, etc..

It is a false premise to establish a diagnosis of hypothyroidism on the basis of a low basal metabolic rate alone because anterior pituitary deficiency and hypoovarian cases can cause such a condition.

A combination of thyroid extract and estrogenic substance is sometimes advocated in arthritis of the menopausal age. The type of menopausal arthritis case which is most favorable and promptly affected by thyroid extract is one in which swelling in or about the articular tissues is present. The menopausal syndrome frequently appears as a pseudo-hyperthyroid state, the complaints being a sense of fulness in the thyroid region, nervousness, activation, vasomotor disturbances, palpitation, and insomnia. In the initial clinical appraisal of the case, therefore, thyroid extract appears to be contraindicated. The administration of estrogenic substance, however, promptly controls the pseudo-hyperthyroid state, and not until then is the true state apparent and the need

for thyroid extract evident. In the main, this type of case tolerates only low dosage of thyroid extract—1/4 grain to 1/2 grains daily—and toleration is usually optimal when thyroid extract is administered in the morning.

The dosage of thyroid extract quite naturally varies with the degree of the thyroid deficiency present. Generally, it is preferable to begin thyroid therapy with a dosage smaller than the estimated requirement and, at weekly intervals, gradually increase the dosage to the physiologic level desired. This procedure is particularly valuable because many arthritic patients are reported as having an intolerance for thyroid extract. This is seldom noticed when clinical signs and symptoms of hypothyroidism coexist with arthritis.

The most that can be said for thyroid therapy in arthritis is that it acts best when a frank thyroid deficiency, such as myxedema, coexists. In the milder hypothyroid states its favorable effect on the arthritis becomes less evident. Its general metabolic effect, however, and particularly its effect on improving elimination with the resultant increased physical and mental drive, enhances its value as a therapeutic agent in the general arthritic regimen in a definite group of cases.

Arthritis and Hypopituitary States.—The anterior pituitary is a source of growth hormone and experimental work has shown that growth hormone exerts a specific proliferative action on cartilaginous tissues of the joint structure.

In acromegaly, which is associated with excessive growth hormone production, hypertrophic changes occur in the articular surfaces. When dealing with hypertrophic arthritis of acromegaly due to hyperfunctional eosinophilic pituitary state, estrogenic therapy is administered in quantities sufficient to suppress or inhibit the pituitary eosinophilic hyperfunction. The best therapeutic results are obtained in acromegalic cases in the climacteric age.

Anterior pituitary deficiencies per se have no apparent primary relationship to arthritis. We have referred to the role of the anterior pituitary as a cause of secondary hypothyroidism. Its chief importance is as a cause of obesity which may complicate the arthritic state.

In the majority of hypopituitary cases we depend upon the oral administration of anterior pituitary extract in total dosage from  $1\frac{1}{2}$  to 3 grains daily, given in divided doses immediately after meals. Hypopituitary cases generally have a coexisting secondary hypothyroidism, consequently thyroid extract is also administered in dosage which is from  $1/5$  to  $1/4$  of the total amount of anterior pituitary extract administered.

For those who desire a more rapid therapeutic action from anterior pituitary preparations, commercially available as Pölyarsyn, used hypodermically, is recommended. This should be administered in 1 to 2 cc doses two to three times weekly.

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SPECIAL THERAPEUTIC AGENTS IN ARTHRITIS

Gold Salts.—There are several preparations of gold that have been used in this country, some for intramuscular and some for intravenous administration. Apparently the intramuscular route is to be preferred because reactions seem to be fewer and the results as good as obtained by the intravenous route. The great majority of the reports deal with products intended for intramuscular use. Among them may be mentioned Myochrysine, Allochrysine, Sanocrysine, Solganol-B and Parmanil. There may be minor differences in toxicity and therapeutic effects, but for discussion they may be conveniently considered as a group.

Opinion is divided regarding the value of gold salts for therapeusis, with perhaps a slight majority of reports favoring it. A great many reports are indefinite as to diagnosis of the types of arthritis treated, some neglect to mention the length of time patients were treated, and some lacked adequate control. Men such as Key, Stone and Snyder are of the opinion that gold is a valuable therapeutic agent for atrophic arthritis.

Unfortunately the administration of gold salts is fraught with danger; reactions are numerous and sometimes rather severe with even an occasional death. Some of the toxic reactions reported are dizziness, headache, vomiting, diarrhea, abdominal pain, stomatitis, jaundice, erythema, herpes, albuminuria, exfoliative dermatitis, purpura hemorrhagica, agranulocytosis and aplastic anemia.

This is indeed a formidable array of reactions, and makes one hesitate to subject patients to such hazards without some assurance that they will probably derive some benefit from the treatment.

Sulfur.--This agent seems to have about run its course and is apparently headed rapidly for oblivion. The Council on Pharmacy and Chemistry of the American Medical Association, in a critical review of the literature on sulfur, concluded that it is of very questionable value: "It would seem to be of great significance that not one of the leading arthritic clinics of the United States has adopted the use of sulfur in the treatment of arthritis, so far as can be determined."

Bee Venom.--The infrequency of rheumatism among beekeepers is often mentioned in works devoted to the trade of raising bees, although no one seems actually to have made a scientific study of the matter. However, this method of therapy has captured the fancy of the public, and many a patient has "just heard of someone who was cured of arthritis by bee stings." But reports of the use of bee venom in the literature have been disappointing--many investigators stopped using it because it was so disagreeable to patients, and still produced no noteworthy effects. Some investigators used one of the various products for intradermal injection, and some used actual stings of bees. Results were equally bad in both cases.

However, bee venom may have a place in a well-rounded program for some patients, if it is used with the conviction that it is a

counterirritant and probably nothing else.

Chaulmoogra Oil.---This remedy has not gained a great deal of popularity, probably because of the considerable pain incident to the injection and the frequency (5 per cent) of abscess formation at the site of injection, together with rather poor results. There are several reports which condemn its use.

Sulfa Drugs.---There seem to be no favorable reports concerning the use of the various sulfa drugs in the treatment of atrophic and hypertrophic arthritis.

Artificial Jaundice.---Several clinicians have noted independently that the spontaneous development of jaundice in arthritic patients produces a definite remission of joint symptoms. Attempts have been made to reproduce this effect by deliberately producing jaundice in arthritic patients by various methods. These investigations open another very interesting field for research---there seems to be a difference between spontaneous jaundice and jaundice produced by the methods so far attempted. Perhaps an agent, if found, that will produce a jaundice similar to the spontaneous type, will change the present concept of the treatment of arthritis; at any rate, this subject is deserving of considerable more study.

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METABOLIC AND DIETETIC CONSIDERATIONS IN  
THE TREATMENT OF ARTHRITIS

The role attributed to nutritive factors in the pathogenesis, symptomatology, and therapy of arthritis is often exaggerated or minimized. On one hand, the role of nutritional factors is emphasized far beyond its appropriate sphere of influence, and bizarre dietary measures based upon doubtful premises are exploited in certain uncritical quarters. On the other hand, consideration of nutritional factors is summarily dismissed in some quarters merely because there is no clear-cut evidence that any single nutritional deficit or excess is responsible for the complete clinical pattern of any of the major syndromes of arthritis. The view, however, that considerations of nutrition can be dismissed because of recognized limitations is dependent upon the erroneous assumption that such factors must play either an exclusive role or none at all.

Many clinical conditions, particularly the chronic arthritides, are complicated if not characterized by subclinical manifestations which appear in the disease entities beri-beri, xerophthalmia, scurvy, rickets and pellagra, now universally regarded as deficiency syndromes. It is reasonable to suspect that such features, when presented by arthritics, arise as results of minor degrees of corresponding nutritional deficiencies.

In addition to individual vitamin deficiencies, which may complicate an arthritic condition, other kinds of nutritional dis-

turbances may be present. These may be secondary results of the increased demands or decreased capacity for absorption and utilization of certain foodstuffs incidental to the arthritic state.

In order to obtain the maximum benefits which can be realized by dietetic control or management it is essential to check each patient with respect to symptoms which may have an origin in dietary imbalance, special nutritive requirements and capacities, adjusting the diet in the several particulars indicated by individual analysis. It is, therefore, the purpose of this discussion to direct attention to both the singular and collective role of nutritional factors in respect to some of the deviations encountered among arthritics and to indicate, in the light of available information the general and specific therapeutic implications to be derived therefrom.

The General Role of Nutrition.---Nutrition in the broad sense includes more than is suggested by diet, which refers to materials ingested. Nutrition involves the maintenance of tissue cells in a medium suitable for their growth, development, and for their functional maintenance and repair. There are several recognized levels of nutrition, viz., inadequate, adequate, and optimal. The aim of any therapeutic regimen is the achievement of optimal nutrition. The presence of infection, vascular defects, and other conditions of a similar nature often existing in the arthritic, imposes further limits upon the extent to which a given supply of dietary materials may meet the nutritional needs of the colonies of cells

comprising tissues and organs. The presence of infection exerts both a direct and indirect influence upon cells and modifies the amount of materials required for the maintenance of normal or optimal function. During periods of fever, the total metabolic interchange is increased over the basal afebrile level, so that materials of fixed tissues are consumed unless sufficient calories are provided from outside sources.

Optimal nutrition requires more than the simple provision of certain quantities of various substances; it demands that these materials be provided under circumstances most favorable for their utilization. This involves attention to the presence of infection, to the physical and physiologic activity of the organism as a whole, and to the balance of the several foodstuffs. The full value of one factor can only be realized when it is used in conjunction with all the essential factors.

Caloric Value.--The caloric value of the diet is estimated with regard to the individual requirement and not determined by the clinical type alone. A patient who is essentially normal in weight but who is being treated in bed will be given a diet providing about a 10 per cent excess over the basal energy expenditure.

The patient who is grossly underweight naturally requires foodstuffs providing a supply of calories in excess of the quantity actually desired during the course of the day. Not only must the basal needs be covered but, in addition, a quantity provided which can restore reserves. The underweight individual not only

needs an excess of calories in order to restore tissue substance, but he also requires a quantitative excess of the specific materials used. A diet providing merely an overabundance of calories is not necessarily optimal for the underweight individual. It is both theoretically and empirically necessary to provide liberal amounts of all of the known essential food factors. This requires emphasis upon qualitatively good proteins and vitamins.

When, however, the patient is grossly overweight and it is desirable to induce a general weight reduction in order to diminish the traumata to weight-bearing joints, it is necessary to lower the level of the caloric intake below the amount required for maintenance. When a reducing regimen is undertaken, care is exercised to provide a little more than the average proportion of protein and to supply sufficient accessory substances, usually in the form of a fairly bulky diet. The first provision tends to augment the rate of metabolism due to the specific dynamic action of protein and, coincidentally, to favor losses of body water.

#### COMPONENTS OF THE ARTHRITIC DIET

Protein.—The fact that the proteins of the diet provide the amino acids or structural units of which the framework of tissues is constructed, suggests that proteins of good biologic quality should be liberally provided in the diet of patients whose disorders are characterized by wasting manifestations.

Attempts made in the laboratory to produce gross articular pathology in rats by feeding diets inadequate in the amino-acids,

cystine and lysine, and by rations in which the incomplete protein gelatin provided the nitrogenous fraction were negative. While these preliminary experiments do not exclude the possibility that certain deficiencies of amino-acids may be significant in the pathogenesis of some phases of the arthritic syndrome, they suggest that the clinical pattern is not based upon the aforementioned deficiencies alone. The protein supply should be provided from a number of biologic sources in order to insure not only a variety in taste, but an adequacy of amino-acid composition. The latter requirement can be met by the liberal use of meats, dairy products and eggs. No particular variety of protein from any source is known to be generally contraindicated. The total protein should amount to at least one gram per kilogram of body weight.

Carbohydrate.—Wide differences of opinion are expressed in regard to the proper level of carbohydrate in the diet for the arthritic. Thus, on the one hand, it is stated that the arthritic can tolerate a high carbohydrate diet; and, on the other that the arthritic fares better on diets low in concentrated carbohydrate foodstuffs. In support of the former view the normal respiratory quotient of arthritics is cited as evidence of a normal capacity to metabolize carbohydrates and furthermore the ingestion of rations high in carbohydrate does not always induce exacerbation of the disease. On the other hand, attention is directed to the delayed rate of removal of ingested glucose from the blood of many

arthritics. It is further alleged that patients do better when the concentrated carbohydrate of the diet are kept at minimum levels.

These apparently contradictory views can be harmonized by recognizing that carbohydrates are not toxic per se, and that the benefits of carbohydrate restriction when present are related to certain limited but definite factors. One of the general empirical reasons for restriction of concentrated carbohydrates relates to the relatively low amounts of accessory substances or vitamins in foodstuffs of this kind. Since the supply of vitamin B is often barely minimal under ordinary conditions, the available supply may be relatively inadequate by excessively high carbohydrate ingestion. Another relevant consideration relates to the influence of carbohydrates upon the management of the low grade edema presented by some chronic arthritis. Carbohydrates, when stored as such hold considerable portions of water, and limitation of glucose favors a state of relative dehydration. The influence of the solute sodium chloride in holding tissue water is well recognized; the comparable role of the solute glucose is less widely appreciated; the control of the edema of the chronic arthritic can be considerably influenced by regulation of this latter factor.

Exclusive of the aforementioned instances, a supply of  $1/3$  to  $1/2$  of the calories (exclusive of that provided by protein) in the form of carbohydrate is empirically desirable. No special kind of dietary carbohydrate is known to be contra-indicated for the rheumatic.

Fat.—The quantity of fat in the diet bears in general a reciprocal relation to the amount of carbohydrate in the ration. The reasons for including a comparatively large amount of fat, as compared with that usually provided by the usual dietary, is to "spare" vitamin B and to minimize the accumulation of tissue water by maintaining metabolic conditions favorable to the elimination of water. In the selection of the kinds of fat to be included, those rich in the fat-soluble vitamins should be considered, not only because of their known vitamin content but because of other associated special nutritive qualities, i.e. essential fatty acids.

There is some evidence to suggest that fats, as well as proteins, may afford certain protective qualities toward noxious agents. Fats might be expected to further augment the defensive qualities conferred by the already recommended relatively large amount of proteins.

While patients with hypertrophic arthritis as a class show a higher level of cholesterol in the blood than do normal patients with atrophic arthritis, this does not necessarily indicate that fats should be reduced to a minimum.

Except for those persons who have an intolerance to fatty foods based upon gastro-intestinal dysfunction or the existence of a gouty diathesis, there are but few instances wherein unusual limitation of fat is indicated among arthritic subjects. The fats should therefore make up about  $1/3$  to  $1/2$  of the caloric value of the diet, exclusive of that provided by protein.

Vitamin A.—Gross deficiency of Vitamin A is not conspicuous among arthritic subjects. However, there are a few symptoms encountered with some frequency which may have an origin partly upon such a nutritional basis.

Frequent upper respiratory infections, indicative of an unusual susceptibility, while by no means pathognomonic, in some instances may be due to deficiency of Vitamin A. The moderate and sometimes profound disturbance in liver function evident in the more acute manifestations of atrophic arthritis and the recognized interference of this with the capacity to transform provitamin A into the active vitamin suggest the desirability of providing very liberal amounts of the preformed substance.

Any widespread evidence of disturbance of epithelial tissues may be regarded as suggestive of evidence of Vitamin A deficiency. A therapeutic trial is the best and final means of determining whether any abnormalities actually arise upon a nutritive basis.

The basal diet of the arthritic should include at least 6,000 International Units of Vitamin A and, if any features of severe deficiency are present, this should be supplemented with 20,000 to 50,000 units per day as a therapeutic dose.

Vitamin B.—Symptoms of Vitamin B deficiencies are frequently encountered in arthritics but the full syndrome of beri-beri does not appear. Furthermore, while beri-beri is often accompanied by joint pain, true arthritis is not a common complication. However, several symptoms conceivably resting upon a basis of such deficiency



do occur among chronic arthritics. Anorexia or lack of appetite is a frequent complaint. A peripheral neuritis is sometimes present, together with an occasional inability to dispose properly of ingested carbohydrate. The low-grade peripheral edema already referred to may be similar in origin to that of the so-called "wet beri-beri".

The basal ration for the arthritic should include at least 250 International Units of thiamin. If deficiency symptoms or subclinical manifestations are conspicuous, therapeutic doses up to 20 mg. of thiamin per day are justifiable.

Vitamin C.—The scorbutic state in its fully developed form is fortunately rare. The syndrome responds favorably to the administration of adequate doses of cevitamic acid.

There are several other clinical states within the class of rheumatoid diseases which show many features of the scorbutic state in a mild form; the generalized connective tissue weakness, that is, a decrease in the integrity of the intercellular cement substance, is often notable. One site where the consequences of this situation may be recognized by the clinical inspection is the gums. The gingivae of arthritics are frequently tender, spongy or swollen and infected. Some patients in the rheumatoid group, although by no means all, show evidence of decreased capillary strength, evident clinically by an increased tendency to bruising or by one of the several procedures for estimating rupture level of the cutaneous capillaries. Muscular tenderness

and weakness is another frequent feature of the arthritic which may have an origin in a deficiency of cevitamic acid. It is also well recognized that infectious conditions are associated with increased demands for cevitamic acid, so that patients present abnormally low levels of this material in the blood even in the presence of an otherwise adequate supply of cevitamic acid. Infectious agents of several kinds inactivate or destroy Vitamin C.

The basal ration should include at least 300 International Units, equivalent to 100 mg. of cevitamic acid. If additional symptoms are present, doses of cevitamic acid up to 400 mg. per day are indicated.

Vitamin D.---The syndrome of rickets, recognized as a deficiency disease, does not loom large among rheumatoid disorders. However, there are some features of this deficiency syndrome which appear with some frequency and severity among arthritics.

There is a long-established and clinically justifiable practice of giving chronic arthritics whatever benefits may be inherent in the provision of extra supplies of calciferol in the form of cod liver oil. Within the past few years claims have been advanced for the therapeutic value of certain material related to Vitamin D when administered in extremely high dosage. The effects are usually associated with some evidence of mild toxicity rather than with evidence of a replacement of nutritive influence. The results of such therapy have, therefore, been disappointing.

Other Accessory Factors.---No claims have yet been made for the

role of other accessory foodstuffs, such as riboflavin, Vitamins E, K, B<sub>6</sub>, and P, the filtrate factor W, and pantothenic acid. None of the recognized features of experimental syndromes based upon deficiencies of these materials appears with remarkable frequency among patients with chronic rheumatic disease.

Minerals.--Claims for the therapeutic value of mineral waters and the concentrated salts derived from mineral springs and from the ash of seaweed and other materials have been made with the implication that these substances make up deficits in the mineral supply of the ordinary dietary. Most of the alleged benefits are attributed to the pharmacologic effects as gastrointestinal stimulants rather than to their nutritional qualities.

While the administration of potassium iodide is sometimes beneficial in certain cases of arthritis, the comprehensive claims advanced by pseudoscientific "experts" for the antirheumatic efficacy of iodine-bearing salts is not valid. There is no data indicating that such cases occur with unusual frequency in the area of the low iodine or "goiter belt" of the Midwest.

One of the most widely exploited aspects of the role of minerals in the management of chronic rheumatic disorders relates to the alleged disturbances in the acid-base balance. It is widely believed among the laity that the arthritic suffers from an "acid condition". On this premise of "acidosis" a diet containing an alkaline ash or a dietary supplement of an "alkalinizer" is recommended. There are, however, no generally recognized data supporting this

view. It is conceivable but not proved that the low-grade edema characterizing certain stages of chronic disease might be benefitted by the use of diets low in sodium. Certainly this possibility does not constitute sufficient basis for the routine administration of diets extremely low in NaCl.

Water.—The amount of water required for the individual is usually adequately regulated by thirst. There is no clear evidence to indicate that the arthritic has special requirements in this respect.

#### OTHER FACTORS IN DIETETIC THERAPY

Bulk of the Diet.—Intestinal stasis can be overcome generally, in part at least, by the inclusion of considerable portions of indigestible bulky residues in the ration. However, there are some patients in any group of arthritics who are adversely affected by foods containing indigestible residues, since they have irritable intestinal tracts. For these persons a less bulky diet is indicated. Sometimes this latter situation requires the administration of supplementary amounts of concentrated accessory factors or vitamins.

Palatability.—Often artificially developed likes and dislikes for certain kinds of foods contribute to the development of nutritional deficiencies. The correction of improper eating habits of this sort requires more than simple recommendation as to the needs for particular foods; it demands convincing and compelling arguments to break down long-established customs.

Not infrequently chronically ill arthritics complain of a lack of appetite and no foods seem palatable. Under these circumstances optimal nutrition cannot be secured by merely presenting a well-balanced and attractive tray. Under these circumstances supplementary administration of vitamin B may stimulate the appetite. Bittertonics such as nux vomica may be used in this connection. In extreme cases the administration of insulin is recommended to induce active hunger and overcome the barrier of subjective unpalatability.

While individual idiosyncrasy may appear among persons with rheumatoid disease, it occurs with no greater frequency than among persons in the general population.

#### SUMMARY

Many patients with arthritis show evidence of nutritional imbalance. In these and in most other arthritics convalescence and recovery may be initiated, or at least expedited, by the institution of appropriate dietetic measures.

The requirements of the sick arthritic are rarely satisfied by the provision of materials in amounts comparable to those which are adequate for the normal subject. Dietary requirements for patients may vary widely, not only from one another, but also from time to time in the same individual, depending upon the physiologic demands of activity, infection and nutritive reserve. It is, therefore, necessary to evaluate each individual patient with respect to the entire clinical state.

In the presence of symptoms conceivable having an origin in

dietary deficiency, additional supplements of the indicated factors should be provided in therapeutically sufficient amounts. Under ordinary circumstances the caloric value of the ration should be adjusted to cover, but not exceed, the energy output. Gross overweight and underweight should be controlled by appropriate periods of modified caloric balance coupled with due regard for the qualitative requirements for essential amino-acids and vitamins.

The cumulative effect of modifying the several features of the disorder by means of directional dietary control, together with the other measures will afford benefit to the majority of patients.

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THE TREATMENT OF CHRONIC ARTHRITIS WITH  
MICRODOSAGE OF BACTERIAL PRODUCTS

The employment of bacterial products in chronic arthritis need not be withheld because of the lack of a proved infectious agent. To withhold such therapy in the circumstances would be about as logical as to refuse the use of gold salts in treatment because gold can in no manner be concerned in the causation of the disease. Observations and experience justify the concept that in bacterial products we have very potent agents affecting the chronic forms of arthritis both adversely and favorable, depending upon the dosage.

A large part of the work with bacterial suspension in treatment of arthritis has been by methods which employ dosages so much larger than these that the underlying principles involved in reality constitute this as a separate and distinct method. When large doses are used, such factors as parenteral introduction of foreign proteins or of bacterial toxins or endotoxins must be considered as likely to be, in part, responsible for the reactions or the responses of the patient. In the method of microdosage the foreign protein factor is eliminated by extreme dilution of the agent used in treatment so that intravenous injections are followed by symptoms no different from those of subcutaneous administration. Bacterial toxins may be largely eliminated by the use of relatively avirulent strains of bacteria, as well as by the processing of fractional preparations derived from them.

It is important to emphasize the fact that patients with arthritis react similarly to minute doses of suspensions or extracts of all gram-positive cocci, whether streptococci, staphylococci or pneumococci. Immunologic specificity does not appear to enter into consideration in this form of treatment, so that a primary simplification of the procedure is that of choosing a standard preparation concerning which something has been learned regarding dosage and reactions.

The details of the methods with microdosage of bacterial suspensions, and with soluble fractions of bacteria, are similar. Unfortunately there is no method of estimating the dosage which is likely to be most effective in a given individual, so that it is necessary to resort to clinical trial and analysis. It has been found that a convenient range of concentrations of the vaccines is as follows: 500,000, 50,000, 500, and 50 bacteria respectively per cubic centimeter. It appears more desirable to begin the dosage tenfold at intervals of four or five days until some reaction is noted after which the dose should be adjusted just below the amount producing it.

Briefly, there are four conditions which may arise following a trial injection:

1. No change--the patient remains in status quo. This indicates that the dosage has been too small.
2. Improvement may occur, beginning within a few hours after the injection. Pain, stiffness and swelling become less. There is a definite feeling of well being.



2. (cont'd) The interpretation here is that the dosage has been correct, or nearly so.
3. The joints may become worse within the first twenty-four hours. Pain, swelling and stiffness are aggravated. There may also be transient flashes of pain in joints not previously involved. This is referred to as the focal reaction, and indicates that the dosage has been too large.
4. The patient may become worse. This is a general reaction, with such symptoms as lassitude, drowsiness, inertia, general aching and malaise, headache, anorexia and possibly a slight rise of temperature. In this instance the dosage has been very much too large.

The period of improvement after the second dose may be several days longer than was that following the first dose. This may be due to cumulative action. The intervals between doses will be determined by the length of these periods of improvement. Dosage is increased only when, on established constant dosage, the periods of improvement becomes shorter. This is the only criterion for increasing dosage in a patient who has been doing well, and success with this method of treatment depends very largely upon its strict observance.

These increases to maintain the periods of improvement become necessary at varying intervals in different patients. As the patient improves gradually through the months of treatment,

the intervals between injections may usually be increased, so that ten, fourteen, twenty-one, or even twenty-eight days come to be used. With this improvement relapse phases no longer appear, as the effects of individual doses are dissipated. Cessation of treatment at this stage is followed by an actual reactivation of the arthritis, usually at the end of two or three months. Because of this it has become the established practice to continue the treatments at intervals of twenty-one to twenty-eight days for at least a year after it is reasonably certain that the arthritis has become inactive.

This report is undoubtedly overly enthusiastic but certainly deserves further consideration and study.

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ORTHOPEDIC MANAGEMENT OF OSTEOARTHRITIS

The subject of prevention and correction of arthritic deformities is of interest not only to the orthopedic surgeon who is usually consulted when deformity has become evident, but is of great importance to the general practitioner as well. The family physician, who treats most cases in the early stage, is in position to prevent deformity by the simple procedure of proper splinting. Prevention cannot therefore be overemphasized as splinting is easily done and is almost always successful. On the other hand, deformity, once established, is most difficult to correct; it leads to much time loss, expense and discomfort and never yields as good a joint as can be obtained by splinting. When one considers the neglected patient who, for want of plaster of Paris forearm or leg splint, has developed deformities rendering luxation of the knee joints, the importance of prevention is obvious. The orthopedist, working to correct such a condition, may require two or three years, utilizing measures from wedge casts to the difficult operation of arthroplasty. The patient suffers unnecessarily and much money is spent—all for the want of an ounce of prevention. And again it is pointed out that the corrected case never secures as good a result as the one in which deformity was prevented.

The atrophic form is much more likely to result in deformity than the hypertrophic form; hence it is in this form that prevention is most necessary. Fortunately the immobilization which is

necessary to prevent deformity is a most valuable form of local treatment in all types of arthritis.

If deformities do occur in osteoarthritis they are due to the osteophyte formation with the subsequent limitation of movement, formation of joint mice, semilunar tears, or postural strain. The management of these conditions must fall within the specialty of orthopedic surgery. There is, thus, an obvious need for close cooperation between the general practitioner and the orthopedic surgeon.

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SUMMARY AND CONCLUSIONS OF THERAPY

The consensus of students everywhere is that arthritis is a disease of systemic nature with joint manifestations. The final etiology of this type of arthritis is by no means established, the evidence is quite clear that it is in any event varied. In view of this generic nature and varied etiology it is almost axiomatic that therapy must be directed at many factors and cannot depend upon any single agency.

It follows, therefore, that if therapy is to proceed along many lines, it must be integrated and coordinated; that is, welded into a whole. Almost all therapy of known efficiency in medicine carries with it both limitations and dangers. Perhaps in no other syndrome is the truth of this more obvious than in the field of rheumatoid disease. In view of the fact that many systems of the body are involved, it becomes tempting to the increasing number of those who appreciate the wide-spread nature of the problem, to bring to bear as early and as vigorously as possible the several agencies which are known or believed to be of benefit. It is precisely here, however, that great caution must be exercised. The arthritic is at best a fragile subject, as has been too often demonstrated on the operating table. Unless adequate appreciation is entertained of the instability of the nervous system, the changes in the blood and in the finer vascular beds, the disturbance of metabolism in the fluid tissues, as well as in the muscular and tendinous systems, all attempts at integration of therapy or, any

line of therapy vigorously pursued, are likely to result in a medical debacle.

The extent to which arthritics, already reduced to a low level by the chronicity and suffering of their invalidism, have been subjected to operative procedures, vigorous forms of physical therapy, the injection of vaccines, of nonspecific protein, and the application of such measures as hyperpyrexia, is a commentary upon the unfamiliarity of many of the profession with the problem as a whole. It should appear reasonable, therefore, to all who are required to treat arthritics, to provide at the outset that nothing be done to disturb further the precarious equilibrium, such as it is, that already exists; at least until the steps under consideration are shown to be essential.

By the same token that the dislocated systems of the body can be adjusted more or less successfully to or toward a normal equilibrium, so can minor disturbances in those systems be influenced in the prodromal stages of the disease. This means that much can be accomplished in the way of preventative medicine in the field of arthritis if consideration be had for the disturbances of the systems which later arise. The point of view which envisages nervous, physical and mental fatigue, faulty body posture, ptosis, and gravitational strain upon organs, anemia, infection, faulty nutrition and faulty alimentation, as significant factors in the full-blown picture, can be made equally

appreciative of minor disturbances along the same lines. The success of measures, based on this point of view, in preventing arthritis, and indeed a host of other disorders, is already well established in the opinion of many.

It should follow, therefore, that the first step in the care of the arthritic should be an attempt to achieve equilibrium in the organism as a whole. The only way in which such a basic approach to therapy of the sick arthritic can be initiated, is to treat him as other seriously ill individuals are treated, such as the tuberculosis patient, and put him to bed.

It is generally recognized that systemic rest is almost a sine qua non in the therapy of the seriously ill arthritic. By preference this means hospitalization, and it is important that both the medical profession and society awake as early as possible to the basic significance of this measure. If one were to inquire of dispassionate students what one measure which, in their opinion, could be supposed to have the greatest influence on the syndrome, the verdict would almost certainly be in favor of systemic rest. At one stroke this reaches, to some extent at least, the strain and imbalance of the nervous system, the faulty position and function of exposed organs, the faulty distribution of blood throughout the body and the improper closure of the finer capillary beds. This last-mentioned factor is so open to the proper influences that the body heat conserved by the bed covers may alter for the better, almost immediately, the faulty physiology of the lower extremities. In principle, the problem is literally as

simple as that in a few selected cases.

The gastro-intestinal tract may present anatomic derangement in arthritis, and the redundant and convoluted loops of the large bowel, which sometimes reflect this situation, may experience less tortuosity when the drag of gravity is removed.

The question of nutrition is increasingly recognized as having great significance in chronic disease, especially perhaps in arthritis, and this, too, is greatly influenced reciprocally by systemic rest. Not only are all the nutritive requirements then reduced, but betterment is instituted in the way in which the food elements are utilized. Perhaps no field of therapy toward the arthritic has been less appreciated and less developed than that of optimal nutrition.

As the several influences of systemic rest are thus brought to bear, it slowly becomes evident that a step has been taken in rectification of most of the systems of the body and this step should now be followed up with more intensive therapy. The nervous system will benefit by sedation, preferably of a gentle nature. The faulty dynamics of the circulation can be greatly influenced by the application of heat, not to mention the intelligent use of physical therapy. The function of a ptosed stomach showing hypochlorhydria can be abetted by the administration of hydrochloric acid, and the intestinal tract as a whole may benefit by lubrication or administration of a diet that is soft but bulky.

It is greatly to be feared that we are in danger of doing



injustice to hosts of arthritics through short-sighted neglect of the limited but definite role of focal infection. So significant is this role, always to be understood as having a limited part only, that the mere examination of a subject for focal infection may induce an exacerbation so severe as to reduce the individual to an even lower ebb. This consequence follows even more readily upon attempts at removing focal infection unless they are carried out cautiously and at the right time.

The exhibition of gold in the arthritic syndrome is now perhaps the most widely practiced of the new measures of therapy. Like all heavy metals, however, gold is intoxicating and may have serious reactions. It is therefore obvious that measures carrying any element of danger should come late rather than early in any well-considered scheme of therapy. Not only will the danger of intoxication then be minimized because of a general betterment of the background which the individual presents, but in the majority of instances such measures may not be required at all.

Vaccines have a limited though definite place, but it is believed that an arthritic being treated at the outset of therapy by such measures as vaccines and nonspecific protein injections, usually implies ignorance of the field as a whole. There are few cases in which it is sound to require a sick arthritic to develop, at the expense of the organism in general, antibodies whose specificity at best is problematical.

The use of drugs in the arthritic syndrome has constituted one of the most abused phases of therapy. One of the few that have stood the test of time is the group represented by the salicylates. These should be used to meet emergencies chiefly, and it is im-

portant to realize that in large doses over a long period of time, a psychopathic state may be engendered, much as in addiction to the opiates. Opiates should never be given to arthritics.

Inasmuch as the present work deals primarily with the review of treatment and not with the development of any one phase of treatment, it may be well to present a plan as outlined by Pember-ton as a general sequence to be followed in average cases.

1. Rest, systemic as well as local.
2. Sedation and/or stimulation.
3. Optimal nutrition in the refined sense discussed.
4. Proper gastro-intestinal function.
5. Examination of the blood and body chemistry.
6. Time for establishment of a general equilibrium.
7. Examination for foci of infection.
8. Medication, such as iron, arsenic, nux, etc..
9. Treatment of foci, conservatively.
10. Use of physical therapy, conservatively—meaning chiefly heat, gentle massage, postural exercise.
11. Orthopedic help.
12. Psychic re-education.
13. Last, if at all, vaccines, gold, etc..

"It is not, of course, to be supposed that adherence to this simplified plan would necessarily reach successfully every case of arthritis, but it could confidently be expected that the majority of patients would respond with gratifying results if the details

in such a regimen were carried out faithfully. The reader must be cautioned, however, that mere titular familiarity with the above headings no more assures the rewards of intelligent therapy than reading a book on golf assures playing a round in par.

One might conclude from this review that there is no well established cure for the arthritic. This will continue to be true as long as the etiology of the condition remains unknown or due to multiple causes. The treatment, of necessity, is varied and consists mainly of assisting the human body to combat the condition by correcting the specific disturbances of each individual case.

This paper also demonstrates clearly that further research into the etiology of this condition is indicated. It likewise points out the need of standardization of the reports on the results of therapy, i.e., what constitutes a "cure", what type of arthritis is being treated, duration of treatment, etc., Until such is done evaluation of any form of treatment will be difficult and new "fads" will continue to be exploited.

It should also be pointed out that patients who have a mixed type of arthritis are very difficult to treat. They respond very slowly, if at all, to therapy which must be carefully carried out to prevent the deformities so dreaded in atrophic arthritis and yet give the rest necessary for osteoarthritis.

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