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Vitamin Deficiency, Megadoses, and Some Supplemental History
A letter by William Kaufman, M.D., Ph.D.
April 7,1992
(Reprinted with the kind permission of Charlotte Kaufman)

My attention has been called to the cover story on vitamins which appeared in the April 6,1992 *Time* magazine. Another major article on nutrition appeared in the March 10,1992 *New York Times* with the heading on page B5 "Vitamins Win Support as Potent Agents of Health" and on page B9 "New Support for Vitamins as Agents of Health." Both articles were probably inspired by a New York Academy of Sciences meeting held in Arlington , Virginia some weeks ago on the theme of Vitamins, Nutrition and Health.

I will comment on the *Time*magazine's feature article on Vitamins a little later. Now, I'll list the vitamins that were first available commercially from 1934 through 1940 from Merck & Co.. More than a half century ago I started to use these vitamins in the successful treatment of my patients who had a variety of health problems.

1934 Ascorbic Acid (vitamin C)
1937 Thiamine Hydrochloride (vitamin B 1)
1938 Nicotinic acid (niacin)
1938 Nicotinic acid amide (niacinamide)
1938 Riboflavin (vitamin B 2)
1940 Pyridoxine Hydrochloride (vitamin B 6)
1940 Alpha-tocopherol (Vitamin E)
1940 Vitamin K I
1940 Menadione (Has strong vitamin K activity)
1940 Calcium pantothenate (vitamin B 5)

Vitamin A and D were available before 1934, Biotin in 1943, and Beta carotene, vitamin B 12, and folic acid soon thereafter.

Thus, none of these vitamins are "Johnny-come-lately's. In over a half century, a huge medical literature is available on the diagnosis of vitamin deficiencies and the safe therapeutic use of vitamins even when some were used in megadoses. Food as food and additional vitamins, macro- and micro-minerals supplements are often important factors in improving the health and well being of many millions of people in this country.

DIET
First of all, food and water must serve as the basis for diets, nutrition and the support of life provided the food can be eaten by the person, then be digested, metabolized properly and used to run the machinery of life, supply needed energy and provide materials for cellular repair. However, **it has never been proven scientifically with double blind controls that food and water alone can provide all the nutrients in amounts that will ensure optimal long term health to all individuals.**

Humans display considerable biochemical individuality, and therefore there are also differences in nutritional needs for different people. A diet that is healthful for a non-allergic person, may make another person allergic to some of the components of such a diet quite ill. Individuals foods can vary greatly in their nutritional content at the time of purchase. **Food tables will not dependably tell you the vitamin and mineral content of the food you are purchasing.** Simply putting vinegar on a freshly cut cole slaw salad will cause a 53% loss of vitamin C content in an hour. Potatoes are a good source of vitamin C. But reconstituting dehydrated potato flakes to make mashed potatoes and keeping this on the steam table for an hour will eliminate all the vitamin C. Oranges and potatoes held in storage for many months before being sold to grocery stores will have a decreased

nutritional value. Cooking foods in a conventional manner can cause considerable loss of both heat labile and heat stable vitamins as well as of minerals. A nutritionally important oil has been genetically engineered out of soybeans to decrease spoilage which simultaneously decreased this type of soybean's nutritional value.

Now that preservation of some foods by exposure to heavy doses of radiation is being allowed, it would not be surprising if these foods have their nutritional value diminished plus the possibility that some of the molecular changes in the foods caused by the radiation may engender toxic substances which over time might cause ill-health. Milling wheat to make white flour causes a 70 to 80% loss of vitamins and minerals which, despite the so-called current “enrichment,” leaves white bread inferior to whole wheat bread nutritionally because the loss of vitamin B6, vitamin E, chromium, manganese and fiber, all of which have not been corrected by additional supplementation.

DOCTORS WHO BELIEVE FOOD ALONE SUPPLIES ALL NUTRITIONAL NEEDS

Doctors who believe that you can get all the nourishment including vitamins and minerals you need to sustain optimal health throughout life from food alone can be very smug. They have the equivalent of an orthodox religious belief: "food is everything." They don't have to concern themselves with the fact that the nutritional value of foods their patient eats may be greatly inferior to the listed nutritional values given in food tables. They don't have to concern themselves looking for evidences of malnutrition as long as the patient eats food that sustains his weight. The patient's diet may not include whole grains or organ meats, a diet that will cause the patient to have a chromium deficiency which deepens over time leading to important and potentially lethal forms of degenerative diseases which the "food is everything" doctor will mistakenly ascribe to aging alone These "food is everything" doctors don't have to trouble themselves with thinking about how a patient's health can be improved over the long term by providing him with the additional beneficial vitamins, macro- and micro- mineral supplements tailored to his actual nutritional needs.

During the early part of World War II, GI's whose severe wound infections were treated with penicillin had to save all their urine so that the penicillin which had been excreted in their urine could be recovered and then used to treat other GI's with life threatening wound infections. If one only considered the penicillin that was excreted in the urine and not the benefits that the GI had in having his infection cured by penicillin, one could sneer that penicillin's only function was to give the GI an expensive urine. If one considered only the function of penicillin in the GI's body, one would have to marvel at the miracle of its curing a potentially lethal infection,

The two-liner attributed to Dr. Victor Herbert in the *Time m*agazine's vitamin article "We get all the vitamins we need in our diets. Taking supplements only gives you an expensive urine" completely overlooks the benefits vitamin supplements can produce in our bodies before being excreted in our urine.

MOST DOCTORS ARE NUTRITIONALLY ILLITERATE

The subject of nutrition is not taught well in most medical schools. Thus, medical students, residents, doctors, and medical faculty may not even be able to recognize classic vitamin deficiencies. The University of Alabama's Dr. Butterworth referred to in the *Time* magazine article on vitamins, was a guest lecturer at Yale University School of Medicine some twenty years ago when I attended his lecture. During his talk on the nutrition of surgical patients, Dr. Butterworth showed a large number of color slides of a patient who had classic pellagra and of another patient who had classic scurvy. Not a single medical student, resident, dietician or faculty member attending the lecture was able to make the correct diagnosis. If doctors fail to recognize classic vitamin these afflicted patients cannot receive prompt life-saving vitamin treatment. But even worse, medical students are not taught to recognize the enormously prevalent non-classic vitamin deficiency (and micro- and macro-mineral deficiency) disorders which impair the health and well being of many millions of Americans. Unless such conditions are recognized, they cannot receive "curative" treatment. Furthermore, such undiagnosed non-classic vitamin (and mineral) deficiency patients instead of being given the "curative" vitamins (and minerals) they need, they often are given drugs which they do not need Thus, in addition to unneeded pharmacologic effects, they are also exposed to the drugs' health reducing side-effects.

In 1992, what do United States medical schools teach medical students about nutrition? Marian Burros in her column entitled "EATING WELL" which appeared in the April 1,1992 *New York Times* gives a stunning answer to this question.

"Only about one third of the 125 or so medical schools require students to take courses in nutrition. And, most of the courses are short. The one at Cornell is eight hours...." "The University of Alabama at Birmingham in one of the exceptions requiring 52 hours of nutrition education for its medical students."... "The remaining two thirds of this country's medical schools only offer elective courses. *(Editor's note: Professor Emanuel Cheraskin, M.D., D.M.D., is another one of the persons we can thank for the superior nutrition program at the U. of Alabama at Birmingham.)*

"Nutrition, of course is laced through the many departments in medical school--physiology, gastroenterology, cardiology, biochemistry. But students do not necessarily recognize that it can be applied to preventive medicine. ... Dr. Young said "All studies show that if information is not taught as nutrition but is incorporated into other courses, students come away not knowing that it is nutrition. They think of it as physiology or whatever and so they do not use it in terms of practical applications of preventive medical care."... In a recent survey conducted in the southeastern region of the United States in 1986, eighty-five percent of the medical students were dissatisfied with the amount of medical nutrition education and sixty percent were dissatisfied with the quality

"Without question," Dr. Weinsier said, "A greater awareness and knowledge (of nutrition) among physicians could well impact on the prevalence of disease..."

Is it any wonder that most doctors are nutritional illiterates? Is it any wonder why doctors who are nutritional illiterates, often hide their lack of nutritional knowledge under the aegis "food provides all the nutrition a person will ever need"?

For the last half century, there have been recommendations that nutrition should be taught in medical schools as a required course. Currently, experts suggest that all medical schools should devote at least 40 hours to teaching medical students nutrition.

LINUS PAULING

I have had an "off and on" correspondence with Dr. Linus Pauling for several decades. He has referred to my use of niacinamide in the treatment of arthritis in some of his publications on nutrition. Some years ago, Pauling's foundation invited me to come to California to work with Dr. Pauling on cancer research. Unfortunately, at that time I could not make such a move.

I think the three reporters who made the denigrating statement in the Time Magazine's Vitamin article "Certainly Linus Pauling lost much of his Nobel-Laureate luster when he began championing Vitamin C back in the 1970's as a panacea for everything from the common cold to cancer" were very remiss in not first reading and then calling attention in their article to the important government sponsored meeting which resulted in the following report:

SPECIAL COMMUNICATION:
VITAMIN C: BIOLOGIC FUNCTIONS AND RELATION TO CANCER. SPONSORED BY NATIONAL CANCER INSTITUTE AND NATIONAL INSTITUTE OF DIABETES AND DIGESTIVE AND KIDNEY DISEASES. SEPTEMBER 10-12,1990, BETHESDA, MARYLAND

"(T)here has been considerable public interest in the possibility of a role of this vitamin (vitamin C) in cancer. In order that this debate might take place in a rigorous and informed manner, we attempted to bring together not only the latest research on basic actions, such as free-radical scavenging or enzyme functions, but also some of the basic laboratory and animal studies relating to cancer

"The well known anti-oxidant and free-radical scavenging activities (of vitamin C) are discussed in the first series of papers. Because free-radical damage and formation of lipid peroxides are suspected in carcinogenesis as well as cardiovascular disease, this (vitamin C) may be important for disease prevention

"Approximately half of the symposium addressed the role of ascorbate in cancer prevention or as adjuvant in cancer therapy, primarily in animal models. In vitro studies included research on oncogenic transformations and effects on the HIV virus. Moreover, several researchers presented data that suggest a role for ascorbate in reducing the toxicity or improving the effectiveness of conventional (anti-cancer) therapies. Finally, a review is presented of all human epidemiologic studies between vitamin C and cancer prevention."

Here are a few statement's taken from Gladys Block's abstract, EPIDEMIOLOGIC DATA ON THE ROLE OF ASCORBIC ACID IN CANCER PREVENTION".

"Approximately three-fourths of the epidemiological studies (33 of 46) of the role of vitamin C in cancer incidence or mortality have found statistically significant protection effects. . . The evidence for a protective effect of vitamin C or some component of fruits is strong and consistent for cancers of the esophagus, larynx, oral cavity and pancreas and there is strong evidence for cancers of the stomach and cervix . . .A major meta-analysis of breast cancer studies suggests a significant protective role for vitamin C in that cancer as well. While it is likely that ascorbic acid, carotenoids, folate, and other factors in fruits and vegetables act jointly, an increasingly important role for ascorbic acid (Vitamin C) in cancer prevention would appear to be emerging."

I cannot take the time to note all the titles of abstracts that indicate vitamin C inhibits the growth of cancer. However, to give you the flavor, I will cite just three:

(1) INHIBITING EFFECT OF ASCORBIC ACID. ON THE GROWTH OF HUMAN MAMMARY TUMOR XENOGRAFTS IN MICE,

(2) INHIBITION BY VITAMIN C OF INCIDENCE AND SEVERITY OF RENAL TUMORS INDUCED BY ESTRADIOL OR DI ETHYLSTI LBESTEROL

(3) REDUCED INCIDENCE AND TUMOR BURDEN IN SPONTANEOUS MOUSE MAMMARY TUMORS AND UV--INDUCED TUMORS WITH INCREASING ASCORBIC ACID.

Thus, Linus Pauling's view that Vitamin C has important anti-cancer properties is gaining substantial support in current laboratory and animal experiments. Where are the people who formerly ridiculed his ideas that vitamin C has anti-cancer actions?

A word about Vitamin C for colds: In the early 1940's, the health service of one of a mid-west University prescribed vitamin C to relieve students' nasal congestion associated with colds. Although Charlotte and I go decades without having colds, we have used 250 milligram doses of vitamin C to decongested our nasal membranes when these get congested from a variety of allergies. However, this effect of vitamin C has a short half-life. Thus, it needs to be given at one and a half to two hour intervals during the day and upon awakening during the night. This keeps the nasal membranes decongested, reduces pain and discomfort and prevents sinusitis. Usually, in 24 hours there is no further need to take vitamin C in this manner.

THE FDA

The *Time* magazine article points out that the FDA are planning to destroy the RDA (Recommend Daily Allowance) system as a practical guide to the amounts of various nutrients that would be required to provide decent nutrition to infants, children and adolescents, adult males of different ages, women of different ages, pregnant and lactating women. According to the article in Time magazine, the FDA plans replacing the RDA system with the so-called Reference Daily Intake.

The RDI system proposes to ignore the RDA's for different age groups and sexes. ,,"Instead of endorsing an allotment appropriate to ravenous fast growing teenage males, it would simply average the RDA's for different age groups. The new figures are considerably lower, and are a better barometer nutritional needs. Essentially the reflect the requirements of adult women.", This new system the FDA have created slashes the RDA's of Vitamin A, B's, C E and other nutrients from 10 to 80%. This will allow food manufacturers to put food products on the market legally that are much less nutritious than the ones that now have to conform to the RDA system.

There is already an enormous amount of malnutrition in this country because the large population of the poor cannot afford decent nutrition and much of their ill-health and lack of initiative is based on such malnutrition. The FDA will worsen this situation with its reduction of the RDA's.

One of the very important documents in the field of nutrition, is the Bulletin of the National Research Council Number 109 November 1943 "INADEQUTE DIETS AND NUTRITIONAL DEFICIENCIES IN THE UNITED STATES, THEIR PREVALENCE AND SIGNIFICANCE," published by the National Research Council, National Academy of sciences, Washington, D.C. This was the "REPORT OF THE COMMITTEE ON DIAGNOSIS AND PATHOLOGY OF NUTRITIONAL DEFICIENCIES. FOOD AND NUTRITION BOARD.

Its conclusions and recommendations are just as applicable to today's widespread malnutrition as they were when this report was issued

Items taken from the Summary and Conclusions of this Report:

"All the evidence from numerous surveys over the past ten years to the present among persons of all ages in many localities is without exception in complete agreement that inadequate diets are widespread in the nation. Although an appreciable percentage of diets failing to meet the Council's recommended dietary allowances were more than 50 percent deficient in amounts of several essential nutriments, most of the diets were less than 50 percent deficient. Accordingly, there is widespread prevalence of moderately deficient diets.

"All the data from numerous surveys with new methods among persons of all ages in many regions are entirely in accord in showing that deficiency states are rife throughout the nation. Relatively few are the traditional severe acute types, Most are milder in intensity and gradual in their course. Predominantly they are subacute or chronic states: some marked, but very many mild or moderate..."

"From this evidence it is clear that there is both a preventive and corrective problem. On the preventive side, it is evident that production of sufficient food should be maintained and that effective distribution of proper food is needed. For the latter, it would seem advisable to give further consideration to the program of judicious enrichment of appropriate foods since this would add much to the guarantee of successful nutrition. It is also evident that diet education must be intensified and extended to the utmost and raised to new heights of effectiveness."...

"On the corrective side, there is need for detection and therapeutic treatment of deficiency states among the population. For this project it is necessary to disseminate the new diagnostic methods among the medical and public health professions. Foremost among the steps in this direction would be (1) preparation of a handbook on methods of detecting deficiency states (2) establishment of training centers for instruction in the medical aspects of nutrition, especially the diagnosis of deficiency states; and, (3) introduction of adequate courses in nutrition, particularly its clinical aspects, into medical schools."

The conditions that existed nutritionally in the 1930's and early 1940's are just about the same as exist now in the working poor, in those on public assistance and even in those better off economically. The suggestions made about the need for prevention and curative measures are just as needed today as they were in the 1930's and 1940's.. So is the need for adequate instruction in nutrition for every medical student in every medical school. So is proper nutritional enrichment of foods.

What the FDA is planning to destroy the RDA system of nutritional standards and substituting an illogical system, RDI (Reference Daily Intake) that promotes a severe reduction of nutritional standards in a manner which if followed would ensure a great increase in nutritional deficiencies in the population of the United States.

What is astonishing in the *Time* magazine article is that leaders in nutrition make such statements "The long term effects of high-dose supplements are still unknown and doctors warn of dangers even in the short term . . .Advises Dr. Walter Willett of the Harvard School of Pubic Health: "At this time I don't take megadoses, I'm not ruling out that in two or three years we might change our mind."

What has been known for more than a half century is that vitamins even in properly chosen megadoses (and macro- and micro-mineral supplements can greatly improve the long term health and well-being of many persons eating their ordinary diets. Some of these older observations that vitamins can improve health are just being rediscovered as if they were brand new scientific findings The rediscovery of old and proven observations can't believe their own findings, They call their conclusions tentative, and seem afraid of recommending vitamin megadoses that should be widely be used in nutritional treatment.

If doctors want to know the long term effects of various vitamin megadoses, they have to go back and study the literature. Since most articles and books on this subject cannot be found by electronic means, it requires that they make such a literature search manually,

The FDA's rejection of the three nutritional applications (which proposed to use vitamins to treat disease) as being premature also is part of the anti-nutritional bias. Just think: if a nutritional approach would delay myocardial infarctions by ten or fifteen years. Would not this be crippling blow

to the profits of pharmaceutical companies that produce cardiac medications and cholesterol reducing agents?

(**My wife) Charlotte and I have taken megadoses of vitamins (and appropriate amounts of macro-and micro-minerals).** The fact that we are alive today is attributable to the beneficial effects of this nutritional supplementation. Dr. Linus Pauling has taken megadoses of vitamin C for decades.

One fascinating thing is that from 2 to 5% of all hospital admissions result from severe adverse effects from prescription drugs. Yet, doctors have no compunction in prescribing these.

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William Kaufman, M.D., PhD.

Wm Kaufman Index

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NIACINAMIDE AND ARTHRITIS

The authors of a 1996 study on niacinamide and osteoarthritis (Jonas WB, Rapoza CP, Blair WF. The effect of niacinamide in osteoarthritis: a pilot study. Inflammatory Research 45:330–334.) could have omitted the words "pilot study" from their title. Dr. William Kaufman had already published, 47 years earlier, his meticulous case notes for hundreds of patients, along with specific niacinamide dosage information applicable to both osteoarthritis and rheumatoid arthritis. In addition, the doctor added some remarkably prescient observations on the antidepressant-antipsychotic properties of B-3. Dr. Kaufman, whom his widow has described as a conservative physician, was nevertheless the first to prescribe as much as 5,000 mg niacinamide daily, in many divided doses, to improve range of joint motion.

A summation of his niacinamide therapy (pages 20-29 of his book) is posted at http://www.doctoryourself.com/kaufman5.html

The entire text of Dr. Kaufman's The Common Form of Joint Dysfunction has been republished on the Internet for free online reading.

Chapter 1 (http://www.doctoryourself.com/kaufman6.html), containing a fascinating passage about "decreased running" (ADHD), presents Dr. Kaufman's niacinamide treatment protocol. He also used ascorbic acid, thiamin, and riboflavin, all in large doses. As his rationale and measurement methods begin the chapter, some readers may wish to scroll down directly to the section on dosage ("Methods of Treatment") and read that first. The chapter closes

with case histories and an insightful, practical discussion of patient management.

Chapter 2 (http://www.doctoryourself.com/kaufman7.html),

Four Complicating Syndromes Frequently Coexisting with Joint Dysfunction, discusses physical and psychological stresses, allergy, posture, obesity and other factors that may interact or interfere with niacinamide megavitamin therapy for arthritis.

Chapter 3 (http://www.doctoryourself.com/kaufman8.html),

Coordination of Treatment, is a brief summary of Dr. Kaufman's practical recommendations for case management.

Chapter 4 (http://www.doctoryourself.com/kaufman9.html),

Analysis of Clinical Data for the Untreated and Treated Population, presents Dr. Kaufman's meticulous records of patients treated with niacinamide.

Chapter 5 (http://www.doctoryourself.com/kaufman10.html),

Some Inferences Concerning Joint Dysfunction, shows Dr. Kaufman's remarkable foresight half a century into the future of orthomolecular medicine. In this chapter, he describes how the lack of a single nutrient can cause diverse diseases; the need for a new way of looking at arthritis, and reviews his treatment and what level of success to expect.

The book's 248 references are posted at

http://www.doctoryourself.com/kaufman11.html

A complete bibliography of Dr. Kaufman's work will be found at http://www.doctoryourself.com/biblio_kaufman.html .

For additional reading:

SOME NOTES ON NIACINAMIDE THERAPY FOR ARTHRITIS
by William Kaufman, M.D., Ph.D. (a 1998 letter) will be found at
http://www.doctoryourself.com/kaufman3.html

"Vitamin Deficiency, Megadoses, and Some Supplemental History" (a 1992 letter by Dr. Kaufman) is posted at
http://www.doctoryourself.com/kaufman2.html

His comments on WHAT TOOK THE FDA SO LONG TO COME OUT IN FAVOR OF FOLIC ACID? are posted at
http://www.doctoryourself.com/kaufman4.html

Also of interest:

Kaufman, W. Niacinamide therapy for joint mobility. Conn. State Med. J. 17:584-589, 1953

Kaufman, W. Niacinamide, a most neglected vitamin. 1978 Tom Spies Memorial Lecture. J. Int. Acad. of Preventive Med. 8:5-25,1983

Kaufman, W. Niacinamide improves mobility in degenerative joint disease. Abstract published in Program of the American Association for the Advancement of Science for its meeting in Philadelphia, May 24-30, 1986

In 2002, Dr. Kaufman's papers were acquired by the University of Michigan, Special Collections Library, 7th Floor, Harlan Hatcher Graduate Library, Ann Arbor, MI 48109. Email: special.collections@umich.edu Phone: 734-764-9377

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obtain it from a physician. Consult your doctor before making any health decision.

Arthritis Treatment Home

THE COMMON FORM OF JOINT DYSFUNCTION
by William Kaufman, M.D., Ph.D.

METHOD OF TREATMENT OF JOINT DYSFUNCTION (pages 20-29)

After completion of his physical examination, the patient was apprised of the normal and abnormal findings revealed by the clinical study. Where problems other than joint dysfunction existed, these were discussed, and appropriate therapeutic recommendations were made. The subject of joint dysfunction was then presented. The meaning of the numerical value of the patient's Joint Range Index was explained to him in terms of the Clinical Classification of Joint Function (see page 21), and the dynamic nature of joint dysfunction was described. The patient was told that joint dysfunction was reversible in time when appropriate therapy was taken.

All patients with joint dysfunction who elected to accept treatment were given niacinamide in suitable doses, either alone or in combination with other vitamins. When indicated the appropriate vitamins were prescribed in addition to niacinamide. The water-soluble vitamins used were never prescribed in aqueous solution, but as tablets or as dry powders in capsule form. When vitamin A was used, it was usually given in conjunction with vitamin D. Vitamin D was always given in conjunction with vitamin A; when vitamin D was administered in this study, the daily dosage rarely exceeded 6,000 U.S.P.units per 24 hours (14) (10) (38) (56) (59) (95).

Participation in the therapeutic program was entirely voluntary on the part of the patient. Some patients at the outset declined to accept treatment for their joint dysfunction. When a patient accepted therapy for his joint dysfunction, with each succeeding visit after the initial one, improvement or lack of improvement in his joint dysfunction was frankly discussed with him. No patient was chided because he was unwilling or unable to carry out the program of therapy as it was originally scheduled. Thus, because there was no “loss of face," most patients cooperated well and gave an accurate account of their deviations, if any, from the suggested therapeutic program. Some patients at the end of the first or second month of treatment, or at a later time, felt so much improved physically that they discontinued therapy for their joint dysfunction, mistakenly believing, in spite of advice to the contrary, that they were "cured," and required no further therapy or medical supervision. Some of these persons, who experienced a recurrence of their original pattern of symptoms upon premature cessation of therapy, returned subsequently for re-evaluation of their therapeutic needs. Other patients, who felt that they had not benefited from therapy for their joint dysfunction, did not continue with treatment though objectively they responded satisfactorily to adequate therapy, as shown by increasing values of the Joint Range Index on serial re-measurements.

Therapy was always individualized. In the therapeutic program introduced for the treatment of joint dysfunction, each patient served as his test object in the bio-assay of the dosage of niacinamide necessary to reverse his joint dysfunction. Therapy with niacinamide (used alone or in combination with other vitamins) was not deemed successful unless there continuous, objective improvement, as judged by continuously increasing values of the Joint Range Index on consecutive reexaminations. (When a patient subsists on a low-protein diet, amounts of niacinamide that would ordinarily be adequate for the treatment of his joint dysfunction prove to be inadequate for satisfactory improvement. In this case, the dosage of niacinamide is continued at the same level, but the protein level of the diet is increased to adequate levels, with subsequent satisfactory improvement in the joint dysfunction.) (118) (120) (172).

The clinical classification of joint function in terms of the numerical values of the Joint Range Index is listed below:

Clinical Classification of Joint Function

Degree of Joint Dysfunction	Joint Range index
No joint dysfunction	96-100
Slight joint dysfunction	86-95
Moderate joint dysfunction	71-85
Severe joint dysfunction	56 -70
Extremely severe joint dysfunction	55 or less

For each clinical grade of joint dysfunction, the initial dosage schedule of niacinamide suggested below effects in time such improvement in joint dysfunction as the writer has considered to be clinically satisfactory. (However, since April 1947, it was found that dosage schedules 50-100% greater than those recommended below (particularly in the moderate, severe and extremely severe grades of joint dysfunction) are therapeutically superior, as judged by the patient's clinical response.)

While the initial dosage may be increased as necessary during treatment, it is not decreased, even though the Joint Range Index increases in response to adequate therapy.

The vitamins were administered orally, usually in equal doses at equal intervals during the day, and, in severe and extremely severe joint dysfunction, during the night when the patient would spontaneously awaken from sleep. In slight grades of joint dysfunction, the daily continuous ingestion of 100 mg of niacinamide after meals and at bedtime sufficed for treatment (400 mg/24 hours). Usually adequate in moderate joint dysfunction was the continuous ingestion of 150 mg niacinamide administered every 3 hours for 6 daily doses (900 mg/24 hours). In extremely severe and severe grades of joint dysfunction, 100-150 mg niacinamide were prescribed every hour (1500-2250 mg/24 hours), every hour and a half (1110-1650 mg./24 hours), or every two hours (800-1200 mg/24 hours), depending on the severity of the joint dysfunction, the more frequent schedule being used in more severe cases (97) (51).

It has been found in the treatment of joint dysfunction that the manner in which the daily dosage of niacinamide is divided has an important bearing on the the therapeutic results achieved; e.g., 300 mg niacinamide given three times daily (900 mg/24 hours) is inferior in its therapeutic action to 150 mg niacinamide administered every 3 hours for 6 daily doses (900 mg/24 hours). Therefore, to define the type of therapy used, the writer routinely records the following data: (a) the number of milligrams or units administered per dose, and (b) the total number of milligrams or units administered per 24 hours.

No untoward effects or clinical signs of toxicity were noted when niacinamide (alone or in combination with other vitamins) was administered on the above dosage schedules to individuals for short or long periods of observation. Before 1943, mild hypoglycemia had been noted clinically in a few persons when niacinamide exceeded certain dosage levels (97) (135) (51) (62), but this phenomenon has not been observed since that time.

"ADEQUATE" AND "OPTIMAL” DOSAGE LEVELS OF NIACINAMIDE IN THE TREATMENT OF JOINT DYSFUNCTION

"Adequate" dosage of niacinamide is defined as that clinically safe dosage of niacinamide which, when ingested in divided doses throughout the day by a person with joint dysfunction whose ordinary diet is not inadequate in protein or calories, and whose joints are not subjected to excessive mechanical joint injury, will effect in time what the writer has considered to be a satisfactory pattern of increasing values of the Joint Range Index. The pattern of recovery from joint dysfunction in response to niacinamide therapy, and the numerical limits of increments in the value of the Joint Range Index which are considered to be satisfactory for the first month of therapy and for succeeding months, are described on page 24.

“Optimal” dosage of niacinamide is defined as that clinically safe dosage niacinamide which, when ingested in divided doses during the day by a person with joint dysfunction, would permit the most rapid recovery in joint function, as demonstrated by the largest possible increments in the values of the Joint Range Index in the shortest possible period of time. At present, the optimal dosage of niacinamide for the treatment of joint dysfunction has not been determined clinically, although it is hoped to approximate such a dosage level eventually. Since **adequate dosages of niacinamide have given clinically satisfactory results without producing any untoward symptoms or**

signs of acute or chronic toxicity, no attempt has been made in this study to determine the optimal level of niacinamide therapy in the treatment of the various clinical grades of joint dysfunction.

However, as the higher dosage levels of niacinamide have been cautiously explored in the past 22 months, it has been found **in severe and extremely severe joint dysfunction that divided doses of niacinamide totaling 4 or 5 grams (4,000-5,000 mg) per 24 hours are therapeutically superior to the lower dosage schedules which previously had been considered adequate.** Even these higher dosage levels of niacinamide may not be optimal for the treatment of joint dysfunction.

The optimal dosage of niacinamide for the treatment of joint dysfunction, as well as the limit of human tolerance for niacinamide, can be established only in those medical centers equipped to provide careful clinical supervision, and to conduct such chemical, metabolic and clinical laboratory studies as would reveal the earliest signs of toxicity, should these occur with the administration of progressively higher dosage levels of niacinamide.

DESCRIPTION OF JOINT DYSFUNCTION AND ITS TREATMENT FOR THE PATIENT

Since the cooperation of the patient is a prerequisite for the successful therapy of joint dysfunction, it was found desirable and necessary before treatment of joint dysfunction was instituted to discuss with the patient his various clinical problems (including the dynamic nature of joint dysfunction, and its response to niacinamide treatment, and the dynamic nature of certain complicating syndromes, and their appropriate treatment), and the therapeutic goals. During the course of therapy, it may become necessary to review and amplify this discussion for the benefit of the patient as various clinical problems arise.

Joint dysfunction is the articular aspect of a generalized, usually slowly progressive metabolic disorder which is corrected in time by adequate niacinamide therapy. Since the retrograde changes in tissue structure and function which characterize this disorder occur insidiously over a period of years, many of its symptoms and signs are incorrectly attributed by laymen and physicians alike to the so-called "normal" aging process. But
these retrograde changes in morphology and function of bodily tissues are usually
reversible in time when adequate levels of niacinamide are supplied continuously to bodily tissues. The patient who takes continuously adequate amounts of niacinamide experiences, in addition to improvement in joint function, an improvement in his general health.

Theoretically, optimal nutrition must be continuously available to bodily tissues to ensure the best possible structure and function of tissues (104) (108). While we do not know what constitutes optimal nutrition, it has been demonstrated empirically that **even persons eating a good or excellent diet according to present-day standards exhibit measurable impairment in ranges of joint movement which tends to be more severe with increasing age** (see page 153). It has also been demonstrated that **when such persons supplement their good or excellent diets with adequate amounts of niacinamide, there is, in time, measurable improvement in ranges of joint movement, regardless of the patients' ages.** In general, the extent of recovery from joint dysfunction of any given degree of severity depends largely on the duration of adequate niacinamide therapy (see pages 187 and 188).

With the ingestion of adequate amounts of niacinamide continuously for a sufficient period of time, a patient whose ordinary diet is not inadequate in protein or calories, whose joints are not subjected to excessive mechanical trauma, will recover from joint dysfunction at the satisfactory rate of 6.0 to 12.0 Joint Range Index units, or better, in the first month of therapy, and 0.5 to 1.0 Joint Range Index unit, or better, for each month of therapy thereafter, until a Joint Range Index of 96-100 is reached. (Rarely, when a patient has one or more ankylosed joints, he may have no appreciable active or passive movement of these ankylosed joints, even after two years of adequate niacinamide therapy, although his other joints recover the full ranges of movement in response to such therapy. In such cases, the Joint Range Index cannot reach 96-100; e.g., when one wrist is ankylosed and has not shown increased movement in response to niacinamide therapy, the maximum Joint Range Index attainable is 90.9; and when both wrists are ankylosed, the maximal Joint Range Index attainable is 81.8.)

In general, the more severe and more chronic the patient's joint dysfunction, the slower is the rate of recovery in response to adequate niacinamide therapy, and the slower his subjective appreciation

of improvement. The rate of recovery for each patient must be established empirically from serial determinations of the Joint Range Index. In order to ensure a continuously satisfactory rate of recovery from joint dysfunction, the physician must re-examine the patient at intervals during the course of niacinamide therapy. **Whenever a patient taking the amounts of niacinamide prescribed by the physician, and eating a good or excellent diet, fails to make satisfactory improvement in his Joint Range Index, in the absence of excessive mechanical joint injury the niacinamide schedule must be revised upward to that level which permits satisfactory improvement. Failure of the patient to take niacinamide as directed will result in failure to improve at a satisfactory rate.**

When a patient has joint dysfunction associated with obvious arthritic deformities, he is told that the physician cannot predict whether or not in his case articular deformities will resolve with adequate niacinamide therapy. However, in response to adequate niacinamide therapy for a sufficient period of time, other patients have shown partial or complete resolution of their arthritic joint deformities. Some patients with arthritic deformities show resolution of some of their joint deformities, but not of others. Only careful observation of the patient's deformities on serial re-examinations will indicate whether or not his deformities are resolving in response toadequate niacinamide therapy. In most instances, the rate of resolution of the deformities will be slow, if it occurs at all.

It cannot be predicted whether or not a given joint that appears to be completely ankylosed clinically will recover any degree of movement. It has been observed many times that joints appearing to be clinically ankylosed prior to therapy tend to have partial or complete recovery of movement in response to adequate niacinamide therapy, although some ankylosed joints have not shown any degree of movement as a result of therapy during an observation period of several years. In response to adequate niacinamide therapy over a sufficient period of time some patients have partial or complete recovery of movement in some of their ankylosed joints, but not in others. Only careful observation of the ranges of joint movement on serial re-examinations will demonstrate whether or not a given ankylosed joint can recover any degree of movement in response to adequate niacinamide therapy.

In general, in the absence of complicating factors, the higher the patient's Joint Range Index rises in response to adequate niacinamide therapy, the fewer articular symptoms he will have; and the better he will feel. However, even though the Joint Range Index increases satisfactorily in response to adequate niacinamide therapy, the patient may not feel well because of complicating syndromes which are not on the basis of aniacinamidosis. Careful clinical study is necessary in order to establish the etiology of whatever complicating syndromes may be present and, with appropriate therapy, the patient is likely to become free from articular symptoms and to feel well. However, at any time symptoms of bodily discomfort may recur which must be studied and given appropriate treatment as promptly as possible, if the patient is to feel well again. While the patient may obtain temporary relief from articular and other symptoms through the use of analgesics, narcotics, sedatives, antihistaminics and local anesthetics, only adequate treatment of joint dysfunction and the complicating syndromes is likely to give more lasting benefits.

In order to assess the effects of niacinamide therapy on joint dysfunction and on the patient's general status, the patient is usually re-studied one month after continuous niacinamide therapy has been instituted. If good progress in recovery from joint dysfunction is noted at that time, he is reexamined in two months, and thereafter every three to six months. For the most part, this schedule of re-examination is found to be satisfactory for the supervision of the therapeutic program of patients presenting the chronic problems of joint dysfunction, although when the individual's problems are of unusual complexity, or when intercurrent problems arise, the time interval between visits is shortened.

When a patient with joint dysfunction fails to make the anticipated progress in response to niacinamide therapy, he is asked if he has taken the medication as prescribed; if not, he is urged to do so. (When a patient has taken multiple vitamin capsules as prescribed and has not made satisfactory improvement in his Joint Range Index in response to such therapy, the druggist is asked how the vitamin powders were compounded. The clinical effectiveness of niacinamide seems to be lessened when niacinamide is mixed with ascorbic acid by vigorous trituration, since this favors inter-molecular reactions between niacinamide and ascorbic acid in the dry powder state. The occurrence of such inter-molecular reactions between niacinamide and ascorbic acid is hindered by the preliminary admixture of each dry powder separately with a small amount of calcium stearate (0.2%) before the final admixture by sieving.)

It is always emphasized that the patient must take his medication continuously as prescribed until such time as the supervising physician may decide, on the basis of objective clinical evidence, that it is necessary to increase the level of niacinamide therapy in order to produce continuously satisfactory improvement in the Joint Range Index.

However, certain factors other than the ingestion of inadequate amounts of niacinamide may tend to depress the Joint Range Index. These include (a) transient or persistent mechanical joint injury resulting from unusual or physical exertion (see page 79) or from psychogenically sustained hypertonia of somatic muscle (see page 115), (b) rapid and excessive gain in weight to obesity levels, (c) excessive ingestion of alcohol, (d) inadequate dietary protein. When any of these factors is operative, it is of limited value to increase the amounts of niacinamide taken by the patient in an effort to effect satisfactory improvement in the Joint Range Index. Instead, treatment should be directed toward lessening the degree of mechanical joint injury, reducing the patient's weight to the normal range, interdicting alcohol, and increasing the protein intake to adequate levels, respectively.

When indicated, the physician describes for the patient four complicating syndromes frequently coexisting with joint dysfunction, and their treatment (see page 76). Most of the articular and non-articular symptoms of a patient with joint dysfunction which are not corrected by niacininide therapy usually originate as part of these four complicating syndromes. When the patient understands the etiologic basis of his symptoms, he will not have anxiety concerning the meaning of symptoms which would otherwise seem mysterious and alarming. The patient with joint dysfunction who has one or more of these complicating syndromes is told that he will not feel well unless joint dysfunction and these coexisting syndromes are correctly identified and successfully treated, and that in order to accomplish this, his active participation in the clinical investigation and therapeutic program is required.

TYPICAL IMPROVEMENT IN MOBILITY OF A SINGIE JOINT IN RESPONSE TO LEVELS OF NIACINAMIDE THERAPY USED PRIOR TO APRIL 1947

In serial determinations of the mobility of single joints in response to levels of niacinamide therapy used prior to April 1947, it was found that niacinamide-induced recovery of full joint mobility was an orderly process. (Since April 1947, **when higher dosage schedules of niacinamide were introduced (see page 21), there has been a marked reduction in the incidence of articular pain and discomfort upon maximal passive movement of the moveable joints during various stages of recovery from joint dysfunction.)**

There is described below typical improvement in joint mobility, as illustrated by several sequential stages occurring during niacinamide-induced recovery of full mobility of the metacarpophalangeal (knuckle) joint.

(Figure 14 is a schematic representation of maximal passive extension of the meta-carpophalangeal joint at four successive stages (a) (b) (c) (d), during the course of niacinamide-induced recovery of full joint mobility. The line touched by the head of the arrow in (a) (b) (c) (d) indicates the upper limit of painless extension. The shaded angle in (b) and (c) indicates the range of painful passive extension.)

Figure 14(a). On the initial examination before niacinamide therapy was instituted, the metacarpophalangeal joint of the forefinger of the right hand could be extended passively to 30% of the full range of extension for this joint. No pain or discomfort was experienced by the patient during this maneuver. The examiner noted the presence of palpatory resistance from the initiation of the movement of passive extension of this metacarpophalangeal joint, and this resistance progressively increased as the joint was extended from the range of 0% to 30% of the maximal extension; the palpatory resistance at the end of the movement was graded as firm. When at the 30% level of passive extension a small increase of force in the direction of extension caused no further extension of this joint, 30% of the full range of extension was taken as the upper limit of maximum passive extension of this metacarpophalangeal joint.

Figure 14 (b). At the end of one month of continuous, adequate niacinamide therapy, maximal passive extension of this metacarpophalangeal joint increased to 60% of the full range of extension. No pain or discomfort was experienced by the patient when the metacarpophalangeal joint was extended from 0% to 40% of the full range of extension. The patient experienced localized joint pain, often severe, as the joint was passively extended from 40% to 60% of the full range of extension. The examiner's palpatory sensation indicated that movement of the joint in passive

extension was free from 0% to 40%, and that there was soft, yielding resistance which progressively increased as the finger was extended at the metacarpophalangeal joint from 40% to 60% of the full range of movement. When a further small increase of the extending force did not increase the degree of extension, 60% of the full range of extension was taken as the upper limit of passive extension of this metacarpophalangeal joint. The palpatory resistance at the end of the movement of extension was rubbery.

Figure 14 (c).After months of continuous, adequate therapy with niacinamide, maximal passive extension of the metacarpophalangeal joint reached 100%; i.e., the full range of movement. Passive extension of the metacarpophalangeal joint from 0% to 85% was without pain or discomfort; passive extension from 85% to 100% was painful. The examiner's palpatory sensation indicated that the movement of this joint was free from 0% to 85%, and that there was soft resistance, which increased progressively with increasing extension of the metacarpophalangeal joint from the level of 85% to 100%. A small additional force in the direction of extension when the 100% level was reached did not cause further extension of this joint. The palpatory resistance at the end of the full range of movement (100%) was rubbery.

Figure 14(d). **With a longer period of continuous, adequate niacinamide therapy, it was possible to achieve full, free and painless extension of this metacarpophalangeal joint to the level of 100%.** Slight additional palpatory force in the direction of extension with the joint fully extended did not increase the amount of movement beyond the full range of extension; i.e., the 100% level. The examiner's palpatory sensation indicated that the movement of extension was free from 0% to 100% of full extension, that the resistance met at the end of this movement was firm, and that the patient experienced no pain from this maneuver.

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has been completed. That has happened here. It is interesting to note the experiments with adrenocorticotropic hormone (ACTH) in connection with acclimatization to heat. Since then this hormone has become famous for quite another reason.

It is safe to say that any one who wishes any information concerning the subjects listed will find it here or will find a bibliography that will give him a thoroughgoing acquaintance with the subject.

The Common Form of Joint Dysfunction: Its Incidence and Treatment. By William Kaufman, M.D. Price, $8.75. Pp. 208, with 35 illustrations. E. L. Hildreth & Co., Brattleboro, Vt.

This monograph proposes the thesis that inadequacy of niacinamide ("aniacinamidosis") is the commonest cause of articular dysfunction. This disorder is reputedly "exceedingly prevalent in many individuals [with or] without joint complaints or clinically obvious arthritis" (page 3). Also "exceedingly prevalent in the group of patients studied" were psychosomatic symptoms and signs (page 130).

Data are based on a study of 455 patients aged 4 to 78 years, seen over a two year period from 1945 to 1947 inclusive. A weighted average of twenty joint measurements constituting a "joint range index" is used to classify severity, dosage requirement and response to treatment. The reported dosage of niacinamide ranged from 400 mg. to 4,000 mg. daily in divided oral doses. Additional components of the B complex, vitamin C and other medical and psychotherapeutic measures were also prescribed. "No matter what associated diseases the patient had, his joint dysfunction responded in a predictable way [correction or amelioration] to adequate therapy with niacinamide" (page 6). The paradox of normal joint range index with persistence of symptoms after treatment which was sometimes encountered was usually attributed to the presence of one or more of "four complicating syndromes frequently coexisting with joint dysfunction."

These are defined as (1) delayed post-traumatic articular syndrome (serious injury excluded), (2) chronic allergic syndrome, (3) sodium retention syndrome and (4) psychogenically induced, sustained hypertonia of somatic muscle. Differentiation of psychogenic or psychosomatic rheumatism from "the commonest form of articular dysfunction" is rather briefly and vaguely dismissed in a footnote (page 144). The author recognizes and regrets that he was unable to study repeated samples from the "untreated population"; likewise, the deficiencies which resulted from lack of controls, roentgenograms, photographs and pathologic studies. Sedimentation rates also were "not routinely determined," these data being obtained for only 172 of the 455 patients.

The author is to be complimented on the detailed description of some of his methods of study and treatment. Generalities frequently encountered in medical texts are thereby avoided. Excellent paper and printing make this book easy to read. A rather extensive bibliography is included, though references to the background of experimental studies relative to deficiencies of niacin are meagerly and tardily reviewed.

Numerous charts and graphs (42 pages) have been compiled, but, unfortunately, "no explanation can be given to account for the biodynamic mechanisms of niacinamide-induced improvements in persons with joint dysfunction" (page 191). The reader will readily agree with the author that much more information is needed before precise knowledge of the relation between niacinamide and dysfunction of joints can be fully evaluated.

Arthritis and Vit B-3
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SOME NOTES ON NIACINAMIDE THERAPY FOR ARTHRITIS

by William Kaufman, M.D., Ph.D.

(Reprinted with the kind permission of Charlotte Kaufman)

The (more frequent) 250 mg dose of niacinamide is 40 to 50 % more effective in the treatment of arthritis than the (less frequent) 500 mg. dose. As an illustration, see the reprint of my Tom Spies Memorial Lecture: Niacinamide, a Most Neglected Vitamin. This illustrative case history begins on page 17 column 2 and continues on page 18 column 2.

Do not use hard gelatin capsules containing 250 mg niacinamide because they do not deliver niacinamide as efficiently as 250mg niacinamide in thin gelatin capsules in the treatment of joint dysfunction (arthritis).

In my paper in *J. Amer Geriat. Society,* 1955 3:927-936 I noted that niacinamide (alone or combined with other vitamins) in a thousand patient-years of use has caused no adverse side effects.

Some brands of niacinamide on the market today contains excipients that act as preservatives, probably meant to prolong shelf life. Some patients have severe adverse reactions to these preparations while most do not experience any ill effects.

Niacinamide has un-gated entrance to the central nervous system. It has a strong affinity for the central nervous system's benzodiazepine receptors and causes a pleasant calmative effect. In addition, it improves central nervous system function in the kinds of central nervous symptom impairments noted in my 1943 book, starting on page 3.

Please keep in mind niacinamide is a systemic therapeutic agent. It **measurably improves joint mobility, muscle strength, decreases fatigability. It increases maximal muscle working capacity, reduces or completely eliminates arthritic joint pain. Niacinamide heals broken strands of DNA and improves many kinds of CNS functioning.**

Some joints are so injured by the arthritic process that no amount of niacinamide therapy will cause improvement in joint mobility, but it takes three months of niacinamide therapy before you can conclude this, since some joints are slow to heal.

WILLIAM KAUFMAN, PhD, MD
January 13,1998

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Joint Dysfunction, Part 1
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CHAPTER I
To read Chapter 2, click this link: http://www.doctoryourself.com/kaufman7.html

THE COMMON FORM OF JOINT DYSFUNCTION
by William Kaufman, M.D., Ph.D. (1949)

Edited by Andrew W. Saul

(This chapter presents Dr. Kaufman's protocol for the treatment of arthritis with niacinamide, vitamin B-3. He also used ascorbic acid (vitamin C), thiamine (B-1), riboflavin (B-2), all in large doses. His rationale and his measurement methods begin the chapter, but you might wish to scroll down to the section on dosage ("Methods of Treatment") and read that first. ***If you are looking for the doctor's comments relevant to ADHD, scroll to nearly the end of the page and they can be found in boldface type.*** *The chapter closes with case histories and an insightful, practical discussion of patient management. Graphs and other original illustrations are not provided here, but may be seen in the original text.)*

The author's preface, and all references cited, are posted at http://www.doctoryourself.com/kaufman11.html

INTRODUCTION

The relationship between the continuous administration of adequate amounts of niacinamide and improvement in both hypertrophic arthritis and rheumatoid arthritis was originally reported in 1943 as part of a clinical study on niacinamide deficiency disease, aniacinamidosis, observed in a group of 150 private patients studied during the years 1941 and 1942 (97). (The term aniacinamidosis was employed by the writer in 1943 to define a syndrome which was thought to be the consequence of a niacinamide tissue deficiency disease. The term aniacinamidosis would be redefined today (1949) without reference to its possible etiology, as the syndrome which is ameliorated or corrected when a person ingests certain nontoxic amounts of niacinamide (far in excess of those obtainable from his usual diet), and recurs in time when such niacinamide supplementation is discontinued.)

The form of aniacinamidosis which was seen by the writer prior to 1943 included, in varying degrees of severity, changes in skin texture and pigmentation; subcutaneous swellings; tenderness of periosteum, cartilage and voluntary muscle to pressure or squeezing; tenderness and enlargement of the liver; gastrointestinal symptoms; changes in the morphology of the lingual mucous membrane; and limitation in ranges of joint movement. This clinical syndrome of aniacinamidosis was characterized (a) by its prompt recession when niacinamide was exhibited orally for a sufficient period of time in adequate doses, and (b) by its recurrence, often in the original degree of severity, upon premature cessation of therapy with niacinamide. Most persons who were treated required maintenance doses of niacinamide continuously to prevent relapse (97).

It was observed in the course of the above study that persons who had clinically both aniacinamidosis and obvious arthritis experienced, in response to adequate oral therapy with niacinamide over a sufficiently long period of time, clinical improvement in both the aniacinamidosis and the arthritis. On the other hand, premature cessation of therapy with niacinamide caused a worsening of both the aniacinamidosis and the arthritis. Furthermore, when the total dosage of niacinamide per day was reduced from apparently adequate to inadequate levels in such persons, there was a more gradual recurrence of the severer aspects of aniacinamidosis and a slower worsening of their

arthritis than occurred with complete cessation of therapy with niacinamide. It was noticed that individuals who suffered from both aniacinamidosis and clinically obvious arthritis required larger daily doses of niacinamide for recovery from niacinamide tissue deficiency disease than those who had no clinically obvious arthritis (97).

With the compulsory enrichment of cereal products in 1943 (25), the niacin content of the average American diet was increased from 11 to 17 mg per 2500 calories (30). Since 1943, the clinical syndrome of aniacinamidosis as originally described has not been seen regularly, but has been supplanted by a syndrome in which most of the manifestations of aniacinamidosis as originally described are milder, and many of the symptoms and signs of the aniacinamidosis of 1941 and 1942 are absent. However, limitation in the ranges of joint movement has continued to be an objective, measurable attribute of the metabolic disorder corrected by adequate niacinamide therapy. In 1944, in an effort to secure quantitative data concerning the relationship between treatment with niacinamide and recovery in arthritic joints, the writer introduced goniometric examination of joint ranges of all persons who had at the time of the initial physical examination clinically obvious arthritis. In 1945, it was decided to broaden the base of this study by routinely measuring the joint ranges of all patients presenting themselves for physical examination. For this purpose, there was introduced as part of every physical examination an abbreviated goniometric examination of the movement of 20 joints or joint groups in easily measured, specified ranges. Within five minutes, this abbreviated goniometric examination of joint ranges could be performed and recorded by the examiner on a special form devised for this purpose. By this method, a sufficiently large number of joints or joint groups were measured in defined ranges to afford an adequate and representative sampling of the mobility of the moveable joints of the body.

With the introduction of routine measurement of the joint ranges of all new patients who presented themselves for examination, it soon became apparent that limitation of joint movement in the 20 measured ranges was exceedingly prevalent in many individuals without joint complaints or clinically obvious arthritis. Moreover, limitation of joint movement in persons without complaints referable to joints was often of the same order as that observed in patients (with and without clinically obvious arthritis) who did have complaints referable to their joints.

It was decided to simplify the approach to the study of limitation of joint movement by combining the numerical values obtained for each of the 20 measurements of joint range movement into a single numerical value which was the "weighted" average of all these measurements. This "weighted" average was called the JOINT RANGE INDEX. As will be shown later, the Joint Range Index is used by the physician in the objective appraisal of joint function (joint mobility) in numerical terms, in the clinical classification of the various grades of severity of joint dysfunction, in the selection of the initial level of niacinamide therapy, in the regulation of subsequent levels of niacinamide therapy, and in the observation of the response of joint dysfunction to adequate and inadequate niacinamide therapy. In addition, the use of the Joint Range Index enables the patient to understand the objective basis for the diagnosis of joint dysfunction in his case, and the objective basis for the evaluation of the response of his joint dysfunction to adequate and inadequate therapy.

A WORKING HYPOTHESIS:
THE DEGENERATIVE PROCESS AND THE REPARATIVE PROCESS IN JOINTS

Certain inductions have been made from factual data acquired during the clinical study of patients with joint dysfunction (with and without clinically obvious arthritis) whose joint ranges were measured for the determination of the Joint Range Index at various time intervals under various conditions of niacinamide therapy: before niacinamide therapy was instituted, during premature cessation of adequate or inadequate niacinamide

therapy, during the substitution of adequate for inadequate niacinamide therapy, and during continuously adequate niacinamide therapy. These inductions have been synthesized into a working hypothesis which explains the status of a patient's joints in terms of two oppositely directed, coexisting articular processes: the deteriorative process, and 'the reparative process.

The deteriorative process consists chiefly of two operational factors tending to cause retrograde changes in joint structure and function, (a) "wear and tear in joint structures, which results from ordinary or unusual joint uses, and (b) a slowly, moderately or rapidly progressive metabolic disorder which is corrected in time by adequate niacinamide therapy. This metabolic disorder occurs even in persons subsisting on what is considered to be the average "good" or "adequate" diet of today (172) (118) (193).

The reparative process tends to overcome the retrograde articular changes caused by the deteriorative process. Even persons subsisting on "good" or "adequate" diets of today lack sufficiently potent reparative mechanisms to offset for any prolonged period of time the retrograde influences of the deteriorative process in joints. However, with supplementation of the average good" or "adequate" diet of today with adequate amounts of niacinamide, the articular reparative process becomes sufficiently powerful to overcome the retrograde changes in articular tissues produced by the deteriorative process, and in time permits improvement in the functional status of joints, as objectively demonstrated in the individual patient by serially increasing values of the Joint Range Index.

For purposes of this study, it has been postulated (a) that clinically perfect articular structures have the fullest ranges of articular movement, (b) that clinically imperfect articular structures have less than full ranges of articular movement, and (c) that the range of joint movement in moveable joints is a practical measure of the degree of clinical perfection of these articular structures. At any given moment, the patient's Joint Range Index is an indirect measure of the balance between deteriorative and reparative articular processes in the joints whose ranges of movement are determined goniometrically.

In an untreated population, the deteriorative process seems to preponderate over the reparative process, as is shown by the average tendency of the Joint Range Indices of this group to decrease with increasing age (see Graph 1G, page 153).

When the ranges of movement of a given joint are re-measured at any given time interval (e.g., one month), there may be no change, an increase, or a decrease in joint movement when the second measurement is compared with the first. When there has been no change in the range of joint movement, it is postulated that the effects of the deteriorative process have been balanced by the effects of the reparative process for this time interval, and that no significant change in the functional status of the joint has occurred. However, when the range of joint movement has decreased, it is assumed that the deteriorative process in articular tissues has been more powerful than the reparative process for a sufficient period during this time interval to permit deteriorative effects to preponderate over reparative effects, with the result that deterioration has occurred in the functional status of the joint. On the other hand, when the range of joint movement has increased, it is assumed that the reparative process in articular tissues has been more powerful than the deteriorative process for a sufficient period during this time interval to permit reparative effects to preponderate over deteriorative effects, with the result that there has been improvement in the functional status of the joint.

It may be that some arthritic joints are damaged by a deteriorative process of such intensity and duration that joint recovery is not possible, even with prolonged adequate niacinamide therapy. Even though initial clinical examination may indicate that eventual recovery of these joints is unlikely, only a prolonged trial of adequate niacinamide therapy will disclose whether or not such joints actually have been damaged beyond

repair. It has been observed that deformed arthritic joints which seemed on the initial clinical examination to have been irreparably damaged by the deteriorative process have shown recovery of the full ranges of joint movement, and a progressive decrease in severity of the obvious arthritic deformities with adequate niacinamide therapy over a prolonged period of time.

METHOD OF STUDY

The observations recorded in this volume were derived chiefly from the clinical study of 455 persons of both sexes, ranging in age from 4 to 78 years, who consulted the writer from March 1945 to February 1947 in the course of his private practice of internal medicine. (In Section IV the frequency distribution by five-year age groups of all patients studied is shown in Table 1A; that of all male patients, in Table 1B; that of all female patients, in Table 1C.) All patients studied were ambulatory. Their occupations were varied. Although no attempt has been made to classify the economic status of these patients, the majority of these patients would be considered to belong to the moderate income groups, and relatively few would be considered to belong to the low income groups. They came chiefly from New England. Many had no complaints referable to health, but desired a routine physical examination; others had minor or major health problems.

For purposes of this study, a detailed enumeration of the incidence of various diseases in the population group examined would be of no significance, since it was found that no matter what associated diseases the patient had, his joint dysfunction responded in a predictable way to adequate therapy with niacinamide, to premature cessation of such therapy, or to the substitution of inadequate for adequate therapy. A partial listing of various diseases other than joint dysfunction seen in this group of patients may, however, be of some interest: gall-bladder disease (with and without stones), chronic hypertrophic gastritis, duodenal ulcer, diverticulosis of the colon, cardiospasm, multiple intestinal polypi, irritable colon, Paget's disease of bone, post-menopausal osteoporosis, multiple sclerosis, syringomyelia, spastic paralysis, chronic and acute anxiety states, anginal syndrome, arteriosclerotic heart disease, rheumatic heart disease, anemias, myeloge nous leukemias, allergic diseases, fibroid tumors of the uterus, hypothyroidism, hyperthyroidism, diabetes, gout and arrested lues (48).

All persons included in this study presented themselves as new private patients. Only in this sense was there selection of the population group studied. All patients were subjected to an initial examination, which consisted of a detailed history, physical examination and certain laboratory studies. These findings were recorded on a special form, together with the physician's impressions and therapeutic recommendations. Kodachrome transparencies were taken of the tongue, gums and eyes of each patient to serve as a point of reference in the objective study of the response of tissues to vitamin therapy (105) (106) (107) (37) (39) (183) (191) (114) (35) (174) (8) (109). In addition, monochrome photographs were taken of selected patients to document clinically obvious arthritic deformities.

During the initial visit, in the course of the general physical examination, certain ranges of joint movement were measured in a standard way (149), and the numerical values obtained were used in computing the Joint Range Index. The sound-proofed room in which the examination was performed was kept at a temperature comfortable for the patient, who was completely disrobed save for the covering sheet. Care was taken to have the patient adequately draped at all times. The examiner informed the patient before each measurement of joint ranges as to what would be done next, indicating that maximal joint ranges were to be measured. The ranges of knee and hip movement were measured with the patient recumbent. All other joint ranges were measured in the sitting position. In addition to measurements of joint ranges, the following data were recorded if they were elicited on physical examination of the joints: pain, crepitus (cracking or other

sound), muscle spasm, redness, unusual warmth, swelling, engorgement or accentuation of the periarticular venous pattern, and deformity.

Instruments used in measuring joint ranges were made of metal according to the writer's specifications:

A gravity-type goniometer, fashioned after the one described by Cooper (34), was found to be a highly versatile instrument (see Figures 1, 2, 3 and 12).

(Figure 1. Illustrates the goniometer, a device for measuring joint movements and angles. The calibrations are also shown.)

A graduated collar was devised which permitted the measurement of neck rotation (see Figures 4 and 5).

One tool consisted of an angle device with provision for the maintenance of any angle by tightening a set screw, and a graduated plate on which the angle device was fitted in order to read the angle therefrom (see Figure 7).

A graduated plate was used to measure flexion and extension of the wrist (see Figure 8) and, rarely, in markedly deformed hands to measure extension of the metacarpophalangeal (knuckle) joints of the fingers (see Figure 11).

A special device was constructed for the measurement of extension of the metacarpophalangeal joints of the fingers (see Figures 9 and 10).

MEASUREMENT OF THE RANGES OF JOINT MOVEMENT USED IN COMPUTING THE JOINT RANGE

Knees. The patient is adequately draped, lying flat on his back with his body weight evenly distributed. He is asked not to contract his lower extremity muscles actively during this measurement, since such contraction lessens the range of movement of the knee joint. His right thigh is flexed passively by the examiner so that it is at right angles to his trunk. The examiner then extends the patient's right leg maximally, taking care not to displace the ipsilateral thigh even slightly, and taking care that the patient does not flex his contralateral thigh even slightly, as this would cause pelvic tilt. The angle which the leg makes with a hypothetical plane passing through the knee joint at right angles to the thigh is measured by reading the indicator dial of the gravity-type goniometer, which is held with its long axis parallel to the long axis of the right leg. The range of movement of the left knee joint is measured in a symmetrical manner (see Figure 2).

(Figure 2. Illustrates the measurement of knee-joint extension, showing a) Knee joint at beginning of measurement; b) Knee extended 50%; c) Knee extended 100%.

Hips. The patient is asked not to contract his lower extremity muscles (particularly the adductor muscles of his homolateral thigh) since such active muscular contraction lessens the range of movement of the hip joint. With the patient lying symmetrically on his back, the right thigh is flexed by the examiner so that it remains perpendicular to the trunk, care being taken that the right foot is not rotated from a neutral position of rest. The right thigh is then abducted maximally by the examiner, care being taken not to displace the contralateral buttock from the table. If the contralateral buttock is levered off the examining table by the examiner's abduction of the ipsilateral thigh, then abduction of the right thigh is maintained, but the patient is permitted to rotate so that both buttocks are on the table again and bear weight symmetrically. The gravity-type goniometer is then applied so that its long axis parallels the long axis of the right thigh, and the appropriate reading of the degree of hip abduction is made and recorded (see Figure 3). The range of movement of the left hip joint is measured in a symmetrical manner.

Figure 3. Illustrates measurement of hip abduction, showing a) Thigh at beginning of measurement; b) Thigh abducted 50%; c) Thigh abducted 100%)

NOTE: For purposes of clarity in illustration, the examiner is pictured as standing behind the thigh that is abducted. In practice, he stands in front of the thigh that is being abducted, so that he can easily read without parallax the scale of the gravity-type goniometer.

Lateral Rotation of the Neck. The patient is asked to sit symmetrically, and to make himself as "tall" as possible. He is asked to hold his neck so that it is neither flexed nor extended, nor laterally bent to the right or left. A specially constructed graduated metal collar (see Figure 4) is fitted symmetrically at the level of the base of the neck so that the 100% graduation always rests on the anteriormost portion of the trapezius ridge, and the patient is asked to rotate his head maximally to the right. Since the examiner wishes to measure and record maximal values, when the patient reaches his initial maximal joint of lateral rotation, he is always urged to do better, to prevent his restraining full neck rotation because of subjective discomfort. During measurement of lateral neck rotation, the patient is at no time permitted to raise his shoulders, or to flex, extend or laterally bend his neck (see Figure 5). When the patient signifies that he has achieved maximal rotation of his neck to the right, the measurement of neck rotation is made. The range of neck rotation is read directly from the graduations on the neck gauge by the examiner, who sights along the plane perpendicular to the center of the patient's chin to avoid parallax, ascertaining the graduation on the neck gauge which would pass, if extended, through the center of the chin. The measurement of rotation of the neck to the left is made in a symmetrical way.

(Figure 4. Illustrates the graduated collar (with degree markings similar to those of a protractor) used in the measurement of neck rotation)

(Figure 5. Illustrates the measurement of lateral neck rotation using the graduated collar, and shows the position of head at beginning of measurement, the head rotated to the right of left 50% and 100%)

Shoulders. The range of circumduction of the shoulder joint is measured by careful inspection and estimation rather than by the use of a particular device. In order to be certain that maximal ranges are elicited and estimated, the maneuver of circumduction of the shoulder is performed several times for each shoulder. The patient is asked not to contract his shoulder girdle or upper extremity muscles, since such active muscular contraction lessens the range of movement of the shoulder joint. In measuring the range of circumduction of the right shoulder, the physician stands to the right of the patient, who faces forward, sitting as "tall" as he can, with his shoulders maintained horizontally. The physician places his left hand on the patient's right shoulder to prevent its displacement from the horizontal position when the patient's right arm is subsequently circumducted for measurement. The physician's right hand holds the patient's right elbow lightly, slightly flexing the patient's right forearm on the right arm, but not holding the right elbow so rigidly as to interfere with subsequent free movement of the shoulder joint during circumduction. In this position, the physician circumducts the shoulder joint of the right arm in a clockwise direction so that the patient's right elbow describes the largest possible "circle" during circumduction (see Figure 6).

(Figure 6 illustrates the method for estimating of the range of shoulder circumduction (range of motion in a circling motion). a) The figure drawn in unbroken lines shows the position of the patient, as well as the position of his right upper extremity (marked 0) at the beginning and end of the maneuver of shoulder circumduction. The physician's left hand maintains the patient's right shoulder horizontally throughout the maneuver of shoulder circumduction. The broken lines show three successive positions (50,100,50) of the right upper extremity during clockwise circumduction. Estimates of the range of shoulder circumduction are made with 0, 50, 100 as positions of reference.

b) Frontal view of the patient's position and the examiner's hands at the begin-fling and end of the maneuver of shoulder circumduction, corresponding to the 0 position in (a).

The movement of shoulder circumduction is graded as 50% when the right arm swept upward in maximum circumduction reaches, at the highest point of the arc, the plane perpendicular to the sagittal plane of the body at the level of the shoulders. The movement of shoulder circumduction is graded as 100% when the arm swept upward in maximum circumduction reaches at the highest point of the arc of circumduction the plane parallel to the sagittal plane of the body and perpendicular to a horizontal plane passing through the level of the shoulders. With some practice, bearing in mind these two reference axes, the physician can make estimates of the fractional ranges of shoulder circumduction with sufficient accuracy to be included in the computation of the Joint Range Index. Circumduction of the left shoulder is measured in a symmetrical manner.

(Figure 7 illustrates measurement of the degree of the wrist to bend. Captions follow below.)

a) Angle device set at 90 degrees, or 100% of a trigonometric quadrant. Its arms may be rotated around its central axis and fixed by a set screw at any desired angle.

b) Measurement of wrist flexion by the angle device. With the wrist held at maximum flexion, the arms of this device are brought into apposition with the surface of the dorsum of the hand and forearm. The set screw holding the arms of the angle device is tightened in this measured position, the angle device is fitted into the graduated plate (c), and a reading of the angle of flexion is made.

c) Graduated plate with angle device fitted to make reading of the range of wrist flexion obtained in (b).

Wrists. The maximum degree of flexion and extension of the wrist is measured either with the angle device (Figure 7) or the plate device (Figure 8), using the dorsum of the forearm and hand as the surfaces between which all angles are measured.

The plate device is more convenient for this measurement, being used so that the central axis of its graduations corresponds to a projection of the center of the right wrist joint. The 0 line is held parallel to the long axis of the right forearm, and the 100 line is held perpendicular to the projection of the central axis of the right wrist joint. The patient is asked not to contract his forearm or hand muscles during this measurement, since such active contraction lessens the range of movement of the wrist. Care is taken to measure maximal passive flexion and extension, and to sight along the dorsum of the hand in such a way that parallax is avoided. The patient is not permitted to flex or extend the fingers during the measurement of maximal flexion or maximal extension of the wrist. Measurement of flexion and extension of the left wrist is made in a symmetrical manner.

(Figure 8 illustrates the measurement of flexion and extension of the wrist with the graduated wrist plate, another protractor-like scale to fit the hand. 50% and 100% flexing is shown.

For clarity in illustration, (d) and (e) picture the examiner's fingers as exerting pressure on the subject's fingertips to induce maximal passive extension. In practice, this pressure is exerted on the palm of the hand, just proximal to the metacarpophalangeal joints.)

Metacarpophalangeal (Knuckle) Joints. The right hand is inserted into the special device (see Figures 9 and 10) with the palm resting on the baseplate. The 100 line of the graduated plate is perpendicular to the projection of the central axis of the metacarpophalangeal joint to be measured. The patient is asked not to contract his

forearm or hand muscles during this measurement, since such active muscular contraction lessens the range of extension of the metacarpophalangeal joints. Only the finger that is being extended by the examiner is permitted to leave the baseplate. The index finger is extended maximally by the examiner. This may be done in the face of objections from the patient, who may experience pain from this maneuver. The angle of extension between the dorsum of the hand and the dorsum of the finger is measured in such a way that parallax is avoided. Extension of the second, third, fourth and fifth fingers of the right hand is measured successively. The metacarpophalangeal joints of the left hand are measured in symmetrical fashion.

(Figure 9. Illustrates the device for the measurement of extension of the metacarpophalangeal (knuckle) joints. This also resembles a custom-fit protractor, with angle measurements in scaled in degrees.)

In some persons, for whom the special device cannot be used because of severe deformities of the interphalangeal joints of the hands, the wrist plate with the central cut-out (see Figure 11) is adapted to the measurement of metacarpophalangeal extension. The plate is fitted between the fingers so that the 0 line is perpendicular to the projection of the central axis of the metacarpophalangeal joints, with the 100 line parallel to the dorsum of the hand and perpendicular to the central axis of the metacarpophalangeal joints. In this use of the wrist plate, 100 minus the plate reading measures the movement of finger extension at the metacarpophalangeal joints. The patient is asked not to contract his forearm or hand muscles during this measurement, since such active muscular contraction lessens the range of extension of the metacarpophalangeal joints. Extension of the metacarpophalangeal joints is measured, holding the plate as described above, for the second, third, fourth and fifth fingers of the right hand. The corresponding joints of the left hand are measured in a symmetrical way.

(Figure 10 illustrates the technique for measuring extension of the metacarpophalangeal (knuckle) joints. Details shown: Hand in the special device (Fig. 10) at the beginning of measurement; (a) lateral view, (d) looking from above downward, (g) frontal view. The metacarpophalangeal joint of left forefinger extended 50%: (b) lateral view, (e) looking from above downward, (h) frontal view. The metacarpophalangeal joint of left forefinger extended 100%: (c) lateral view, (f) looking from above downward, (i) frontal view.

(Figure 11. Illustrates the measurement of extension of metacarpophalangeal joints in severely deformed hands, using the wrist plate. Shown: a) Position of hand at beginning of measurement. b) Metacarpophalangeal joint of left forefinger extended 50%. c) Metacarpophalangeal joint of left forefinger extended 100%.

Neck Bending. This measurement is not used in the computation of the Joint Range Index, since it has not been made routinely. In some persons, it cannot be measured accurately because of their persistent tendency to angulate the shoulders.

The patient sits symmetrically as erectly as he can, with his shoulders held level. His neck is neither flexed nor extended, nor rotated to the right or left. The neck is bent maximally to the right, and the angle of bending is measured by reading the dial of the gravity-type goniometer, applied so that its long axis parallels the long axis of the nose (see Figure 12). Left lateral bending of the neck is measured in a symmetrical manner.

(Figure 12 illustrates the measurement of lateral neck bending with the gravity-type goniometer. Shown: Position of head at beginning of measurement; Right lateral neck bending of 50%; Left lateral neck bending of 50%.)

CERTAIN CONVENTIONS ADOPTED IN MEASURING VARIOUS JOINT RANGES

Save for the range of shoulder joint circumduction, the maximum range of each joint movement, when elicited as described previously, approximates one trigonometric quadrant of 90 degrees. This is true for (a) extension of the knee joint; (b) abduction of

the hip joint; (c) right lateral rotation of the neck; (d) left lateral rotation of the neck; (e) flexion of the wrist; (f) extension of the wrist; (g) extension of the metacarpophalangeal joint. Because the angle of maximal movement of these joint ranges approximates one quadrant, it is convenient to measure these ranges in terms of percentages of a quadrant rather than in degrees.

This convention was adopted chiefly because patients visualize percentages of a range of movement more easily than equivalent measurements expressed in degrees. For all measurements except circumduction of the shoulder joint, simple arithmetic computation permits, when desired, the conversion from percentages to degrees, since 10% of a quadrant is equal to 9 degrees.

In a few individuals, the range of maximal wrist flexion is in excess of one quadrant. Also, in very few persons, either neck rotation to the right or neck rotation to the left, or both, are in excess of one quadrant. In these instances, for purposes of calculating the Joint Range Index, movement beyond one quadrant is considered as 100%, or the full range.

The conventions used in the measurement of shoulder circumduction have already been described (see page 10).

As a convention, the various graduated scales used in the measurement of joint ranges were read to the nearest 5% (4.5 degrees). A few readings were made with the angle device to 1 % (0.9 degree), but this was found to be an unnecessary refinement for purposes of this study.

COMPUTATION OF THE JOINT RANGE INDEX

It will be helpful in understanding the steps used in the computation of the Joint Range Index to refer to the form used for recording the measured values of the 20 specified joint ranges, and for computing the Joint Range Index (see Figure 13). The numerical values obtained upon measurement of the 20 specified joint ranges are entered separately into the appropriate space and column of the form at the time of the physical examination.

(Figure 13 illustrates the worksheet Dr Kaufman designed and used to record degrees of joint dysfunction with his patients. In addition to angular measurements, he also noted clinical data such as intensity of pain, crepitus, muscle spasm, redness, unusual warmth, swelling, prominent or engorged venous pattern, deformity, or the presence of Heberden’s nodes.)

The Joint Range Index is the arbitrarily weighted mean of the numerical values obtained upon the measurement of 20 specified joint ranges. Measurements of the neck, wrists and fingers are weighted so that these joints will not unduly affect the numerical value of the Joint Range Index, since they show increased ranges of movement more rapidly than the larger joints (hips, knees, shoulders) in response to adequate niacinamide therapy.

The following steps are employed in computing the Joint Range Index from the measurements of 20 specified joint ranges:

The neck rotation index is computed by adding the measured values for the maximal ranges of right and left neck rotation and dividing by two. (In computing the various indices entering into the final computation of the Joint Range Index, the figures are rounded off to the nearest whole number; e.g., 0.5 or over is listed as the next highest digit, and less than 0.5 is dropped.)

The resulting quotient is entered into the appropriate space under the heading “Indices.” (Neck bending is similarly averaged, although it is not used in calculating the Joint

Range Index.) Readings for the maximal range of circumduction of the right and left. shoulders are entered separately in the proper spaces. Readings for the maximal ranges of extension and flexion of the right wrist are added and divided by two, the quotient being entered in the appropriate space. A similar computation is made for the left wrist, and similarly recorded. Readings for extension of the four metacarpophalangeal joints of the right hand are added, divided by four, and the quotient entered in the appropriate space. A similar computation is made for extension of the four metacarpophalangeal joints of the left hand. Readings obtained for measurement of maximal abduction of the right and left hips and for maximal extension of the right and left knees are separately recorded in appropriate spaces. The above 11 values are then added, the sum obtained divided by 11, and the resulting quotient is termed the Joint Range Index. This computation is carried to one decimal place. (In about 2% of the patients seen from March 1945 to February 1947 the Joint Range Index could not be computed because one or more of the component ranges of joint motion could not be measured; e.g., in persons who could not flex the thigh to make a right angle with the trunk because of severe arthritis of the hip joint, or in persons with one or more limbs amputated.)

Thus, the Joint Range Index is precisely defined in terms of the "weighted" average of the 20 ranges of joint movement chosen for measurement. A Joint Range Index of less than 96.0 is taken to indicate the presence of joint dysfunction.

METHOD OF TREATMENT OF JOINT DYSFUNCTION (This section, consisting of pages 20-29, is the heart of Dr Kaufman’s work.)

After completion of his physical examination, the patient was apprised of the normal and abnormal findings revealed by the clinical study. Where problems other than joint dysfunction existed, these were discussed, and appropriate therapeutic recommendations were made. The subject of joint dysfunction was then presented. The meaning of the numerical value of the patient's Joint Range Index was explained to him in terms of the Clinical Classification of Joint Function (see page 21), and the dynamic nature of joint dysfunction was described. The patient was told that joint dysfunction was reversible in time when appropriate therapy was taken.

All patients with joint dysfunction who elected to accept treatment were given niacinamide in suitable doses, either alone or in combination with other vitamins. When indicated the appropriate vitamins were prescribed in addition to niacinamide. The water-soluble vitamins used were never prescribed in aqueous solution, but as tablets or as dry powders in capsule form. When vitamin A was used, it was usually given in conjunction with vitamin D. Vitamin D was always given in conjunction with vitamin A; when vitamin D was administered in this study, the daily dosage rarely exceeded 6,000 U.S.P.units per 24 hours (14) (10) (38) (56) (59) (95).

Participation in the therapeutic program was entirely voluntary on the part of the patient. Some patients at the outset declined to accept treatment for their joint dysfunction. When a patient accepted therapy for his joint dysfunction, with each succeeding visit after the initial one, improvement or lack of improvement in his joint dysfunction was frankly discussed with him. No patient was chided because he was unwilling or unable to carry out the program of therapy as it was originally scheduled. Thus, because there was no “loss of face," most patients cooperated well and gave an accurate account of their deviations, if any, from the suggested therapeutic program. Some patients at the end of the first or second month of treatment, or at a later time, felt so much improved physically that they discontinued therapy for their joint dysfunction, mistakenly believing, in spite of advice to the contrary, that they were "cured," and required no further therapy or medical supervision. Some of these persons, who experienced a recurrence of their original pattern of symptoms upon premature cessation of therapy, returned subsequently for re-evaluation of their therapeutic needs. Other patients, who felt that

they had not benefited from therapy for their joint dysfunction, did not continue with treatment though objectively they responded satisfactorily to adequate therapy, as shown by increasing values of the Joint Range Index on serial re-measurements.

Therapy was always individualized. In the therapeutic program introduced for the treatment of joint dysfunction, each patient served as his test object in the bio-assay of the dosage of niacinamide necessary to reverse his joint dysfunction. Therapy with niacinamide (used alone or in combination with other vitamins) was not deemed successful unless there continuous, objective improvement, as judged by continuously increasing values of the Joint Range Index on consecutive reexaminations. (When a patient subsists on a low-protein diet, amounts of niacinamide that would ordinarily be adequate for the treatment of his joint dysfunction prove to be inadequate for satisfactory improvement. In this case, the dosage of niacinamide is continued at the same level, but the protein level of the diet is increased to adequate levels, with subsequent satisfactory improvement in the joint dysfunction.) (118) (120) (172).

The clinical classification of joint function in terms of the numerical values of the Joint Range Index is listed below:

Clinical Classification of Joint Function
Degree of Joint Dysfunction Joint Range index
No joint dysfunction 96-100
Slight joint dysfunction 86-95
Moderate joint dysfunction 71-85
Severe joint dysfunction 56 -70
Extremely severe dysfunction 55 or less

For each clinical grade of joint dysfunction, the initial dosage schedule of niacinamide suggested below effects in time such improvement in joint dysfunction as the writer has considered to be clinically satisfactory. (However, since April 1947, it was found that dosage schedules 50-100% greater than those recommended below (particularly in the moderate, severe and extremely severe grades of joint dysfunction) are therapeutically superior, as judged by the patient's clinical response.)

While the initial dosage may be increased as necessary during treatment, it is not decreased, even though the Joint Range Index increases in response to adequate therapy.

The vitamins were administered orally, usually in equal doses at equal intervals during the day, and, in severe and extremely severe joint dysfunction, during the night when the patient would spontaneously awaken from sleep. In slight grades of joint dysfunction, the daily continuous ingestion of 100 mg of niacinamide after meals and at bedtime sufficed for treatment (400 mg/24 hours). Usually adequate in moderate joint dysfunction was the continuous ingestion of 150 mg niacinamide administered every 3 hours for 6 daily doses (900 mg/24 hours). In extremely severe and severe grades of joint dysfunction, 100-150 mg niacinamide were prescribed every hour (1500-2250 mg/24 hours), every hour and a half (1110-1650 mg./24 hours), or every two hours (800-1200 mg/24 hours), depending on the severity of the joint dysfunction, the more frequent schedule being used in more severe cases (97) (51).

It has been found in the treatment of joint dysfunction that the manner in which the daily dosage of niacinamide is divided has an important bearing on the therapeutic results achieved; e.g., 300 mg niacinamide given three times daily (900 mg/24 hours) is inferior in its therapeutic action to 150 mg niacinamide administered every 3 hours for 6 daily doses (900 mg/24 hours). Therefore, to define the type of therapy used, the writer routinely records the following data: (a) the number of

milligrams or units administered per dose, and (b) the total number of milligrams or units administered per 24 hours.

No untoward effects or clinical signs of toxicity were noted when niacinamide (alone or in combination with other vitamins) was administered on the above dosage schedules to individuals for short or long periods of observation. Before 1943, mild hypoglycemia had been noted clinically in a few persons when niacinamide exceeded certain dosage levels (97) (135) (51) (62), but this phenomenon has not been observed since that time.

"ADEQUATE" AND "OPTIMAL" DOSAGE LEVELS OF NIACINAMIDE IN THE TREATMENT OF JOINT DYSFUNCTION

"Adequate" dosage of niacinamide is defined as that clinically safe dosage of niacinamide which, when ingested in divided doses throughout the day by a person with joint dysfunction whose ordinary diet is not inadequate in protein or calories, and whose joints are not subjected to excessive mechanical joint injury, will effect in time what the writer has considered to be a satisfactory pattern of increasing values of the Joint Range Index. The pattern of recovery from joint dysfunction in response to niacinamide therapy, and the numerical limits of increments in the value of the Joint Range Index which are considered to be satisfactory for the first month of therapy and for succeeding months, are described on page 24.

"Optimal" dosage of niacinamide is defined as that clinically safe dosage niacinamide which, when ingested in divided doses during the day by a person with joint dysfunction, would permit the most rapid recovery in joint function, as demonstrated by the largest possible increments in the values of the Joint Range Index in the shortest possible period of time. At present, the optimal dosage of niacinamide for the treatment of joint dysfunction has not been determined clinically, although it is hoped to approximate such a dosage level eventually. Since adequate dosages of niacinamide have given clinically satisfactory results without producing any untoward symptoms or signs of acute or chronic toxicity, no attempt has been made in this study to determine the optimal level of niacinamide therapy in the treatment of the various clinical grades of joint dysfunction.

However, as the higher dosage levels of niacinamide have been cautiously explored in the past 22 months, it has been found in severe and extremely severe joint dysfunction that divided doses of niacinamide totaling 4 or 5 grams (4,000-5,000 mg) per 24 hours are therapeutically superior to the lower dosage schedules - which previously had been considered adequate. Even these higher dosage levels of niacinamide may not be optimal for the treatment of joint dysfunction.

The optimal dosage of niacinamide for the treatment of joint dysfunction, as well as the limit of human tolerance for niacinamide, can be established only in those medical centers equipped to provide careful clinical supervision, and to conduct such chemical, metabolic and clinical laboratory studies as would reveal the earliest signs of toxicity, should these occur with the administration of progressively higher dosage levels of niacinamide.

DESCRIPTION OF JOINT DYSFUNCTION AND ITS TREATMENT FOR THE PATIENT

Since the cooperation of the patient is a prerequisite for the successful therapy of joint dysfunction, it was found desirable and necessary before treatment of joint dysfunction was instituted to discuss with the patient his various clinical problems (including the dynamic nature of joint dysfunction, and its response to niacinamide treatment, and the dynamic nature of certain complicating syndromes, and their appropriate treatment), and the therapeutic goals. During the course of therapy, it may become necessary to

review and amplify this discussion for the benefit of the patient as various clinical problems arise.

Joint dysfunction is the articular aspect of a generalized, usually slowly progressive metabolic disorder which is corrected in time by adequate niacinamide therapy. Since the retrograde changes in tissue structure and function which characterize this disorder occur insidiously over a period of years, many of its symptoms and signs are incorrectly attributed by laymen and physicians alike to the so-called "normal" aging process. But these retrograde changes in morphology and function of bodily tissues are usually reversible in time when adequate levels of niacinamide are supplied continuously to bodily tissues. The patient who takes continuously adequate amounts of niacinamide experiences, in addition to improvement in joint function, an improvement in his general health.

Theoretically, optimal nutrition must be continuously available to bodily tissues to ensure the best possible structure and function of tissues (104) (108). While we do not know what constitutes optimal nutrition, it has been demonstrated empirically that even persons eating a good or excellent diet according to present-day standards exhibit measurable impairment in ranges of joint movement which tends to be more severe with increasing age (see page 153). It has also been demonstrated that when such persons supplement their good or excellent diets with adequate amounts of niacinamide, there is, in time, measurable improvement in ranges of joint movement, regardless of the patients' ages. In general, the extent of recovery from joint dysfunction of any given degree of severity depends largely on the duration of adequate niacinamide therapy (see pages 187 and 188).

With the ingestion of adequate amounts of niacinamide continuously for a sufficient period of time, a patient whose ordinary diet is not inadequate in protein or calories, whose joints are not subjected to excessive mechanical trauma, will recover from joint dysfunction at the satisfactory rate of 6.0 to 12.0 Joint Range Index units, or better, in the first month of therapy, and 0.5 to 1.0 Joint Range Index unit, or better, for each month of therapy thereafter, until a Joint Range Index of 96-100 is reached. (Rarely, when a patient has one or more ankylosed joints, he may have no appreciable active or passive movement of these ankylosed joints, even after two years of adequate niacinamide therapy, although his other joints recover the full ranges of movement in response to such therapy. In such cases, the Joint Range Index cannot reach 96-100; e.g., when one wrist is ankylosed and has not shown increased movement in response to niacinamide therapy, the maximum Joint Range Index attainable is 90.9; and when both wrists are ankylosed, the maximal Joint Range Index attainable is 81.8.)

In general, the more severe and more chronic the patient's joint dysfunction, the slower is the rate of recovery in response to adequate niacinamide therapy, and the slower his subjective appreciation of improvement. The rate of recovery for each patient must be established empirically from serial determinations of the Joint Range Index. In order to ensure a continuously satisfactory rate of recovery from joint dysfunction, the physician must re-examine the patient at intervals during the course of niacinamide therapy. Whenever a patient taking the amounts of niacinamide prescribed by the physician, and eating a good or excellent diet, fails to make satisfactory improvement in his Joint Range Index, in the absence of excessive mechanical joint injury the niacinamide schedule must be revised upward to that level which permits satisfactory improvement. Failure of the patient to take niacinamide as directed will result in failure to improve at a satisfactory rate.

When a patient has joint dysfunction associated with obvious arthritic deformities, he is told that the physician cannot predict whether or not in his case articular deformities will resolve with adequate niacinamide therapy. However, in response to adequate

niacinamide therapy for a sufficient period of time, other patients have shown partial or complete resolution of their arthritic joint deformities. Some patients with arthritic deformities show resolution of some of their joint deformities, but not of others. Only careful observation of the patient's deformities on serial re-examinations will indicate whether or not his deformities are resolving in response to adequate niacinamide therapy. In most instances, the rate of resolution of the deformities will be slow, if it occurs at all.

It cannot be predicted whether or not a given joint that appears to be completely ankylosed clinically will recover any degree of movement. It has been observed many times that joints appearing to be clinically ankylosed prior to therapy tend to have partial or complete recovery of movement in response to adequate niacinamide therapy, although some ankylosed joints have not shown any degree of movement as a result of therapy during an observation period of several years. In response to adequate niacinamide therapy over a sufficient period of time some patients have partial or complete recovery of movement in some of their ankylosed joints, but not in others. Only careful observation of the ranges of joint movement on serial re-examinations will demonstrate whether or not a given ankylosed joint can recover any degree of movement in response to adequate niacinamide therapy.

In general, in the absence of complicating factors, the higher the patient's Joint Range Index rises in response to adequate niacinamide therapy, the fewer articular symptoms he will have; and the better he will feel. However, even though the Joint Range Index increases satisfactorily in response to adequate niacinamide therapy, the patient may not feel well because of complicating syndromes which are not on the basis of aniacinamidosis. Careful clinical study is necessary in order to establish the etiology of whatever complicating syndromes may be present and, with appropriate therapy, the patient is likely to become free from articular symptoms and to feel well. However, at any time symptoms of bodily discomfort may recur which must be studied and given appropriate treatment as promptly as possible, if the patient is to feel well again. While the patient may obtain temporary relief from articular and other symptoms through the use of analgesics, narcotics, sedatives, antihistaminics and local anesthetics, only adequate treatment of joint dysfunction and the complicating syndromes is likely to give more lasting benefits.

In order to assess the effects of niacinamide therapy on joint dysfunction and on the patient's general status, the patient is usually re-studied one month after continuous niacinamide therapy has been instituted. If good progress in recovery from joint dysfunction is noted at that time, he is reexamined in two months, and thereafter every three to six months. For the most part, this schedule of re-examination is found to be satisfactory for the supervision of the therapeutic program of patients presenting the chronic problems of joint dysfunction, although when the individual's problems are of unusual complexity, or when intercurrent problems arise, the time interval between visits is shortened.

When a patient with joint dysfunction fails to make the anticipated progress in response to niacinamide therapy, he is asked if he has taken the medication as prescribed; if not, he is urged to do so. (When a patient has taken multiple vitamin capsules as prescribed and has not made satisfactory improvement in his Joint Range Index in response to such therapy, the druggist is asked how the vitamin powders were compounded. The clinical effectiveness of niacinamide seems to be lessened when niacinamide is mixed with ascorbic acid by vigorous trituration, since this favors inter-molecular reactions between niacinamide and ascorbic acid in the dry powder state. The occurrence of such inter-molecular reactions between niacinamide and ascorbic acid is hindered by the preliminary admixture of each dry powder separately with a small amount of calcium stearate (0.2%) before the final admixture by sieving.)

It is always emphasized that the patient must take his medication continuously as prescribed until such time as the supervising physician may decide, on the basis of objective clinical evidence, that it is necessary to increase the level of niacinamide therapy in order to produce continuously satisfactory improvement in the Joint Range Index.

However, certain factors other than the ingestion of inadequate amounts of niacinamide may tend to depress the Joint Range Index. These include (a) transient or persistent mechanical joint injury resulting from unusual or physical exertion (see page 79) or from psychogenically sustained hypertonia of somatic muscle (see page 115), (b) rapid and excessive gain in weight to obesity levels, (c) excessive ingestion of alcohol, (d) inadequate dietary protein. When any of these factors is operative, it is of limited value to increase the amounts of niacinamide taken by the patient in an effort to effect satisfactory improvement in the Joint Range Index. Instead, treatment should be directed toward lessening the degree of mechanical joint injury, reducing the patient's weight to the normal range, interdicting alcohol, and increasing the protein intake to adequate levels, respectively.

When indicated, the physician describes for the patient four complicating syndromes frequently coexisting with joint dysfunction, and their treatment (see page 76). Most of the articular and non-articular symptoms of a patient with joint dysfunction which are not corrected by niacininide therapy usually originate as part of these four complicating syndromes. When the patient understands the etiologic basis of his symptoms, he will not have anxiety concerning the meaning of symptoms which would otherwise seem mysterious and alarming. The patient with joint dysfunction who has one or more of these complicating syndromes is told that he will not feel well unless joint dysfunction and these coexisting syndromes are correctly identified and successfully treated, and that in order to accomplish this, his active participation in the clinical investigation and therapeutic program is required.

TYPICAL IMPROVEMENT IN MOBILITY OF A SINGIE JOINT IN RESPONSE TO LEVELS OF NIACINAMIDE THERAPY USED PRIOR TO APRIL 1947

In serial determinations of the mobility of single joints in response to levels of niacinamide therapy used prior to April 1947, it was found that niacinamide-induced recovery of full joint mobility was an orderly process. (Since April 1947, when higher dosage schedules of niacinamide were introduced (see page 21), there has been a marked reduction in the incidence of articular pain and discomfort upon maximal passive movement of the moveable joints during various stages of recovery from joint dysfunction.)

There is described below typical improvement in joint mobility, as illustrated by several sequential stages occurring during niacinamide-induced recovery of full mobility of the metacarpophalangeal (knuckle) joint.

(Figure 14 is a schematic representation of maximal passive extension of the metacarpophalangeal joint at four successive stages (a) (b) (c) (d), during the course of niacinamide-induced recovery of full joint mobility. The line touched by the head of the arrow in (a) (b) (c) (d) indicates the upper limit of painless extension. The shaded angle in (b) and (c) indicates the range of painful passive extension.)

Figure 14(a). On the initial examination before niacinamide therapy was instituted, the metacarpophalangeal joint of the forefinger of the right hand could be extended passively to 30% of the full range of extension for this joint. No pain or discomfort was experienced by the patient during this maneuver. The examiner noted the presence of palpatory resistance from the initiation of the movement of passive extension of this metacarpophalangeal joint, and this resistance progressively increased as the joint was extended from the range of 0% to 30% of the maximal extension; the palpatory

resistance at the end of the movement was graded as firm. When at the 30% level of passive extension a small increase of force in the direction of extension caused no further extension of this joint, 30% of the full range of extension was taken as the upper limit of maximum passive extension of this metacarpophalangeal joint.

Figure 14 (b). At the end of one month of continuous, adequate niacinamide therapy, maximal passive extension of this metacarpophalangeal joint increased to 60% of the full range of extension. No pain or discomfort was experienced by the patient when the metacarpophalangeal joint was extended from 0% to 40% of the full range of extension. The patient experienced localized joint pain, often severe, as the joint was passively extended from 40% to 60% of the full range of extension. The examiner's palpatory sensation indicated that movement of the joint in passive extension was free from 0% to 40%, and that there was soft, yielding resistance which progressively increased as the finger was extended at the metacarpophalangeal joint from 40% to 60% of the full range of movement. When a further small increase of the extending force did not increase the degree of extension, 60% of the full range of extension was taken as the upper limit of passive extension of this metacarpophalangeal joint. The palpatory resistance at the end of the movement of extension was rubbery.

Figure 14 (c).After months of continuous, adequate therapy with niacinamide, maximal passive extension of the metacarpophalangeal joint reached 100%; i.e., the full range of movement. Passive extension of the metacarpophalangeal joint from 0% to 85% was without pain or discomfort; passive extension from 85% to 100% was painful. The examiner's palpatory sensation indicated that the movement of this joint was free from 0% to 85%, and that there was soft resistance, which increased progressively with increasing extension of the metacarpophalangeal joint from the level of 85% to 100%. A small additional force in the direction of extension when the 100% level was reached did not cause further extension of this joint. The palpatory resistance at the end of the full range of movement (100%) was rubbery.

Figure 14(d). With a longer period of continuous, adequate niacinamide therapy, it was possible to achieve full, free and painless extension of this metacarpophalangeal joint to the level of 100%. Slight additional palpatory force in the direction of extension with the joint fully extended did not increase the amount of movement beyond the full range of extension; i.e., the 100% level. The examiner's palpatory sensation indicated that the movement of extension was free from 0% to 100% of full extension, that the resistance met at the end of this movement was firm, and that the patient experienced no pain from this maneuver.

It would appear from clinical observations that, in the absence of joint trauma, there is an orderly and sequential pattern of recovery of joint mobility in a patient with joint dysfunction in response to continuous, adequate niacinamide therapy provided that the patient's diet is not inadequate in protein Or calories. Serial re-examinations of joint ranges during the course of continuous, prolonged, adequate niacinamide therapy reveal that with the passage of time, there are the following changes:

(a) progressive increases in ranges of joint movement;

(b) progressive shifting of painful zones of joint movement toward the periphery of the most recently acquired zones of increased ranges of joint movement, until, ultimately, after the fullest range of movement for the joint has been achieved, there is absence of pain on the execution of the fullest movement possible for the joint in the specified range; and,

(c) progressive shifting of zones of resistance to passive movement toward the periphery of the most recently acquired zones of increased ranges of joint movement until, ultimately, after the fullest range of movement for the joint has been achieved, there is no resistance to passive movement on the execution of the fullest range of

movement possible for the joint in the specified range of movement.
These dynamic changes in joint mobility occurring during the course of treatment suggest that sequential alterations in joint morphology must occur in response to continuous, adequate niacinamide therapy to permit the observed changes in joint mobility described above.

With cessation of adequate niacinamide therapy, the therapeutically-improved joint mobilities cannot be maintained for any prolonged period of time.

SELECTED CASE HISTORIES ILLUSTRATING THE THERAPEUTIC RESPONSE OF JOINT DYSFUNCTION TO NIACINAMIDE ALONE OR IN COMBINATION WITH OTHER VITAMINS

This section presents selected case histories which illustrate and emphasize the dynamic nature of joint dysfunction, with and without clinically obvious arthritis, as demonstrated by changing values of the Joint Range Index over a period of time in response to various levels of niacinamide ingestion. Twenty case histories, abbreviated in various degrees, are presented, together with a figure for each case which summarizes both the response of the Joint Range Index to the type of vitamin therapy employed, and the amounts of the vitamin(s) administered per 24 hours. A few figures summarize additionally the changes observed in the Sedimentation Rate during therapy.

Cases A through K have been chosen to demonstrate the effect on joint dysfunction of (a) adequate therapy with niacinamide, (b) reduction of niacinamide from adequate to inadequate levels, and (c) premature discontinuance of niacinamide therapy.
Cases L through T show the effects on joint dysfuntion of adequate and for the inadequate therapy with niacinamide administered in combination with of the other vitamins. Whenever adequate doses of niacinamide are given in combination with other vitamins to persons with joint dysfunction, improvement in joint function, as indicated by rising values of the Joint Range Index, is of the same order as would be anticipated if niacinamide in the amounts present in the vitamin mixture were the sole therapeutic agent. It will be demonstrated by these case histories that joint dysfunction (with or without clinically obvious arthritis) is ameliorated in time by adequate therapy with niacinamide (alone or in combination with other vitamins). This is true regardless of age, sex, occupation, geographic origin, economic level, or associated diseases. Whenever adequate therapy with niacinamide is replaced by inadequate therapy or by premature cessation of adequate niacinamide therapy, there is a worsening of joint function which in time is reflected by decreasing values of the Joint Range Index.

Whenever inadequate therapy with niacinamide is replaced by adequate therapy with niacinamide, joint function again improves, as measured by increasing values of the Joint Range Index. In general, the expectancy is that, with adequate niacinamide therapy for a sufficiently long period of time, the patient's joint function will improve continuously so that ultimately the Joint Range Index will measure between 96 and 100 (no joint dysfunction) and will be maintained at this level for as long as the amount of niacinamide ingested by the patient continues to be adequate for his bodily needs. In the absence of severe mechanical joint injury, when the diet of the patient is not inadequate in protein or calories, two stages are observed in the recovery of joint dysfunction in response to adequate niacinamide therapy. First, there is the initial large increase in the Joint Range Index of at least 12 units which occurs in a month or less. (At the end of one week of continuous adequate therapy with niacinamide alone or in combination with other vitamins, those few persons whose Joint Range Indices were determined at this interval had an increase in the Joint Range Index which was of the same order as that usually observed at the end of one month of therapy.)

This rapid initial improvement in the Joint Range Index is, in all probability, largely the result of the resolution of tissue edema in response to adequate niacinamide therapy

(97) (189). Associated with this rise in the Joint Range Index, the patient often has marked subjective improvement in feeling tone. The next stage of recovery from joint dysfunction is slow, with a gradual increase in the Joint Range Index of at least 0.5 to 1.0 unit per month. Recovery from joint dysfunction in response to treatment with niacinamide is considered to be clinically satisfactory, and the dosage of niacinamide is considered to be adequate, when the Joint Range Index increases at the end of the first month and thereafter within the limits of recovery for these time intervals as defined above. A lesser rate of recovery in joint dysfunction in response to niacinamide therapy is judged to be unsatisfactory, and the niacinamide dosage schedule is then increased to a level which will permit recovery from joint dysfunction at a satisfactory rate (provided that the patient is not subsisting on a low-protein diet).

Since there are wide individual variations in the need for niacinamide, the physician must determine empirically for each patient that level of niacinamide therapy which will produce satisfactory improvement in joint dysfunction. On the whole, the suggested dosage schedules (see page 22) will cause satisfactory improvement in joint dysfunction. However, on any of these dosage schedules, at any time there may be stabilization of the Joint Range Index until the dosage level of niacinamide is suitably increased, whereupon the Joint Range Index will rise again in a satisfactory manner. In order for the patient to make the best possible progress in recovery from joint dysfunction, periodic re-examinations must be performed by the physician so that the niacinamide dosage schedule may be adjusted as necessary to ensure serially rising values of the Joint Range Index until the level of 96-100 (no joint dysfunction) is reached, and subsequently, to maintain the patient at this level.

In recovering from joint dysfunction, especially of a severe grade, a patient is likely to be less impressed by the physician's Opinion that satisfactory improvement has been made in response to adequate niacinamide therapy, than by his own sudden realization that he is again able to use his body in ways that were impossible for a long time before the institution of niacinamide therapy; e.g., he is able to turn his head enough to enable him to park his car without difficulty; he can go up and down stairs with ease; after sitting in a movie theatre for hours, he does not experience prolonged stiffness and discomfort upon arising from his seat; he can trim his toenails without difficulty.

The selected case histories presented below demonstrate the usefulness of the routine determination of the Joint Range Index in evaluating the severity of the patient's joint dysfunction, in following his response to niacinamide therapy, and in regulating dosage levels of niacinamide during the course of treatment. However, in most instances, if the patient who is recovering from joint dysfunction is to feel well, it is also necessary to evaluate whatever additional coexisting clinical problems he may have, and to institute whatever therapeutic measures may be indicated. In subsequent sections, certain complicating syndromes will be described, which may cause arthralgia as well as other articular and non-articular symptoms, often complicating the treatment of joint dysfunction.

CASE A. No.309, female, age 26, housewife, married.

This case history illustrates, in a woman with clinically obvious rheumatoid arthritis, (a) improvement in joint function as measured by increasing values of the Joint Range Index in response to adequate niacinamide therapy, (b) impairment in joint function as measured by a lowered Joint Range Index as a result of substitution of inadequate for adequate therapy, and brief cessation of therapy, and (c) subsequent improvement in joint function as measured by an increased Joint Range Index in response to the re-introduction of more adequate niacinamide therapy. (These results are summarized in Figure 15.)

When she was 16 years old, she was hospitalized for special study of her joint disorder, and was informed upon completion of this clinical investigation that she had arthritis.

Her bone and joint symptoms were not ameliorated by the therapeutic program which was then recommended, and, indeed, became progressively worse, especially since her marriage at the age of 20, when she first started to do housework. The amount of her housework was considerably increased in volume after her two children were born.

Her presenting complaints include marked limitation of motion and pain (both at rest and on the initiation of joint movement) in the hip joints, knees, low back, neck, and fingers. She states that these joint symptoms are becoming progressively more severe, and are worsened by changes in weather and by any form of physical activity, including her housework. Although she has worn many different types of shoes, her feet have never been comfortable. She is irritable and tired, and frequently awakens during the night because of joint discomfort and muscular aching. Often she awakens in the morning feeling more tired than she did when she went to bed the night before.

Physical Examination: B.P. 130/80. P. 84. R. 18. T. 99.4 degrees. Wt. 135 lbs. Ht. 65 ½ inches. She seems tired, and looks older than her stated age. She moves slowly, as if guarding against rapid movements of her joints which might give her increased pain. Her posture is poor. Slight dorsal kyphosis and slight pelvic tilt are evident upon inspection. Her proximal interphalangeal joints of the fingers of both hands are thickened and swollen. Her skin is yellow, dry, slightly inelastic, and has a prominent reticular pattern. She has severe tenderness on moderate digital pressure over the maxillary and frontal sinuses, over the chondral ribs, the lower third of the sternum and chondrosternal junctions, the right trochanter, the lowermost third of the tibias bilaterally, the third, fourth and fifth cervical vertebrae and the lumbar vertebrae.

The liver edge is at the level of the costal margin in the right mid-clavicular line at the end of deep inspiration, and is tender to palpation. Her tongue shows hyperemia of the anterior third and atrophy of papillae. Her teeth are in good repair, although the gums are slightly retracted, infiltrated and swollen. Her conjunctivae are slightly thickened, and show some increased vascularity. Tickle sense is absent everywhere. She has hypopallesthesia. Her initial Joint Range Index (65.6) indicates severe joint dysfunction.

She was given 100 mg of niacinamide to take every 3 hours for 6 daily doses (600 mg/24 hours) and in one month there was improvement in her Joint Range Index and in her general health. She appeared less tired. She stated that she had experienced less pain, stiffness and limitation of movement since treatment with niacinamide had been instituted. Her color had improved, and her skin appeared less yellow. Her liver was not tender to palpation. The tenderness on digital pressure over the bony prominences, which was so marked on the previous examination, had practically disappeared. Tickle sense was present. She had recovered normal vibratory sensation. However, since the rate of recovery of her lingual mucous membrane in response to therapy with niacinamide was considered to be somewhat slow, the dosage of niacinamide was increased to 100 mg. every 1 ½ hours for 9 daily doses (900 mg/24 hours). She took this amount of niacinamide daily for about 300 days, and showed subjectively and objectively continuous and progressive improvement. The numerical value of her Joint Range Index rose from 65.6 to 90.2 in 300 days. Thus, according to the Clinical Classification of Joint Function, she had progressed from severe joint dysfunction to slight joint dysfunction.

Since she had shown an excellent response to therapy, she was asked to return for her next re-examination in six months, at which time her Joint Range Index had fallen to 78.2, with a concomitant return of many of her presenting symptoms. Upon inquiry, the following facts were elicited:

Shortly after her last visit, she knew that she was feeling better than she had ever felt in her life and thought, therefore, that she was "cured." She gradually decreased her niacinamide intake, and finally, for three weeks before her examination, took none.

As a result of her self-prescribed change in the therapeutic program, she had regressed clinically in all respects. Clinically, her joint dysfunction regressed from slight (90.2) to moderate (78.2). A new dosage schedule of niacinamide was prescribed (150 mg every 3 hours for 6 daily doses, or 900 mg/24 hours), which she took faithfully.

When therapy with niacinamide was thus re-introduced, her Joint Range Index was 78.2. In 84 days it rose to 86.4, and in 184 days to 91.2. Thus, she had again progressed from moderate to slight joint dysfunction. Her symptoms referable to bones and joints disappeared, and there has been progressive resolution of her abnormal physical signs.

Since she has gained some insight into the dynamic nature of her joint dysfunction, it appears likely that this patient will continue with her therapy as directed. It is anticipated that with continuously adequate niacinamide therapy she will in time achieve a Joint Range Index of 96-100 (no joint dysfunction).

CASE B. No.147, female, age 61, housewife, married.
This case history illustrates, in a woman with severe hypertrophic arthritis, (a) improvement in joint function, as measured by an increased Joint Range Index in response to a given dosage of niacinamide, (b) slight impairment in joint function as measured by a lowered Joint Range Index resulting from a small decrease in the niacinamide dosage from the previous level, and (c) an accelerated improvement in the Joint Range Index as a result of two successive increases in the niacinamide level (see Figure 16).

She has had joint discomfort for many years, and moderate deformities of the fingers for at least 10 years. Six to seven years ago she first noticed severe pain in her hip joints. Her knees are very stiff. All her life she has had curvature of the spine, and has had a good deal of pain in the back. Recently she has had increased fatigability and insomnia.

Physical Examination: She looks older than her stated age. B.P. 140/80. Wt. 159 ½ lbs. Ht. 65 inches. She has tenderness on digital pressure over the sternum, medial epicondyles, iliac crest, trochanter, styloid process of the radius, sacroiliac joints. Marked kyphoscoliosis is noted. Her tongue shows evidences of infiltration and atrophy of papillae. The edge of the liver, which is one finger's breadth below the rib margin in the right mid-clavicular line on deep inspiration, is tender to palpation. Bony prominences of the lower extremities are hyperpallesthetic to the tuning fork. Tickle sense is absent. Plantar dysesthesia is present.

This patient had severe joint dysfunction, as measured by her Joint Range Index of 68.2. She was asked to take 100 mg. of niacinamide every 1½ hours. In a month, she had experienced marked improvement in her Joint Range Index, and considerable subjective relief from joint discomfort. The plantar dysesthesia was no longer present. Liver enlargement had diminished markedly (liver tenderness and enlargement disappeared after a longer period of therapy). Hyperpallesthesia of the lower extremities was replaced by a normal vibratory sensation. Tongue showed the improvement expected with one month of niacinamide therapy. She looked younger than on her initial visit. She had no further difficulty with fatigability or insomnia.

She continued to make good progress clinically for over 300 days, when she reduced her niacinamide intake from 1200 mg/24 hours as originally prescribed, to 1000 mg./24 hours in divided doses of 100 mg. per dose. With this self-administered reduction in niacinamide dosage, her Joint Range Index decreased from 85.5 to 84.9.

The level of niacinamide was increased to 150 mg. every 1 ½ hours (1500 mg/24 hours) with an increase in her Joint Range Index from 84.9 to 90.1 in 267 days. The niacinamide dosage was then increased to 200 mg. every 1½ hours (2000 mg./24 hours) with an increase in the Joint Range Index from 90.1 to 92.8 in 58 days.

Thus, in a period of almost two years, this patient's Joint Range Index rose from 68.2 (severe joint dysfunction) to 92.8 (slight joint dysfunction). It is anticipated that with continuously adequate niacinamide therapy, she will in time achieve a Joint Range Index of 96-100 (no joint dysfunction).

CASE C. No.325, female, age 63, housewife, married.

This case history illustrates, in a woman with moderate hypertrophic arthritis, continuous improvement in joint function, as measured by increasing values of the Joint Range Index in response to adequate niacinamide therapy (Figure 17 summarizes this case).

For more than 10 years, she has had "chronic rheumatism," as well as many episodes of "acute rheumatism" characterized by painful transient swellings of her hands, wrists, knees and ankles. Her present complaints include generalized stiffness of joints (severe for an hour after she awakens in the morning) and accentuation of muscular, periosteal and articular discomfort with weather changes. While her wrists, shoulders and fingers have been painful and swollen "off and on," her knees have given her the greatest, most persistent discomfort. In the past year her knees have become so painful that she has had many sleepless nights.

Physical Examination: B.P. 170/80. Wt. 180 lbs. Ht. 61 ¾ inches. She is moderately obese, tired-looking, hyperkinetic. Her skin is relatively inelastic, has increased brownish pigmentation, and the normal reticular pattern is accentuated. The conjunctivae show thickening and increased vascularity. She has some circumcorneal injection. Her teeth are in good repair. The gingival membrane is thickened and retracted, but there is no evidence of gingival infection. Her tongue shows marked atrophy and infiltration of lingual papillae. Her Joint Range Index of 65.8 indicates severe joint dysfunction. She has a moderate upper dorsal kyphosis. Her wrists, fingers and knees are swollen. No objective signs of impaired nerve function are elicited. Her Sedimentation Rate Index is 0.4 mm/min. (Wintrobe-normal range 0.1 - 0.3 mm/min.). Hemoglobin 11.8 g./100 cc. (acid hematin photo-electric colorimeter). An x-ray of her knees taken immediately before therapy was instituted showed evidence of a hypertrophic type of osteoarthritis.

Niacinamide (150 mg every 3 hours for 6 daily doses, which is 900 mg/24 hours) was prescribed. After one month of therapy, she reported subjective improvement in her general feeling tone. Objectively her skin and tongue showed improvement. The prominent swellings had disappeared from the sites enumerated above. Her kyphosis seemed less prominent. She appeared younger and more vigorous than when first seen.

She stated on her fourth visit that she felt almost entirely free from all joint discomfort at the end of about 100 days of continuous therapy with niacinamide. She was particularly pleased that she was no longer awakened at night by knee pain. Objectively, her tongue and skin continued to show resolution of the abnormalities noted at the initial examination.

During five months of treatment, she has made objective improvement in joint function, as indicated by an increase in the Joint Range Index from 65.8 (severe joint dysfunction) to 83.2 (moderate joint dysfunction).

CASE D. No.461, female, age 68, widow, invalid.
This case history illustrates, in a woman with severe chronic rheumatoid arthritis, improved joint function as measured by increasing values of the Joint Range Index and by decreasing values of the Sedimentation Rate Index in response to therapy with niacinamide in the early months of such therapy (see Figure 18).

Much of the initial history had to be elicited with the patient reclining on a couch because she was too tired to sit up. She states that she had her first attack of "acute

rheumatism" more than 40 years ago. These attacks of "rheumatism" recurred irregularly at frequent intervals until 2 years ago, when they apparently ceased. They were characterized by abruptly increased swelling, stiffness, pain and limitation in the range of joint movement. The joints were hot to the touch, but not red. In the course of these various attacks, not a single joint or joint group the body was "missed." However, not all of the joints were involved at any one time. The acute episodes usually lasted 2 or 3 days and were followed by her ordinary chronic joint discomfort, which was somewhat more endurable than the severe exacerbations of her difficulty. However, in the past 5 years, her chronic discomfort and disability have increased so much that she doesn't think "it's worth going on living this way.

For more than 25 years, she has had severe deformities which have become progressively worse, so that now her hands are of little use to her. In addition, her wrists, elbows, shoulders, knees, ankles, feet (including the toes) are deformed, swollen and painful. For many years she has not been able to move her right wrist actively or passively, presumably because of complete ankylosis of the wrist joint; the range of movement of the left wrist is negligible. The ulnar deviation of her fingers prevents her from doing very much with her hands. She cannot raise her arms in abduction high enough to comb her hair nor can she fully extend her elbow joints. She is unable to flex or extend her ankles appreciably. Her toes are fixed in abnormal positions by joint deformities. Her knees, the most painful joints in her body, are hot and swollen. She thinks her knees have become markedly worse in the past year. Even with assistance she can scarcely get out of a chair because the pain in her knees is so severe that she thinks her legs might suddenly “let go." She is unable to walk upstairs and for years has lived on the first floor of her house. For more than 5 years, she has been unable to turn her head. If she wants to see someone behind her or to the side, she has to turn her whole body. For the past 5 years when she wakes at night and wants to turn her head, she has to turn her whole body in bed since her neck won't turn. Since her knee deformities do not permit full extension of these joints, when she is recumbent in bed she has to have two large pillows under her knees to support them in the least uncomfortable position. When she arises in the morning she is "terribly stiff" for about an hour. This severe stiffness recurs late in the afternoon.

During the past 5 years, she has had severe wasting of the muscles everywhere, but most markedly in her forearms and hands. She has suffered for the past 10 years from paresthesias of certain fingers of her hands.

She has an allergic colitis which is subject to exacerbations when she eats certain offending foods, such as milk, onions and chocolate. In the past 5 years, she has slowly and progressively lost more than 40 pounds in weight. She is so tired that for the past 5 years she has been unable to be up for longer than half an hour at a time.

Her arthritis had not been helped by any form of treatment which she had received to date.

Physical Examination: She is an extremely tired, crippled, chronically ill woman who is emaciated and has practically no subcutaneous fat. Extreme wasting of somatic musculature is noted. Wt. 90 ¾ lbs. Ht. 67 ¾ inches. B.P. 124/82. P.80. R. 18. Grips: R. 24, L. 20 (normal range for women 60-80). The skin is inelastic and thickened everywhere. There is a pervading color of light brown that is not sunburn. The reticular pattern of the skin is moderately accentuated. Severe callusing of the feet is noted. There is marked swelling noticeable in her face, around her elbows, wrists, fingers, knees, ankles, feet. Digital pressure over the bony eminences causes no pain, although severe pain can be elicited from every moveable joint upon maximal passive or active movement. Examination of the eyes reveals circumeorneal injection and conjunctival thickening. The optic disc out-lines are not distinct. Arteries are slightly tortuous, being narrowed from 0 to 2-plus; the veins and arteries are 2-plus infiltrated. No nicking or en-

gorgement is seen. The vermilion borders of the lips are thickened and magenta-colored. No cheilosis is noted. The gums show slight pitting and moderate infiltration and retraction. The tongue is magenta-colored, and its substance is swollen. The lateral lingual margins show complete atrophy of all papillae. Elsewhere, fungiform papillae are extinguished and filiform papillae are atrophic. There are many transverse fissures in the lingual mucous membrane. Her thyroid gland is 1-plus enlarged in the isthmus, but the lobes are not enlarged. Trachea in the midline. Chest is negative to auscultation and percussion excepting for emphysema. Heart is enlarged by percussion, the point of maximal impulse being 8 ½ cms in the 6th intercostal space. She has a soft, 1-plus non-transmitted mitral systolic murmur. Apical sounds are distant and of fair quality. No liver tenderness. No organs or masses are felt in the abdomen. Her temporal, branchial and radial arteries are slightly thickened. Her abdominal arteries, aorta, right and left internal iliac vessels are thickened and tender. Right and left posterior tibials pulsate 3-plus and are firm. The dorsalis pedis arteries are not palpable. She has moderately severe dorsal kyphosis and swollen ankles, knees, wrists and fingers. The fingers, held in marked ulnar deviation, are markedly deformed, as are her toes. The wrists are apparently ankylosed. Crepitus is elicited from the neck joints and from all moveable extremity joints. Vibratory sensation in the right lower extremity (toes, malleolus and tibia) is more marked than in the left. Vibratory sensation in the upper extremities within normal limits. No plantar dysesthesia. Tickle sense 2-plus on forehead, absent elsewhere. Sense of light touch and sense of motion and position are intact.

Urinalysis negative. Hemoglobin 9.0 g/100 cc (acid hematin photoelectric colorimeter). Sedimentation Rate Index 1.65 mm/min. (Wintrobe-normal 0.1-0.3 mm/min.).

Her Joint Range Index was 45.0, indicating extremely severe joint dysfunction. (In order to obtain an initial value for her Joint Range Index, measurement of hip and knee ranges used in computing the Joint Range Index was made in the usual way, save for the fact that the marked flexion deformities of the knees caused some pelvic tilt with the patient recumbent. However, on the 139th day, the flexion deformity of the knees could no longer be demonstrated. Also, since the fixation of the fingers of the deformed hands did not permit extension of all of her fingers to the zero, or neutral level - i.e., the level where the finger would be neither flexed nor extended - a new convention was introduced in this instance. When the fingers on maximal extension did not reach the zero line, the percentage of the quadrant between the dorsura of the finger being measured and the zero line was noted with a minus sign, and tile finger index was derived in the usual way, adding algebraically the various measured values obtained for each hand.)

She was asked to take 150 mg of niacinamide hourly during the day (2400 mg/24 hours). After 34 days of such therapy, she stated that she had been feeling stronger, and that she tired somewhat less readily than formerly. She stated emphatically that her shoulders were almost entirely comfortable, and moved much more freely. She could comb her hair for the first time in 5 years. Her knees were still painful, and she was not as "spry getting out of a chair" as she would like to be, but she was able to get out of a chair without assistance. Her color, she thought, had improved.

When she walked, she held herself more erectly and moved with better balance than she had when first seen. She seemed mentally alert and responsive. She was able to get up from her chair without assistance, although she had some difficulty in doing so, and some pain in her knees. Her skin had become a little more elastic and was lighter in color. The reticular pattern of the skin was less prominent. Her lingual mucous membrane showed some signs of improvement. The tissue swellings previously noted had almost disappeared. She had gained 1 ¼ lbs in weight. Her Joint Range Index had increased from 45.0 to 58.5. The venous pattern around the knee joints was much less prominent than it had been when she was first seen. She could extend her knees almost completely, and was able to lie flat on the examining table without a pillow under

her head, and required only a small pillow under her knees for comfort. The ulnar deviation of the fingers was less marked than when she was first seen. The Sedimentation Rate Index had improved slightly, having declined from 1.65 to 1.50 mm/min. In 76 days of treatment with niacinamide, her Joint Range Index had stabilized at 58.2. There was no discernible tissue edema. She had had further improvement in her feeling tone. She was very much more comfortable physically, and was troubled hardly at all by pain and discomfort in her joints. Her stiffness was markedly decreased. Since her Joint Range Index had apparently stabilized, the dosage of niacinamide was increased so that she took on alternate hours 150 mg and 200 mg of niacinamide (2800 mg/24 hours).

In 139 days she had a Joint Range Index of 61.5. She thought that her was improved considerably. She weighed 5 lbs. more than when first seen. She was generally more cheerful and seemed to be more youth-in appearance and behavior. She could now be up for several hours at a time without requiring a nap. She was able for the first time in many years to go upstairs without assistance, although she still had moderate pain in her knee joints on doing so. She could get out of a chair easily without assistance and with very little discomfort. She was able to lie flat on the examining table without pillows under her head or knees, and without pain or subjective discomfort. Her Sedimentation Rate Index had decreased from 1.50 mm/min. (34th day) to 0.44 mm/min. (139th day). Her niacinamide schedule was increased from the previous level to 250 mg per hour (4000 mg/24 hours), since it was felt at this time that the severity of her joint dysfunction warranted such a therapeutic trial at that time.

About 3 weeks before her next scheduled visit, she was feeling so well that she took liberties with her diet, eating foods (milk, onions, chocolate) to which she knew she was extremely allergic. The ingestion of these offending foods activated her allergic colitis, as a result of which she lost 4 lbs. in 10 days. She had resumed her usual diet (avoiding milk, onions and chocolate) about 10 days before her visit, and was again feeling better, although her colon was still somewhat irritable and hyperactive. Save for this interlude of allergic colitis, which she considered to be an unimportant incident, she felt very well physically.

In 202 days of niacinamide therapy, she was almost completely free from joint symptoms, including pain. Her Joint Range Index had risen from 61.5 (139th day) to 62.9 (202th day). Her elbows, which could not be fully extended initially, were now easily extended. Her right wrist, which had been clinically completely ankylosed, now moved 10% in extension and 0% in flexion. The left wrist, which on the initial examination had moved 0% in extension and 10% in flexion, now moved 15% and 50%, respectively. She was able to lie on the examining table without any pillows under her head or knees. She was able to get out of a chair as any normal person would. Her knees, which had been originally markedly swollen, were markedly decreased in size. Since the initial visit, there had been a decrease in the transverse diameter of the knees of 0.44 inch across the right knee and 1.38 inches across the left knee (measured across the broadest part of the knees).

Summary: This case history illustrates the effects of niacinamide therapy in the early months of such therapy in a person with extremely severe joint dysfunction (severe chronic rheumatoid arthritis of long duration). A summary of certain clinical and laboratory data obtained during the various office visits is listed in Table 0A.

Subjectively, as a result of treatment with niacinamide, in the early months of therapy this patient experienced a sense of well-being, including greater strength, less fatigability and freedom from joint pain and stiffness. She had less limitation in the ranges of joint motion. She had an increased appetite and enjoyment of food. She had a new zest for living.

Her weight loss between the 139th day and 202nd day was attributed to her allergic colitis, which she induced by eating foods to which she knew was hypersensitive.

Her severe hand deformities showed some signs of resolution, so that the fingers which were formerly fixed in ulnar deviation could now be passively brought into the normal position without pain. The wrist joints which were clinically ankylosed showed some tendency toward renewed movement, although objectively the right wrist was not considered to have shown significant improvement thus far. The left wrist showed marked improvement, and it is anticipated that in time, with continuously adequate niacinamide therapy, there will be further movement of this joint both in flexion and extension.

During the above period of clinical observation the increased Joint Range Index, decreased Sedimentation Rate Index, increased weight, decrease in joint swelling and in generalized tissue edema, increased hemoglobin, red blood count and hematocrit, all indicate the arrest and partial reversal of her severe chronic rheumatoid arthritis, as a direct result of therapy with niacinamide as the sole therapeutic agent. Further observation of this patient is necessary in order to determine the maximal degree of clinical recovery possible for her in response to continuously adequate niacinamide therapy over a much longer period of time.

CASE E. No.339, female, age 78, spinster.
This case history illustrates, in an elderly woman with severe acute rheumatoid arthritis (probably superimposed on mild chronic hypertrophic arthritis), improvement in joint function as evidenced by rising values of the Joint Range Index in response to adequate therapy with niacinamide (see Figure 19).

This woman considered that for her age she had enjoyed excellent health until 6 months ago, when her younger sister, aged 75, had a stroke. Before her sister's illness, the patient had never done much physical work. However, since the sister did not wish to be hospitalized, or to be taken care of by strangers, the patient undertook to give nursing care to her sister at their home. The bedrooms were on the second floor, and the patient made many extra trips up and down the rather steep flight of stairs, usually carrying her sister's meals to her. She was so busy with her sister's care that she neglected to eat her usual abundant diet, substituting starchy foods for high-protein foods.

After a month of such increased physical activity and change in her dietary habits, she was aware of pain, stiffness and swelling of her joints. She took 8-10 aspirin tablets (0.3 g) a day with only slightly increased comfort. Although prior to her sister's illness she had been able to go up and down stairs without difficulty, now she could not climb the stairs without gripping the banister with her left hand and pulling herself upward step by step in this way.

Her sister improved gradually over a period of several months, so that at the time of her initial visit she had much less to do physically, although she continued to have a high-carbohydrate diet. Her joints continued to give her trouble, so that she had constantly severe pain in the neck, severe low back pain, and painful swelling of the knees, ankles, wrists, hands, elbows and shoulder joints. She had persistent numbness and tingling of her hands, which were so swollen that she could not "make a fist." She noticed that many of her joints were extremely hot to the touch, and that she had considerable crepitus in most of her joints. Every morning for several hours she felt stiff, until the aspirin "took hold." Her stiffness recurred toward evening, when it was not relieved by aspirin. With changes in weather, she had increased joint discomfort. Her sleep was disturbed and restless because of her joint discomfort. She had lost 16 lbs. in the past 3 months. She felt that she was becoming progressively weaker, and felt exhausted most of the time.

Physical Examination: T. 99.2 degrees. P.74. R. 18. B.P. 150/90. Wt. 156 lbs. Ht. 62 ¼ inches. Grips: R. 20, L. 12 (normal range for women 60-80). She is a sick old lady who is apparently in great pain during the interview and physical examination. She seems dulled mentally. Her voice is quavery and quernious. She walks with extreme slowness and some dysequilibrium.

Her Joint Range Index is 62.9, indicating severe joint dysfunction. The joints of the left side of her body are somewhat more involved by the arthritic process than those of the right. She has marked dorsal kyphosis. Her knees, ankles, wrists, hands, elbows and shoulder joints show the marked swelling seen in classic rheumatoid arthritis. Prominent venous engorgement around the knees is noted. Her extremity joints are hot to the touch. A few subcutaneous periosteal nodules are felt on the ulna and tibia.

Her skin is yellow-brown and somewhat atrophic. The reticular pattern of the skin is accentuated. She has a few ecchymoses. Many hyperkeratotic hair follicles are observed on the extensor surfaces of her extremities. She has Bit6t spots. Her edentulous gums are swollen and reddened. Her tongue shows hyperemia of the tip and lateral margins, and marked atrophy of papillae. Her heart is enlarged by percussion, the point of maximal impulse being felt 10 cm. to the left of the mid-sternal line in the 5th intercostal space. Throughout systole there is heard a 8-plus, moderately high-pitched, rough, non-transmitted aortic systolic murmur. The lungs are emphysematous but otherwise negative to physical examination. The liver margin is felt 3 fingers' breadth below the costal margin in the right midclavicular line at the end of deep inspiration, and is 8-plus tender. No other organs or masses are felt. Reflexes are within the range of normal. Her dorsalis pedis arteries are firm, pulsate 8-plus and are equal; her posterior tibial arteries are firm, pulsate 1-plus and are equal. Tickle sense is absent, but vibratory sense, sense of light touch and sense of motion and position are intact. Her Sedimentation Rate Index is extremely elevated, being 1.80 mm/min (Wintrobe-normal 0.14).3 mm./min.). Hemoglobin 11.4 /100 cc (acid hematin photoelectric colorimeter).

Niacinamide was prescribed, to be taken 150 mg. every 3 hours for 6 doses daily (900 mg/24 hours). After 22 days of this therapy, much of her joint swelling had resolved, although she still complained of pain and stiffness. She walked and sat more erectly than on her first visit. She walked with better balance, and more rapidly than she had originally. Her liver margin was palpated 2 fingers' breadth below the right costal margin in the right mid-clavicular line on deep inspiration, and was 2-plus tender. Her Joint Range Index had risen from 62.9 (severe joint dysfunction) to 73.2 (moderate joint dysfunction).

In 84 days of therapy, her Joint Range Index had apparently stabilized at 72.8. Although slight ankle edema still persisted, edema around other joints was no longer evident. Her Sedimentation Rate Index had decreased from 1.80 mm/min to 1.00 mm/min. In order to be completely free from bone and joint symptoms she required only one aspirin tablet a day. Her voice had lost its quaver. She seemed to be more alert mentally and more vigorous physically. There had been considerable improvement in her lingual mucous membrane.

In 172 days of treatment, her Sedimentation Rate Index had improved further, so that it was 0.85 mm/min and her Joint Range Index had risen to 76.2. She stated emphatically that she felt better than she had in many years, and was almost entirely free from joint discomfort and pain. She was delighted to report that she no longer required the help of aspirin to be comfortable. Her liver was no longer enlarged or tender to palpation. Wt. 158 lbs.

At the end of 280 days of treatment, her Sedimentation Rate Index had fallen to 0.65 mm/min and her Joint Range Index had risen to 80.7. She was able for the first time in almost a year to go upstairs without either pulling herself up by the banister or climbing

up the steps hand over hand, foot over foot, as an animal would. Her skin had become more elastic and less atrophic. Her color was improved, and the yellow-brown color had been disappearing. No evidences of joint swelling could be made out. The ulnar and tibial subcutaneous nodules originally present could no longer be identified. She had no evidence of liver enlargement or swelling of the liver on palpation.

However, since the rate of recovery of her lingual mucous membrane in response to therapy with niacinamide was considered to be somewhat slow, it was decided to increase her dosage schedule from 150 to 180 mg. of niacinamide per capsule, to be taken one every 3 hours for 6 daily doses (an increase from 900 to 1080 mg. of niacinamide per 24 hours).

For one month she adhered faithfully to the revised program of therapy, and felt in such excellent health and spirits that she became careless, reducing her niacinamide intake to approximately one capsule every 3 1/2 hours for 5 daily doses (900 mg niacinamide per 24 hours).

When she was next seen on the 355th day of niacinamide treatment, her Joint Range Index had risen from 80.7 to 84.1, although the Sedimentation Rate Index had risen slightly from 0.65 to 0.75 mm./min. When she was informed that the Sedimentation Rate Index was less good than previously, she agreed to take her medication faithfully.

On the 417th day, her Joint Range Index had risen from 84.1 to 86.0, and her Sedimentation Rate Index had fallen from 0.75 to 0.56 mm/min. At this time she was euphoric, and did not remember when she had felt so well. She was physically and mentally vigorous. Her voice was clear, resonant and decisive. With considerable satisfaction, she reported a renewed interest in being with people, and in entertaining guests. She looked younger than when first seen, appearing to be closer to 60 than 80 years of age. She had been entirely free from bone and joint symptoms, and had not taken any aspirin for about 8 months. She could walk up and down stairs without difficulty and without any sense of physical impairment or exhaustion.

Her carriage was erect, although she still had a dorsal kyphosis which would be graded as moderate. Her skin was smoother, softer, less atrophic and more elastic than it was on her first examination; the reticular pattern was less marked than it had been, but still accentuated. She had no discernible joint swellings or deformities. There was no hepatic tenderness or enlargement. The lingual mucous membrane showed a more satisfactory rate of recovery than it had to date in response to niacinamide therapy. Her muscular strength as measured by the dynamometer had improved (Grips: R. 50, L. 46). Hemoglobin 12.0 g/100 cc (acid hematin photoelectric colorimeter).

Summary: This elderly lady with severe joint dysfunction (acute severe rheumatoid arthritis probably superimposed on a mild chronic hypertrophic arthritis) showed in 417 days in response to treatment with niacinamide as the sole therapeutic agent, an improvement in the Joint Range Index from 62.9 (severe joint dysfunction) to 86.0 (slight joint dysfunction). Her Sedimentation Rate Index improved from the exceedingly high rate of 1.80 mm/min to 0.56 mm/min. (Wintrobe-normal 0.1 - 0.3 mm/min). Her muscular strength (grips) as measured with a dynamometer in pounds per square inch rose from the initial measurement of R. 20, L. 12 to R. 50, L. 46 (normal range for women 60-80). In addition to the objective improvement in all of her joints and in her general health, there was a striking decrease in her apparent age. It is anticipated that with continuously adequate niacinamide therapy she will in time achieve a Joint Range Index of 96-100 (no joint dysfunction).

CASE F. No.85, female, age 69, housewife, married.

This case history illustrates, in a woman with severe joint dysfunction and severe, chronic hypertrophic arthritis, (a) improved joint function, as measured by an increased

Joint Range Index in response to adequate therapy with niacinamide for one month, (b) impaired joint function, as measured by a lowered Joint Range Index, as a result of substitution of inadequate for adequate niacinamide therapy, and (c) improved joint function, as measured by subsequent increases in the Joint Range Index in response to the re-introduction of more adequate therapy with niacinamide (see Figure20).

She has had arthritis for a long time. For at least 10 years, she has had marked deformities of the hands. Her arthritic symptoms have become more severe in the past 6 months, during which time she has been increasingly tired, more forgetful and more irritable.

Physical Examination: B.P. 168/78. Wt. 118 lbs. Ht. 62 ½ inches. Her skin has a yellowish cast and is inelastic, with a markedly accentuated reticular pattern. She has no periosteal tenderness on digital pressure, and no liver tenderness or enlargement. The lingual papillae are atrophic. Sedimentation Rate Index 0.75 mm/min. (Wintrobe-normal 0.1-0.3 mm/min). Hemoglobin 9.9g/100 cc (acid hematin photoelectric colorimeter). White blood count 8,000. Her Joint Range Index was 59.6, indicating that her joint dysfunction fell within the lower range of the severe grade of joint dysfunction. Hypertrophic deformities of the joints of the fingers were noted.

She had severe joint dysfunction (severe hypertrophic arthritis). She was given niacinamide, 150 mg every 3 hours for 6 doses daily (900 mg/24 hours). For one month she took the medication as prescribed, making the expected improvement in her Joint Range Index, which rose to 78.3. During the next two months she gradually reduced her dosage of niacinamide, with a concomitant fall in the Joint Range Index. She then resumed taking the niacinamide as originally directed, with subsequent improvement in the Joint Range Index.

Since her Joint Range Index appeared to have stabilized (80.2 and 80.7), her niacinamide intake was increased to 250 mg every 3 hours for 6 doses daily, with a resultant improvement in the Joint Range Index. In 349 days her Sedimentation Rate Index decreased from 0.75 to 0.35 mm/min (Wintrobe-normal 0.1-0.3 mm/min). In 735 days her Joint Range Index had risen from 59.6 to 88.7, a shift from the lower range of severe joint dysfunction to slight joint dysfunction. This patient subsequently discontinued treatment because she mistakenly thought she was cured, since she felt so well.

CASE C. No.336, female, age 29, private secretary, single.

This case history illustrates, in a woman with moderate joint dysfunction, without clinically obvious arthritis, (a) improvement in joint function as measured by increasing values of the Joint Range Index in response to adequate niacinamide therapy, (b) impairment in joint function as measured by a lowered Joint Range Index in response to premature cessation of niacinamide therapy, and (c) subsequent improvement in joint function as measured by an increased Joint Range Index in response to the re-introduction of adequate niacinamide therapy (see Figure 21).

Her presenting symptoms are increasing fatigue and irritability. She has no symptoms referable to bones and joints.

Physical Examination: She looks and acts tired. Her skin has a yellowish cast, and is generally coarse. She has marked atrophy and infiltration of the lingual papillae. Her liver on deep inspiration is felt at the costal margin in the right mid clavicular line and is 1-plus tender. She shows no clinical evidence of arthritis, although her Joint Range Index of 73.7 indicates moderate joint dysfunction.

In response to 150 mg of niacinamide every 3 hours for 6 daily doses (900 mg/24 hours) she displayed progressive improvement in her joint dysfunction, as shown by increasing values of the Joint Range Index (a value of 90.4 was 6btained after 207 days of continuous niacinamide therapy). This patient experienced also improvement in her

general health, with complete resolution of excessive fatigue and irritability, and concomitant improvement in the lingual mucous membrane.

She lost interest in continuing with therapy, and for four months took no medication. There was a gradual recurrence of her presenting symptoms, and she returned for study and treatment. Her Joint Range Index had dropped from 90.4 on the 207th day to 79.5 on the 442nd day. With resumption of therapy, her Joint Range Index rose from 79.5 on the 442nd day to 92.7 on the 470th day, and to 96.5 on the 725th day.

CASE H. No.208, male, age 10, schoolboy.
This case history illustrates, in a boy with moderate joint dysfunction, without clinically obvious arthritis, improvement in joint function as measured by an increasing Joint Range Index in response to adequate therapy with niacinamide (see Figure 22).

He has experienced ill-health, including many severe infections. He is jittery, nervous and apparently unable to fix his attention on anything for even short periods of time. He has paresthesias in the legs if he sits for more than half an hour. He is irritable and easily tired.

Physical Examination: B.P. 110/70. Wt. 67 lbs. Ht. 55 ¼ inches. His skin is yellow-brown everywhere, and roughened and discolored, particularly over the knees, ankles, elbows and hands. The reticular pattern is slight. He has many ecchymoses, particularly on the right leg. There is tenderness on pressure over the sternum, sternoclavicular junction and chondrosternal junction. He has mild atrophic changes in the lingual papillae. The conjunctivae lack lustre, but are not otherwise abnormal. Teeth are in good repair. Gums are swollen, slightly hyperemic, slightly retracted. No infection of the gums was noted. The liver edge is 2-plus tender and 2 fingers' breadth below the costal margin in the right middavicular line. He has plantar dysesthesia lasting 35 seconds. He has hyperpallesthesia in the lower extremities. Tickle sense is absent on the legs, but present elsewhere. Standing, he is unable to touch his fingers to the floor with knees unbent, the distance from fingers to floor with maximal bending being well over 12 inches. The Joint Range Index of 78.0 indicated moderate joint dysfunction.

After one month of treatment with niacinamide (100 mg three times a day after meals and at bedtime; 400 mg/24 hours), his Joint Range Index showed improvement. Tenderness and enlargement of the liver had disappeared, as had his abnormal neurologic signs. There was a marked improvement in his personality.

In 1,003 days of continuous niacinamide therapy, this boy's Joint Range Index has improved from 78.0 (moderate joint dysfunction) to 98.2 (no joint dysfunction). He is now able to bend over as described above and touch the floor with his fingers. His color is no longer yellow. He is cheerful, cooperative and alert, and has stopped being a "problem child." He does not suffer from irritability or excessive fatigability

CASE I. No.431, female, age 87, interior decorator, divorced.

Figure 23 illustrates, in a woman with moderate joint dysfunction and moderate hypertrophic arthritis, improvement in joint dysfunction, as measured by a continuously rising Joint Range Index.

CASE J. No.808, female, age 39, commercial artist, widow.

This case history illustrates, in a woman with moderate joint dysfunction (mild, clinically obvious hypertrophic arthritis), (a) improved joint function, as measured by an increased Joint Range Index in response to adequate therapy with niacinamide for one month, (b) impaired joint function as measured by a lowered Joint Range Index, as a result of substitution of inadequate for adequate niacinamide therapy, and (c) improved joint function as measured by subsequent increase in the Joint Range Index in response to

the re-introduction of more adequate therapy with niacinamide
Figure 24).

She had a "nervous breakdown" 3 ½ years ago when her husband died, was followed by typical menopausal symptoms. She has had transient low back pain and right shoulder discomfort after a day's work at the drawing board. She has had for the past 3 years persistent stiffness of joints.

Physical Examination: B.P. 130/90. Wt. 153 lbs. Ht. 66 inches. Hemoglobin 11.8g/100 cc (acid hematin photoelectric colorimeter). She has generalized pallor, and moderate accentuation of the reticular pattern of skin. Her Joint Range Index of 79.4 indicated moderate joint dysfunction

For the control of her menopausal symptoms she was given 50 micrograms of ethinyl estradiol once daily for a week, and thereafter every other day. In addition, she was given 150 mg of niacinamide every 3 hours for 6 daily doses (900 mg/24 hours), which she took for one month with the expected improvement in her Joint Range Index to 86.6.

However, the next month, though she continued the ethinyl estradiol at the prescribed level, upon the advice of a "friendly druggist" she dropped the amount of niacinamide ingested to 600 mg/24 hours, taking 100 mg instead of 150 mg every 3 hours for 6 daily doses, with a resultant fall in her Joint Range Index to 81.4. Subsequently, she resumed taking niacinamide at the level originally recommended, and her Joint Range Index rose from 81.4 to 87.3.

Thus, in four months her Joint Range Index shifted from 79.4 (moderate joint dysfunction) to 87.3 (slight joint dysfunction), even though for one month the patient had reduced her niacinamide from adequate to inadequate levels.

CASE K. No.416, male, age 60, accountant, married.

This case history illustrates, in a male with severe joint dysfunction (mild but clinically obvious hypertrophic arthritis); improvement in joint function as measured by increasing values of the Joint Range Index in response to adequate niacinamide therapy (see Figure 25).

He was given 160 mg of niacinamide every 2 hours for 8 doses daily (1200 mg/24 hours) and in 315 days of such therapy his Joint Range Index rose from 65.5 to 91.8, a shift from severe to slight joint dysfunction. With this therapy, he experienced a feeling of physical well-being and vigor such as he had not had for many years.

CASE L. No.413, male, age 61, mechanical engineer, widower.

This case history illustrates, in a man with severe joint dysfunction (clinically obvious hypertrophic arthritis), improvement in joint function as measured by increasing values of the Joint Range Index in response to therapy with niacinamide in combination with other vitamins (see Figure 26).

This man suffered for more than 6 years from severe, persistent headaches (occipital and cervical pain) which varied in intensity from day to day, but from which he had no relief, in spite of a regular, liberal intake of aspirin. In the past 2 years his headaches had become increasingly more severe. He has noticed crepitus in many of his joints, especially in the neck. He is stiff in the morning when he first awakens, and when the weather changes. His shoulders have been painful. At times he has noticed marked stiffness and pain in his finger joints.

Physical Examination: He is a tired, listless adult male who looks older than his stated age. B.P. 120/80. P. 70. R. 18. T. 97.2 degrees. Wt. 143 ½ lbs. Ht. 67 ¼ inches. His

pigmentation is yellowish-brown. The skin of his neck and face has a sharkskin-like appearance, and the reticular pattern is markedly accentuated on his body. His fingernails are thickened. Callusing at pressure points is very noticeable. He has many hyperkeratotic hair follicles on the extensor surfaces of his arms and thighs, and on his abdomen and buttocks. He has marked tenderness on digital pressure over the ensiform process and the maxillary sinuses. His occipital bone is tender to digital pressure. His eyes show marked circumeorneal injection and photophobia. There is some thickening and increased vascularity of the conjunctivae. He is edentulous; the gums have a purplish, swollen appearance. His tongue is magenta-colored and showed marked atrophy and hypertrophy of papillae. He has cheilosis, perhaps partly the result of ill-fitting dentures. His liver margin is felt 3 fingers' breadth below the right costal margin in the right mid-clavicular line on deep inspiration. His posterior tibial and dorsalis pedis arteries pulsate 2-plus. He has marked plantar dysesthesia. Tickle sense is absent, although his sense of light touch, sense of motion and position and vibratory sense are intact. He has moderate dorsal kyphosis and moderate deformities of the fingers. His Joint Range Index was 67.5.

He was given a vitamin dosage schedule as follows:

	Per Dose	Per 24 Hours
Niacinamide	162.5 mg	975 mg
Riboflavin	7 mg	42 mg
Thiamine HCl	3 mg	18 mg
Ascorbic Acid	225 mg	1350 mg

At the end of one month of the above therapy, there was a marked change in his appearance. He seemed less listless and lethargic. He looked younger in appearance. His color was less brown. There was increased range of movement in his neck, and he had much less spasm of the neck muscles. He stated that his headaches were much less severe than formerly, that his spirits were much improved, and that he was less tired generally. However, his tongue, gums and eyes showed little resolution of their severe deficiency signs at this time. His Joint Range Index had risen to 77.8. He had no evidence of liver enlargement or tenderness.

With the passage of time and the continuance of therapy at the prescribed level, there has been progressive improvement in his tissues and m his Joint Range Index. His dorsal kyphosis is now less apparent. He now has headaches at rare intervals, which tend to be mild and occur only when he has held his head in an awkward position for a considerable period of time; e.g., when he studies blueprints. With each successive visit, he has appeared to be a younger, more vigorous man.

With continuous therapy with niacinamide in combination with other his Joint Range Index rose in 190 days from 67.5 (severe joint dysfunction) to 87.1 (slight joint dysfunction).

CASE No. 427, male, age 45, attorney, married.

This chart illustrates, in a man with severe joint dysfunction (without arthritis), improvement in joint function, as judged by increasing of the Joint Range Index in response to therapy with niacinamide in combination with other vitamins (see Figure 27).

This patient's Joint Range Index rose from 67.7 (severe joint dysfunction) to 86.0 (slight joint dysfunction) in 178 days of therapy.

CASE N. No. 337, female, age 36, business woman, single.

This chart demonstrates, in a woman with moderate joint dysfunction (without clinically obvious arthritis), continuous improvement in joint function, as demonstrated by

increasing values of the Joint Range Index in response to therapy with niacinamide in combination with other vitamins (see Figure 28).

This patient had hypothyroidism which was controlled with 90 mg of thyroid (U.S.P.) daily. A 3-week lapse in the ingestion of thyroid caused a recurrence of her hypothyroid symptoms, and the resumption of thyroid caused these symptoms to disappear. This lapse in thyroid therapy did not influence the pattern of recovery of her joint dysfunction. Her Joint Range Index rose from the initial value of 75.8 (moderate joint dysfunction) to 92.5.(slight joint dysfunction) in 385 days of continuous vitamin therapy.

Case 0. No.194, female, age 52, business woman, married.

This case history illustrates, in a woman with moderate joint dysfunction (without clinically obvious arthritis), (a) improvement in joint function in response to a given level of vitamin therapy which proved to be inadequate, as demonstrated by stabilization over a period of time the Joint Range Index below the 96-100 level, and (b) subsequent improvement in joint function, as indicated by rising values of the Joint range Index in response to a small increase in the level of vitamin therapy

For 511 days this patient was given the following vitamins:

	Per Dose	Per 24 Hours
Niacinamide	100 mg	400 mg
Ascorbic Acid	100 mg	400 mg

With the above level of treatment, her Joint Range Index rose from 79.0 to 83.0 in 70 days. In 295, 391 and 511 days the Joint Range Index measured 89.2, 89.8 and 89.2, respectively.

Her dosage schedule was changed to:

	Per Dose	Per 24 Hours
Niacinamide	100 mg	600 mg
Ascorbic Acid	100 mg	600 mg

Subsequently, her Joint Range Index rose, so that on the 632nd day after the initial visit, it was 91.7, and in 748 days it was 93.4, indicating a shift from moderate to slight joint dysfunction. In 910 days of therapy her Joint Range Index rose to 96.9 (no joint dysfunction).

CASE P. No.362, male, age 28, attorney, single

This chart illustrates that a man with moderate joint dysfunction (without obvious arthritis) and mild untreated hypothyroidism (basal metabolic rate -18%) had no change in his Joint Range Index as a result of the daily ingestion of 60 mg of thyroid substance (U.S.P.) for 30 days. However, when he received in addition to his thyroid medication an adequate dosage of niacinamide in combination with certain other vitamins, there was improvement in his Joint Range Index (see Figure 30).

CASE Q. No.278, female, age 47, housewife, married.

This case history illustrates, in a woman with severe joint dysfunction (with clinically obvious hypertrophic arthritis), cyclically, (a) improved joint function as shown by an increased Joint Range Index in response to adequate therapy with niacinamide in combination with other vitamins, (b) impaired joint function as shown by a lowered Joint Range Index as a result of substitution of inadequate for adequate therapy, and (c)

improved joint function as shown by increased Joint Range Index in response to re-introduction of more adequate therapy (see Figure 31).

She has been aware of soreness in her joints, stiffness and limitation of movement for more than 10 years. She has had soreness of the tongue off and on for many years.

Physical Examination: She is a tired woman who looks older than her stated age. B.P. 110/70. Wt. 114 lbs. Ht. 63 inches. Hgb. 10.5 g/100 cc. (acid hematin photoelectric colorimeter). Her skin is wrinkled, dry, yellow-brown. There is accentuation of the reticular pattern, increased callusing and a marked tendency to freckling. Her eyes show conjunctival thickening and injection. She is partially edentulous. The gums are pitted, infiltrated, swollen and retracted. Tongue shows moderate atrophy of papillae, with considerable redness of the tip and lateral margins. The margin of the liver is tender and just palpable at the costal margin. She has hyperpallesthesia in the bony eminences of the lower extremities. Plantar dysesthesia is in excess of 20 seconds. Tickle sense is present on the forehead, but not elsewhere. She has a low Joint Range Index of 67.9, indicative of severe joint dysfunction.

The following vitamins were prescribed in the manner indicated:

	Per Dose	Per 24 Hours
Niacinamide	150 mg	900 mg
Riboflavin	4mg	24 mg
Thiamine HC1	2mg	12 mg
Ascorbic Acid	175 mg	1,050 mg
Vitamin A	5,000 units	15,000 units
Vitamin D	1,000 units	3,000 units

At the end of one month, her Joint Range Index showed the expected increase in response to therapy. Her color was less yellow-brown than originally. Her liver was no longer palpable or tender. The intensity of her neuropsychiatric symptoms had lessened. She was less tired, less irritable, and had marked lessening in her subjective sensations referable to joints. Her hyperpallesthesia was replaced by normal vibratory sensation. Plantar dysesthesia had disappeared. Slight tickle sense was present everywhere.

This patient had considerable difficulty in maintaining the therapeutic program as originally prescribed for her because at various times during treatment she suffered from anxiety states, fearing that she was pregnant. During these periods of anxiety, she invariably reduced her vitamin intake. Her vitamin intake as she reported it is shown in Figure 29, together with corresponding fluctuations in the Joint Range Index.

In spite of her difficulties in taking the medications as prescribed, she managed to take sufficient amounts over a period of time so that eventually her joint dysfunction improved from severe (Joint Range Index 67.9) to slight (Joint Range Index 92.3) in 682 days.

CASE R. No.77, female, age 57, nurse, unmarried.

This case history illustrates, in a woman with severe joint dysfunction (clinically obvious hypertrophic arthritis), (a) initial improvement in joint function, as shown by an increased Joint Range Index in response to adequate therapy with niacinamide in combination with other vitamins, and (b) gradual decline of the Joint Range Index as a result of progressively greater departure from adequate therapy (see Figure 32).

She has not worked for 5 years because she has suffered from gastrointestinal symptoms consisting mainly of heartburn and indigestion occur-ring about an hour after meals, relieved by bicarbonate of soda. Repeated x-ray studies have revealed no abnormalities of the gastro-intestinal tract. She has mild menopausal symptoms.

During the 5 years that she has been unemployed, she has lived without cost to herself with her sister and brother-in-law. Her poor health was used by her as an excuse for not doing even minimal housework.

Physical Examination: She is tense, tired and impatient. Wt. 150 lbs. Ht. 63 inches. B.P. 130/84. Skin is yellow, with the reticular pattern moderately accentuated, as is callusing. She has moderate, early Bitot spots. Her receded gums are hyperemic, and slightly edematous. The anterior third of the tongue is reddened, and there is moderate atrophy of papillae. She has liver tenderness graded as 2-plus, with the liver edge at the level of the costal margin. Her Joint Range Index showed severe joint dysfunction (61.6).

She was given a regimen of therapy, including a bland diet, anti-spasmodic and vitamins prescribed in the manner indicated below:

	Per Dose	Per 24 Hours
Niacinamide	175 mg	1,050 mg
Riboflavin	4.5 mg	27 mg
Thiamine HC1	3.5 mg	21 mg
Ascorbic Acid	175 mg	1,050 mg

In one month she had made the expected progress, as indicated by improvement in her physical condition and in the Joint Range Index of 76.1. When she realized that she was improving physically, she became panicky and developed many new psychosomatic symptoms, including severe headaches with a bizarre pattern and syncopal spells. The psychiatrist who studied her elicited the information that she hated to work, and when her brother-in-law found that she was feeling better, he would probably insist that she work as a nurse and contribute to her own support. As a result of the family situation, she gradually decreased the amount of vitamins taken so that ultimately she was taking about one-third the amount which had been prescribed. The approximate pattern of reduction in dosage as she described it is shown in Figure 32. At no time did she have insight into her basic emotional problems.

CASE S. No.201, male, age 52, manufacturer, unmarried.
This case history illustrates the effect on the Joint Range Index of varying levels of vitamin intake over a relatively long period of time (see Figure 33).

This man did not get along well with one of his business partners. The periods when he was under the greatest emotional strain at work corresponded exactly with the periods when he failed to take his vitamin therapy as prescribed. Conversely, when there was greater harmony at work, he had no difficulty in adhering strictly to the prescribed program.

While intellectually he appreciated the above relationship, when he was emotionally disturbed he was unable to keep his vitamin therapy at the recommended levels. However, at each interview he reported the approximate amounts of the medications that he had been able to take for each time interval between examinations. His initial Joint Range Index was 72.6 (moderate joint dysfunction), and in 509 days his Joint Range Index was 89.0 (slight joint dysfunction). The Joint Range Indices reflected alterations in the level of his vitamin ingestion.

CASE T. No. 345, female, age 41, housewife, married.
I
This case history illustrates, in a woman with moderate joint dysfunction (without clinically obvious arthritis), (a) improved joint function in response to one month of therapy with niacinamide in combination with other vitamins, (b) impaired joint function as measured by a lowered Joint Range Index as a result of premature cessation of vitamin therapy, and (c) improved joint function as measured by subsequent increase in the Joint Range Index in response to re-introduction of vitamin therapy at a higher level than originally (see Figure 34).

Her Joint Range Index was 80.7 at the time of the initial visit. For one month she took the following vitamins:

	Per Dose	Per 24 Hours
Niacinamide	150 mg	600 mg
Riboflavin	5 mg	20 mg
Thiamine HCl	2.5 mg	10 mg
Pyridoxine HCl	5 mg.	20 mg
Ascorbic Acid	200 mg.	800 mg

At the end of one month of such therapy her Joint Range Index had risen to 84.9. For 6 months she took no further therapy, and when she returned at the end of this time for examination, her Joint Range Index had fallen to 79.7. Vitamins were prescribed for her as follows:

	Per Dose	Per 24 Hours
Niacinamide	190 mg	1,140 mg
Riboflavin	7 mg	42 mg
Thiamine HCl	4 mg	24mg
Pyridoxine HCl	6 mg	36 mg
Ascorbic Acid	250 mg	1,500 mg

At the end of one month of the above therapy, her Joint Range Index had risen to 92.6. Although not indicated in Figure 34, in 693 days this patient had a Joint Range Index of 96.4 (no joint dysfunction).

SOME REASONS WHY CERTAIN PATIENTS WITH JOINT DYSFUNCTION FAILTOTAKE NIACINAMIDE THERAPY AS DIRECTED

As will be seen subsequently, not all of the 455 patients who were studied clinically accepted niacinamide therapy for joint dysfunction and returned for the necessary re-examinations. Analysis of the data in Section IV indicates that 80.7% of the total population studied (78.5% of all males and 82.1% of all females) accepted niacinamide therapy for some period of time. It has been learned directly or indirectly that certain patients continued with niacinamide therapy without returning for necessary medical supervision; the exact number of such patients is not known. Therefore, less than 20% of the patients with joint dysfunction who were studied clinically did not accept niacinamide therapy. While it is not always possible to ascertain the reasons why a patient fails to take niacinamide therapy as prescribed, some of the apparent reasons are presented below.

The patient is unwilling to accept a method of medical treatment that is unfamiliar to him. Sometimes, a patient may believe that diet alone should be adequate to supply all his nutritional needs, and thinks that he can "get along" as his ancestors did, without vitamin therapy. Some patients desire only a thorough physical examination and an evaluation of their health status, and are uninterested in any form of therapy. Sometimes, a patient feels that it is a sign of weakness to take medications unless he is acutely ill, and will submit to treatment only for the duration of any medical or surgical emergency that may arise. Some patients want magical cures, and do not wish to undertake any treatment that requires sustained, active patient-physician cooperation; they feel that the treatment demands too much of them, especially the taking of medications at stated intervals, and the necessity for re-examinations. Certain patients are very impatient, and want treatment that will give "immediate results." They may request that instead of the niacinamide treatment they be given injections (gold, sulfur, liver, bacterial vaccine, vitamin "shots"). Some patients who present themselves for clinical study want only to be reassured that they are in perfect health, even though they may have major medical or surgical problems, and want to be told that any imperfections they may have are of no significance. Other

patients want only to be told that they are ill, and should "take it easy," or take a long vacation, or be relieved of responsibilities and duties. Some patients are "shopping" for an operation. Other patients want only to have prolonged and expensive hospitalization, with special studies and treatment. Some patients who consult the physician unwillingly, at the insistence of a friend or relative, have no intention of following any medical advice. Some patients present themselves for study only to satisfy their curiosity about the physician and his methods.

Sometimes, a patient may be discouraged from taking niacinamide therapy for joint dysfunction by a "friendly" and crusading nurse, druggist, or physician, who insists that the niacinamide therapy of joint dysfunction is unnecessary or useless, and tells the patient that he needs no such treatment, or that he should try some other type of therapy which is in more general use.

A patient usually does not continue with niacinamide therapy of joint dysfunction when, on the first day of therapy, he takes niacin-containing medications dispensed mistakenly by the druggist instead of niacinamide, and experiences, unexpectedly, severe flushing and other unpleasant symptoms characteristic of niacin reactions (113). (No flushing or other untoward reactions have been observed in properly selected patients with joint dysfunction who have taken as much as four grams of niacinamide daily for a year or more.)

A few patients have initial difficulties in forming regular habits of taking medication during the first months of treatment of joint dysfunction. Unless certain patients are seen at relatively frequent intervals, they lose interest in continuing with niacinamide therapy. Some patients do not take medications as prescribed as a device for gaining the attention of family and physician.

Sometimes a patient will not take niacinamide therapy for joint dysfunction because he develops a strong negative transference reaction to the physician. Occasionally, such reactions may appear as masked negative transference reactions, when at the initial visit the patient seems excessively cordial, agreeing with everything the physician says, speaking confidently of how well he expects to feel in the future under the physician's care. Such a patient may never return for re-examination. If he does return, he never takes niacinamide therapy as prescribed, stating he is "too busy to take the medicine," that he has "too many pills to take," that he "forgets" to have his prescription refilled. He then states with apparent pleasure that he doesn't "feel better in any way," or that the treatment hasn't helped at all," even though he may continue to return for serial re-examinations.

Some patients who have joint dysfunction and one or more of the four complicating syndromes are impatient and unwilling to cooperate in the clinical investigation of their complicating syndromes, and they soon drop therapy.

A patient who does not have articular symptoms or arthritic deformities often sees no reason why he should take any medical therapy, even though his joint dysfunction may be severe. A patient who has articular symptoms and arthritic deformities may believe that his symptoms and deformities are not sufficiently troublesome to him to warrant the nuisance and expense of treatment.

Some patients with recurrent or continuous articular symptoms (with or without clinically obvious arthritis) are often unable to accept the fact that their joint dysfunction can be reversed in time, and if they begin niacinamide therapy, it is with the greatest skepticism. These patients, previously studied by many physicians over a period of years, had been advised repeatedly that there was no effective therapy for their articular illness. Thus, unless they feel subjectively improved within a few weeks of beginning treatment, they usually drop therapy.

Certain patients who enjoy secondary gains from their articular illness may not begin niacinamide therapy for fear that they may be "cured"; if they do accept therapy, they always take less than the prescribed amount of niacinamide.

In some instances of severe or extremely severe joint dysfunction with clinically obvious arthritis, but not in all instances, there may be a relatively long latent period between objective improvement in the Joint Range Index and subjective awareness of improved health as a result of therapy. Some persons who do not feel better subjectively during this period, fail to continue with therapy, in spite of objective evidence for clinical improvement. Such persons often drop therapy prematurely.

Whenever certain patients are exposed to an anxiety-producing situation, they reduce their vitamin intake to inadequate levels, and when the tensional situation has passed, they resume vitamin treatment as directed.

Some patients are afraid of "powerful" medicines, and when they have made good improvement in response to niacinamide therapy, they reduce their niacinamide intake for fear that the medicine is "too strong."

Certain suspicious patients reduce the niacinamide level below the recommended dosages, or stop niacinamide therapy prematurely without informing the physician of this. If such a patient's Joint Range Index has been maintained at a high level in response to a sufficient period of adequate niacinamide therapy, there may be some lag between the reduction in niacinamide intake and the decrease in his Joint Range Index. Such patients use this as proof that the physician is wrong about joint dysfunction and its proper treatment. Some of these patients who return for study after having discontinued niacinamide therapy for a year or more, show demonstrable regression of the Joint Range Index.

A patient with joint dysfunction who has mental symptoms which are extinguished by adequate niacinamide therapy may experience such marked improvement in his feeling tone during the first month of adequate niacinamide therapy that he may mistakenly believe he is "cured," even though he has made only the expected improvement in his joint dysfunction. He is likely to drop niacinamide therapy prematurely, and usually experiences a slow or rapid recurrence of his mental symptoms.

Some patients have a response to niacinamide therapy which seems to be the clinical equivalent of "decreased running" observed in experimental animals (226). When these animals are deprived experimentally of certain essential nutriments, they display "excessive running," or hyperkinesis. When these deficient animals receive the essential nutriments in sufficient amounts for a sufficient period of time, there is exhibited a marked "decrease in running," or hypokinesis. Thus, certain patients may discontinue therapy because they believe they feel less well as a result of niacinamide. They may have the impression that vitamin therapy is depriving them of their usual abundant energy, and may state that they are being "de-pepped" by the treatment.

A patient in this group may wonder whether or not his vitamin medications contain a sedative. He recalls that before vitamin therapy was instituted, he had a great deal of energy and "drive," and considered himself to be a "very dynamic person." Analysis of his history indicates that prior to niacinamide therapy, even though he often felt tired, he did not need to rest or relax during the day, since he found it easier td "keep on going" than to stop and rest, and that he suffered from a type of compulsive impatience, starting many projects which he left unfinished as a new interest distracted him, returning perhaps after a lapse of time to complete the original project. Without realizing it, he was often careless and inefficient in his work, but was "busy all the time." With vitamin therapy, such a patient becomes unaccustomedly calm, working more efficiently, finishing what he starts, and he loses the feeling that he is constantly driving himself. He has leisure time that he does not know how to use. When he feels tired, he is able to rest, and does not feel impelled to carry on in spite of fatigue. All these

changes he interprets to mean that vitamin therapy has robbed him of his vitality. If such a patient can be persuaded to continue with niacinamide therapy, in time he comes to enjoy a sense of well-being, realizing in retrospect that what he thought in the past was a super-abundance of energy and vitality was in reality an abnormal "wound-up" feeling, which was an expression of aniacinamidosis.

Some patients become tired of taking medications for prolonged periods of time, and stop niacinamide therapy for joint dysfunction.

Rarely, patients are unable to continue with niacinamide therapy for economic reasons.

LIMITATIONS OF THIS STUDY

Certain limitations were imposed on this study by the nature of the writer's private practice:

1. No repeated determinations of the Joint Range Index could be performed on a large sampling of the untreated population over a prolonged period of time.

2. No control series could be studied which had been treated with placebos, single vitamins other than niacinamide, or multiple vitamin mixtures not containing niacinamide.

3. No large series of determinations of the Joint Range Index could be made from two separate sets of measurements made in the same individual on the same day. (However, it was found in a trial with a small series of subjects that two Joint Range Indices determined from two separate sets of joint range measurements made on the same day in the same individual agreed within plus or minus 0.3.)

4. No routine x-ray studies of the joints whose ranges were measured for inclusion in the Joint Range Index could be obtained. However, a sufficient sampling of x-rays of measured joints was obtained in the course of this study to indicate that it would be of value to have such x-ray documentation, routinely performed before treatment was instituted, and at intervals during the course of treatment.

5. No standard photographic method was available for taking serial photographs which could be used in making accurate, detailed comparisons of gross joint morphology before therapy and at various intervals during the course of prolonged, adequate niacinamide therapy. In documenting the gross morphology of joint deformities, certain variables must be controlled rigidly if serial photographs are to be strictly comparable; e.g., positioning of the deformed joints, lighting, lens aperture, film exposure, size of film image, film development, type of printing paper, exposure of printing paper, size of print image, and print development.

6. No attempt was made clinically to find the highest dosage level of niacinamide which could be tolerated safely by patients with joint dysfunction, or to explore the effects of such doses on the rate of recovery in joint dysfunction. Only those dosages of niacinamide which seemed to be clinically safe and therapeutically effective were employed in the treatment of joint dysfunction.

7. No gross or histopathologic studies could be performed on the joint structures of patients with joint dysfunction in the course of this study.

8. No highly specialized chemical or metabolic studies could be performed prior to treatment with niacinamide, or subsequently, to follow in a patient with joint dysfunction, (a) the fate of the ingested niacinamide and the concomitant metabolic changes in body chemistry and metabolism during the course of adequate treatment of joint dysfunction; (b) changes in body chemistry and metabolism induced by the substitution of inadequate for previously adequate niacinamide therapy; (c) changes in body chemistry and metabolism induced by the premature cessation of adequate niacinamide therapy.

(End of Chapter 1, which consists of pages 1-75. *The author's preface, and all references cited, are posted at* http://www.doctoryourself.com/kaufman11.html)

To read Chapter 2, click this link: http://www.doctoryourself.com/kaufman7.html

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Joint Dysfunction, Part 2
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CHAPTER 2

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THE COMMON FORM OF JOINT DYSFUNCTION

by William Kaufman, M.D., Ph.D. (1949)

Edited by Andrew W. Saul

(Dr. Kaufman now discusses physical and psychological stresses, allergy, posture, obesity and other factors that may interact or interfere with niacinamide megavitamin therapy for arthritis. This chapter's three original photographs are not provided here, but may be seen in the original text, available through this website. For ordering information, you may either click here or scroll to the very bottom of this webpage.)

References cited in this chapter are posted at http://www.doctoryourself.com/kaufman11.html

Four Complicating Syndromes Frequently Coexisting with Joint Dysfunction

It might appear to the reader that the niacinamide treatment of a patient with joint dysfunction is a more or less mechanical and uninteresting procedure. However, in practice, the treatment of a patient with joint dysfunction is never a mechanical or dull routine, since therapy of joint dysfunction and commonly occurring complicating syndromes must always be adapted to the special needs of the individual patient. For the most part, the treatment of a patient with joint dysfunction is a constantly interesting and instructive discipline both for the patient and physician.

Commonly occurring complicating syndromes coexisting with joint dysfunction must often be corrected if the patient is to be able and willing to take niacinamide therapy as prescribed, and if he is to feel well ultimately. Even though joint dysfunction improves to the level of 96-100 (no joint dysfunction) in response to adequate niacinamide therapy, the patient may have continuing articular and non-articular symptoms, of one or more of these complicating syndromes, and he may erroneously conclude that the niacinamide treatment of his joint dysfunction has failed. On the other hand, whether or not a patient is taking niacinamide treatment, when these complicating syndromes are corrected, he may have an improved sense of well-being and freedom from articular and non-articular symptoms, but it does not follow necessarily that his joint dysfunction is improving, since serial re-measurements of his Joint Range Index may indicate that his joint dysfunction may be unimproved or worsened.

In the treatment of a patient with joint dysfunction who has one or more of four complicating syndromes frequently coexisting with joint dysfunction, the physician must correctly identify the basis of the patient's articular and non-articular symptoms, and must institute concurrently the appropriate specific therapy required for the successful management of joint dysfunction and any of these four syndromes which the patient may have:

(a) the delayed post-traumatic articular syndrome (see page 79);
(b) the chronic allergic syndromes (page 96);
(c) the sodium retention syndrome (page 114);
(d) the syndrome of psychogenically induced, sustained hypertonia of somatic muscle (page 115).

The articular symptoms of any one or any combination of these four syndromes may be present in a patient without joint dysfunction, or may be absent in a patient with joint dysfunction (with or without clinically obvious arthritis); and may occur in a patient with joint dysfunction before niacinamide therapy is instituted, during the course of adequate niacinamide therapy, when adequate niacinamide therapy is replaced by inadequate niacinamide therapy or upon premature cessation of niacinamide therapy. The articular and non-articular symptoms of bodily discomfort of these four syndromes may vary in intensity, duration and extensiveness. With each of these syndromes a patient may have a steady state of discomfort which persists until the syndrome is successfully treated.

The four complicating syndromes frequently coexisting with joint dysfunction will be described as if each were an independent clinical entity. Often, the successful management of any one of these syndromes will not materially influence the clinical course of the other untreated coexisting syndromes. At times, however, these complicating syndromes may be interrelated, in the sense that when one of the untreated complicating syndromes becomes more severe, the other coexisting untreated complicating syndromes also become more severe; and in the sense that the successful treatment of one of the complicating syndromes may simultaneously ameliorate or lessen the intensity of symptoms of the other untreated coexisting complicating syndromes. Clinically, it may be very easy, or it may be extremely difficult, to ascertain the etiologic basis of the patient's articular and non-articular symptoms. The most helpful clues to the etiology of the patient's symptoms are obtained from careful clinical study, including a detailed history of the onset and development of symptoms, re-examination of the patient, an analysis of the food-symptom diary kept by the patient (see page 103), and an evaluation of the patient's response to a trial of therapy directed toward the amelioration of the symptoms of a given complicating syndrome.

Although from the physician's point of view, the patient's symptoms are subjective phenomena, to the patient his symptoms are real and have objective existence. By giving verbal expression to his symptoms, the patient is exteriorizing the fact that he does not feel well, and implying that if his symptoms could be made to disappear, he would feel well.

The physician must give careful consideration to the possible meaning of all the patient's symptoms, whether or not they seem to be trivial, atypical or bizarre at the time of their recital. The physician should regard the patient's symptoms as direct or indirect clues to the nature of the patient's ill health, even if the clinical meaning of these symptoms continues to be inapparent. Once the etiology of the patient's symptoms is recognized by the physician, it often becomes possible to institute appropriate treatment which, in time, ameliorates these symptoms. While the etiologic basis of some symptoms may be readily perceived by the physician, the clinical significance of other symptoms may remain obscure for a long time or may never be ascertained. Even some symptoms which at first hearing appear fantastic to the physician may prove, in time, to have a definite clinical basis which can be identified. When the nature of the patient's disorder becomes manifest, it is often found that most patients with puzzling symptoms were entirely accurate and honest in their reporting of symptoms. It is the rare patient who deliberately distorts facts and invents complaints and illnesses, and even such a patient by so doing gives valuable clues to the nature of his illness.

In evaluating the clinical significance of articular and non-articular symptoms, it is necessary to remember that the patient's prevailing emotional state influences the nature of his complaints (29) (182) (242). A patient who is mildly depressed may complain at great length about his various symptoms, and may express considerable doubt that he will ever get well. On the other hand, a patient who is euphoric will complain little or not at all of articular and non-articular symptoms, and his general attitude toward all of his life situations will be optimistic. A patient who has feelings of

anxiety, guilt, hostility or frustration may find substitute satisfaction in complaining bitterly about articular and non-articular symptoms. A patient whose attention is fixed on his symptoms will have many complaints excepting when his attention is distracted by more interesting matters. A patient with a rigid conception of his own perfection seldom will complain of symptoms. Occasionally, a patient unconsciously attempts to gain the approval of the physician by exaggerating his favorable response to therapy. On the other hand, a patient may use his complaints about poor health to "punish" the physician (authoritarian figure) by insisting with evident satisfaction that his health has been unimproved or worsened by treatment, when it is obvious from physical examination and from the remainder of the patient's story that he has in fact improved physically. At times, when a patient has secondary gains from his illness, he seems impelled to complain about his symptoms, and even when he has improved as a result of treatment and has fewer symptoms, he continues to complain more and more about less and less.

DELAYED POST-TRAUMATIC ARTICULAR SYNDROME
(In this section, there is excluded from discussion such severe accidental injuries as lacerations of the supporting structures of joints, bone fractures involving joint structures, torn articular cartilages causing internal derangement of joints, and penetrating joint wounds.)

Without knowledge of the clinical patterns of the delayed post-traumatic articular syndrome, the cause of many articular symptoms and signs often remains obscure. With knowledge of such patterns, and with knowledge of the patient's physical activities, occupation, and emotional tensions, the physician can often identify the basis for the patient's troublesome articular symptoms and signs, and can advise the patient how to modify his way of living so that in the future he will be less likely to experience such symptoms and signs.

The delayed post-traumatic articular syndrome is the consequence of certain types of mechanical joint injury:

(a) articular trauma which is likely to occur in the course of more or less ordinary physical activity;

(b) alterations in the alignment of joints due to certain acquired habits of posture, or indirectly due to niacinamide-induced improvement in joint mobility;

(c) psychogenically induced, sustained hypertonia of somatic muscle.

In general, the severity of the patient's delayed post-traumatic articular symptoms seems to depend on the following factors: the clinical grade of severity of his joint dysfunction; the severity, repetitiveness and duration of the inciting mechanical joint injury; the patient's prevailing moods; and his attitudes toward his symptoms and life situations.

Mechanical joint injury may be well tolerated by persons with the milder grades of joint dysfunction, who will have either no clinically discernible articular sequelae or will develop relatively mild symptoms and signs of the delayed post-traumatic articular syndrome for relatively short periods of time; but mechanical joint injury usually is poorly tolerated by persons with the more severe clinical grades of joint dysfunction, who tend to develop severe symptoms and signs of the delayed post-traumatic articular syndrome which last for relatively long periods of time (97). In general, immediate and delayed post-traumatic articular symptoms and signs tend to be more severe in untreated persons with joint dysfunction than in persons with joint dysfunction who are receiving adequate amounts of niacinamide. A patient with joint dysfunction who is receiving inadequate niacinamide therapy is more likely to suffer from the delayed post-traumatic articular syndrome than if he were receiving adequate niacinamide therapy. If his

niacinamide intake is increased from inadequate to adequate levels, even though mechanical joint injury continues at the same level as previously, the niacinamide-induced reparative process will often preponderate over the trauma-induced deteriorative process, and the delayed articular post-traumatic syndrome will be ameliorated.

The immediate effects of a single episode of extremely severe joint injury are well understood because of the close temporal relationship between the articular injury and the ensuing articular symptoms of discomfort, pain and disability, which may be associated with one or more of the following physical signs in the mechanically injured joint region: tenderness to palpation, swelling, heat, redness, congestion of the superficial circumarticular veins, spasm of somatic muscles operating the injured joint, and painful or painless limitation of active and passive articular movement. The delayed effects of such severe mechanical joint injury may include a continuance of articular discomfort, pain and disability lasting for months or years, and clinically well-defined arthritic changes in the injured joints (33) (121) (19) (131).

The immediate effects of a single episode of a less severe grade of mechanical joint injury are also well understood, but the delayed effects of such an injury to the joints have not been given the clinical attention they deserve. Because there is often an asymptomatic period of two to four days between the subsidence of the immediate post-traumatic articular symptoms and the appearance of the delayed post-traumatic articular syndrome, the physician and patient may be unable to perceive the causal relationship between the inciting mechanical joint injury and the delayed post-traumatic articular symptoms. When the delayed post-traumatic symptoms of joint discomfort, pain and disability occur three or four days after the inciting joint injury, there may be one or more of the following objective findings in the injured articular regions: tenderness to palpation, swelling, heat, redness, congestion of the superficial circumarticular veins, spasm of the somatic muscles operating the injured joint, and painful or painless limitation of active and passive articular movement. These delayed post-traumatic articular symptoms and signs may be more severe and more persistent than those occurring immediately after joint injury, and gradually decrease in severity, usually disappearing by the tenth to fourteenth day following the inciting injury to the joint. Occasionally, the delayed post-traumatic articular syndrome may persist for a month or more after a single joint injury, particularly when the patient's joint dysfunction is extremely severe, or when the inciting trauma is unusually great. At times, there may be no articular symptoms and signs immediately following mechanical joint injury, or such immediate articular symptoms as may appear immediately after the injury may seem so insignificant to the patient that he disregards them. Sometimes, the only sign of the delayed post-traumatic articular syndrome may be increased painless limitation in the ranges of movement of the injured joint. Even relatively slight injury, when sufficiently repetitive, may lead, in time, to a steady state of articular discomfort, pain and disability, and to the appearance of clinically obvious arthritic deformities in the injured joint region (96).

Sometimes, the cause of delayed post-traumatic articular symptoms may be identified only with difficulty after a prolonged period of clinical study. When a patient with joint dysfunction suddenly experiences a single isolated episode of joint pain and disability, or gradually develops a persistent state of articular discomfort (with or without periodic exacerbations) or merely an asymptomatic lowering of the ranges of joint motion, careful clinical study may disclose the fact that in the performance of a particular physical act either once or repetitively, the patient inadvertently or unknowingly injured the affected joints, or may disclose the fact that the patient has developed psychogenically induced, sustained hypertonia of somatic muscle of sufficient severity to injure his joints. Joints used statically or dynamically in the performance of everyday activities may incur mechanical trauma sufficiently severe to cause a single episode of

articular discomfort, pain and disability, or may incur mechanical trauma sufficiently severe and repetitive to cause a steady state of articular discomfort, pain and disability.

When a patient has joint dysfunction of a high clinical grade of severity, his articular structures are particularly vulnerable to lesser grades of joint trauma, which may give rise to the more severe and persistent symptoms and signs of the delayed post-traumatic articular syndrome. When a patient is recovering satisfactorily from joint dysfunction in response to continuously adequate niacinamide therapy, and a specific joint is subjected to a single episode of moderate injury, usually there is temporarily a delayed post-traumatic decrease in the range of movement of this joint -with or without accompanying symptoms of the delayed post-traumatic articular syndrome - although his uninjured joints continue to improve at a satisfactory rate. If the articular injury is more or less continuous, the range of movement of the injured joint decreases, and, in time, tends to stabilize for as long as the niacinamide-induced reparative process balances the trauma-induced deteriorative process in the injured joint. At this time, an increase in the patient's niacinamide intake does not materially improve the range of movement of the continuously injured joint, except in some instances where previous levels of niacinamide treatment have been inadequate. However, a decrease in niacinamide intake causes the range of movement of the continuously injured joint to decrease at a more rapid rate than if adequate amounts of niacinamide were taken continuously.

The Joint Range Index may or may not be significantly depressed by the post-traumatically decreased range of movement of a single joint. It is, therefore, necessary to analyze the component joint ranges which are measured for the computation of the Joint Range Index in order to observe which joints show post-traumatically decreased ranges of joint movement and which joints simultaneously have made satisfactory improvement in the ranges of joint movement for the period of observation during which the patient was ingesting continuously adequate amounts of niacinamide.

It is often possible to identify the type of behavior which caused mechanical injury of certain joints from an analysis of the distribution of joints with decreased ranges of movement and those with increased ranges of movement, and from knowledge of the patient and his physical activities and hobbies at various seasons of the year, and of his emotional tensions. For example, when the fingers of the right hand, right wrist and right shoulder
show decreased movement, and the patient has recently returned from a train trip, one can establish that the most likely cause of the decreased ranges of movement was the carrying of a suitcase. When mechanical articular injury is sufficiently generalized, there is a delayed post-traumatic decrease in the ranges of movement of the injured joints and in the Joint Range Index even though the patient with joint dysfunction is ingesting continuously adequate amounts of niacinamide; however, with cessation of joint injury there is usually a satisfactory rise in the Joint Range Index in response to adequate niacinamide therapy.

Certain physical activities have been identified as causes of the delayed post-traumatic articular syndrome in some patients at various times during this study, and include: sawing, planing, hammering, house-painting, weeding, spading, hoeing, spraying, hedge-clipping, lawn-mowing, bowling, sailing, rowing, paddling a canoe, fly-fishing, driving a car, knitting, crocheting, tatting, wringing of clothes, house-cleaning, cleaning, scrubbing floors, waxing floors. In some persons the repetitive performance of a physically awkward act may cause joint injury; e.g., the frequent daily use of a desk telephone with a short cord, which requires the user to twist his body into an awkward position each time he uses the telephone. In some patients, holding the joints in a fixed position and carrying moderate weights for relatively short or long periods of time may give rise to a delayed post-traumatic cycle of joint discomfort and disability; e.g., maintaining one knee and ankle fixed in an awkward position by sitting on the medial

aspect of the ipsilateral heel, or sitting in a chair with the dorsum of the ipsilateral foot twisted behind one leg of the chair; hanging onto an overhead strap in a subway or bus; holding a knitting bag, handbag, shopping bag, brief-case, suitcase, or even holding a strong dog in leash. Similarly, certain jerky movements requiring the sudden exertion of extra muscular force will also give rise to a post-traumatic cycle of joint discomfort and disability; e.g., opening a window or drawer that "sticks," or loosening a stubborn jar cover with a strong steady twisting movement, or opening and closing a "tight" water faucet. Joint trauma may occur during the night when the patient maintains awkward sleeping postures for relatively long periods of time, particularly if he simultaneously has during sleep psychogenically induced, sustained hypertonia of somatic muscle. Certain recently acquired or old methods of walking which the patient habitually uses will cause injury to the knee and hip joints and will cause a steady state of symptoms of articular discomfort, pain and disability, and signs of impaired mobility of hip and knee joints.

Joint trauma may occur also when a patient with joint dysfunction (with or without clinicallv obvious arthritic deformities) has mental tensions which are exteriorized through psychogenically induced, sustained hypertonia of somatic muscle. Although such a patient may erroneously believe that he is completely relaxed, the coapting pressures exerted continuously against articular surfaces, and the accompanying tensions on periarticular structures often cause continuous joint trauma for as long as this sustained somatic muscle hypertonia persists. When psychogenically induced, sustained hypertonia of somatic muscle is present and the patient uses his joints in everyday activities, there is joint trauma in excess of what would have occurred in the performance of these activities in the absence of sustained hypertonia of somatic muscle. Psychogenically induced, sustained hypertonia of somatic muscle in persons with the more severe grades of joint dysfunction may cause articular swelling, redness, increased congestion of the superficial circumarticular veins, increased heat, spasm of the somatic muscles operating the joints, stiffness, and limitation in the ranges of active and passive joint movement. In time, repetitive joint trauma from this source will favor the appearance of clinically obvious arthritic deformities. Ordinarily, the patient is unaware of his mental tensions and his psychogenically induced, sustained hypertonia of somatic muscle, although he is very aware of his symptoms due to the delayed post-traumatic articular syndrome.

Many persons with joint dysfunction (with or without clinical or radiographic evidence of arthritic changes in joints) may be unaware of any articular discomfort or disorder until joint trauma gives rise to the delayed post-traumatic articular syndrome. The anxiety and mental tension developed by such patients as a result of this articular discomfort, pain and disability (particularly when a steady state of articular discomfort is reached) often create secondary psychogenically induced, sustained hypertonia of somatic muscle which is sufficiently severe to perpetuate joint injury and its sequelae.

TREATMENT OF THE DELAYED POST-TRAUMATIC ARTICULAR SYNDROME

Treatment of the delayed post-traumatic articular syndrome should be directed toward preventing the joint traumata which produce this syndrome and toward giving the patient relief from whatever delayed post-traumatic articular symptoms he may have. Since joint injury may be caused by ordinary or unusual, essential or non-essential daily activities, it is not always possible to prevent articular trauma, even when the physical act producing joint injury is known. However, once the causation of mechanical joint injury is recognized, the patient should be advised how to keep joint injuries to a minimum in the performance of his essential everyday physical activities. A patient who understands the temporal and causal relationship between the mechanical joint injuries of everyday activities and the symptoms of the delayed post-traumatic articular syndrome is likely to modify his activities so that mechanical injury to his joints will be minimal and, when possible, to avoid those unessential physical activities which may actuate the delayed post-traumatic articular syndrome.

Many patients erroneously believe that "exercise loosens the joints." It is often necessary to demonstrate to a patient that after exercise his Joint Range Index and the ranges of movement of his exercised joints are depressed, sometimes for days or weeks. In patients who have the lesser clinical grades of joint dysfunction, such delayed post-traumatic depression of joint ranges may not be sufficiently severe or prolonged to warrant the interdiction by the physician of all unessential physical exercise. However, in patients who have the more severe clinical grades of joint dysfunction, such delayed post-traumatic depression of the joint ranges may be sufficiently marked and prolonged to impede satisfactory joint recovery in response to niacinamide therapy. For each patient, where possible, physical exercise should be adjusted so that the resultant joint injury will not materially impede satisfactory niacinamide-induced recovery from joint dysfunction.

Although physically strenuous exercise may give some patients with the more severe grades of joint dysfunction temporary benefit through transient release of psychogenically induced, sustained hypertonia of somatic muscle, the joints are not benefited by such exercise. It may be desirable to permit a patient with unresolved mental tensions to continue to enjoy his strenuous physical exercise, since the advantages of obtaining transitory relief from sustained hypertonia of somatic muscle may outweigh the disadvantages of actuating the post-traumatic articular syndrome. However, in time, with satisfactory psychotherapeutic resolution of his emotional tensions, the patient usually is relieved of his psychogenically induced, sustained hypertonia of somatic muscle, and consequently does not have the urgent need for seeking emotional release through excessive physical activity.

The more niacinamide-induced recovery a patient has had from his initial clinical grade of joint dysfunction, the better he will be able to tolerate the articular trauma of his everyday activities. The substitution of inadequate for adequate niacinamide therapy, or the premature cessation of adequate niacinamide therapy, tends to make the delayed post-traumatic syndrome more severe. Continuously adequate niacinamide therapy helps to minimize the symptoms and signs of the delayed post-traumatic articular syndrome but does not prevent their occurrence.

The use of plain or enteric coated aspirin (0.3 to 0.6 g per dose) or enteric coated sodium salicylate (0.6 g per dose) distributed as needed during the day - in a person having no intolerance for these drugs - often gives the patient relief from his localized or generalized post-traumatic articular symptoms. Rarely, for the relief of articular pain, it is necessary to give additionally codeine (0.030 to 0.060 g per dose) or demerol (0.100 to 0.150 g per dose), as required. Procaine hydrochloride infiltration of an injured joint region has not been used (33) (211), nor were intravenous procaine hydrochloride injections used (63).

Relative rest of the injured joints tends to hasten recovery from the delayed post-traumatic articular syndrome, provided that there is daily movement of the joint, without weight-bearing, through the fullest possible ranges of active and passive movement. When the delayed posttraumatic articular syndrome occurs in a given joint region, it is often helpful to apply massive hot, wet, Epsom salt dressings (for 30 minutes 3 or 4 times daily) to a large region, including and surrounding the injured joint. Moist heat seems to be more efficacious than dry heat, although it is often more convenient to use dry heat (heating pad, or heat from an electric incandescent bulb). With the use of moist or dry heat special care must be taken not to burn the patient. Certain types of massage administered to injured articular regions may be helpful in giving some patients subjective relief from localized post-traumatic articular symptoms. A patient who injures his joints and develops generalized delayed post-traumatic articular symptoms may have temporary relief from these symptoms by soaking in a tepid bath for 20 or 30 minutes. In selected instances, a suitable type of body massage following the bath may give additional benefit.

MISCELLANEOUS TYPES OF MECHANICAL JOINT INJURY AND THEIR TREATMENT

Posture. Certain types of posture in sitting, standing; walking and working cause mechanical joint injury, regardless of the patient's clinical grade of joint dysfunction, whether or not he is receiving adequate niacinamide treatment. Often there is a correlation between the patient's posture and his symptoms of bodily fatigue and joint discomfort, pain and disability, and therefore the physician must constantly analyze the patient's static and dynamic postures and make appropriate suggestions for the correction of faulty posture. A few commonly occurring types of static and dynamic postural abnormalities are described below, together with suggestions for their treatment. No general discussion of posture is included, since a number of excellent descriptions of what constitutes good posture are available in the literature (33) (84) (73).

It was observed that many patients who were making satisfactory recovery from severe or extremely severe joint dysfunction in response to adequate niacinamide therapy (even those who had reached the level of slight joint dysfunction or no joint dysfunction) had continuance or worsening of symptoms referable to hip and knee joints and to the muscles of their lower extremities, and that objectively, recovery of movement in hip and knee joints lagged behind recovery of movement in other moveable joints. When it was recognized that these patients were continuing to use habitually the abnormal posture described below, even though therapeutically increased ranges of joint movement permitted more efficient walking posture, appropriate suggestions were made for the correction of improper postures. When the patient taking adequate niacinamide therapy adopted these suggested changes in walking posture, he experienced some immediate relief from his symptoms and, in time, when the recommended posture became habitual, he usually became entirely free from symptoms referable to his hip and knee joints and to his lower extremity muscles, and the rate of recovery in the ranges of hip and knee joint movement was accelerated. Now that patients are routinely advised, as described below, to modify improper walking posture at the outset of niacinamide therapy, the continuance or accentuation of this pattern of articular and muscular symptoms of the lower extremities is seldom seen, and recovery of movement in hip and knee joints parallels that of other joints in response to adequate niacinamide therapy.

This commonly occurring postural abnormality of standing and walking results chiefly from sustained hypertonia of the quadriceps muscles, associated with various degrees of cocontraction (sustained hypertonia) of the flexor and adductor muscles of the thighs. At first this postural abnormality may occur only as an unconsciously adopted accompaniment of unresolved emotional problems, which initiate psychogenically induced, sustained hypertonia of somatic muscle. In time, such postures and the sustained hypertonia of somatic muscle may become habitual, whether or not the patient continues to have unresolved emotional problems. In the standing position, the patient's muscles contract more forcefully than necessary to maintain his stance efficiently. In addition, the patient usually has increased pelvic tilt and increased lumbar lordosis, and holds his head in a forward position which accentuates the thoracicocervical curve. Any dorsal kyphosis the patient may have seems to become more prominent as a result of this abnormal posture. Often in this posture the patient's abdominal muscles become so lax that his abdomen becomes pendulous (6). In walking, the person with sustained muscular hypertonia tends to maintain the poor standing posture described above. In forward progression, he tends to inhibit the natural swinging movement of the arms. With each consecutive step, the ipsilateral trunk-thigh muscles elevate the thigh sufficiently to permit pendulum-like swinging of the entire ipsilateral lower extremity as a more or less rigid unit, with little or no associated knee movement. Upon simultaneous palpation of the anterior and posterior thigh muscles of the patient as he walks, it is possible for the physician to detect a high degree of

cocontraction of antagonists and protagonists of the hip and knee joint movement without palpable relaxation of these thigh muscles during walking. It is tiring for the patient to stand and walk in the manner described above. He also experiences a sense of resistance to walking which he describes as dragginess, heaviness, weakness, unsteadiness and stiffness of the lower extremities. He may have pain, discomfort and stiffness in the muscles of his thighs, back and neck; there are often associated symptoms of discomfort, pain and disability in the hip and knee joints. In addition, the patient may have pain and discomfort in the joints of his lumbosacral region, in his upper thoracic spine, and in the cervical spine. He may have noticed that over a period of time he has become "round-shouldered," that it is hard for him to straighten up, and that his "stomach" has become more prominent. When such a posture is habitual for many years, the patient with joint dysfunction suffers from the steady state of the post-traumatic articular syndrome, and is likely to develop arthritic changes in the various joint regions subjected to excessive mechanical trauma, resulting in part from improper alignment of joints, and in part from continuously sustained hypertonia of somatic muscle.

Such a patient is shown how to modify 'his gait so that he consciously lifts his feet, raising and flexing each knee alternately with each successive step, instead of walking stiff-kneed. He may notice at once that walking in this way is relatively effortless and comfortable as compared with his usual gait, which caused his lower extremities to feel draggy, heavy, weak, unsteady and stiff, and his thigh muscles to feel painful and uncomfortable. With this correction in gait, simultaneous palpation of anterior and posterior thigh muscles will indicate that there is alternately well-coordinated contraction and relaxation of the opposing thigh muscles. When, in addition, the patient learns to hold himself as tall as possible in standing, walking and sitting, he may lose his pelvic tilt, lumbar lordosis and anterior neck flexion. The patient must practice the therapeutically suggested alterations in posture so that ultimately he habitually uses those static and dynamic postures which cause the least injury to his joints, and as a result he will no longer be troubled with symptoms from this type of improper p05ture. When a patient has marked limitation in ranges of movement of hip and knee joints before niacinamide therapy is instituted, he is unable to correct his gait in the manner suggested. When niacinamide-induced recovery permits sufficient increase in hip and knee movement, this correction of gait is possible. Occasionally, irreversible arthritic joint changes are present which make this improvement in posture mechanically impossible.

Sacro-iliac Joint Strains. A patient with a history of recurrent sacro-iliac strains is given certain suggestions concerning posture which are often helpful in preventing recurrences of such strains: he should avoid twisting his trunk in the performance of any physical act while standing with his trunk bent at an angle of 35 to 55 degrees with his thighs, since this maneuver is frequently the cause of sacro-iliac strain. He should not "cross his knees" when sitting. He should not stand asymmetrically with most of his body weight resting on one foot. He should sleep on a non-sagging bed.

High Heels. Women who wear high-heeled shoes are likely to have postural back strains caused by compensatory lumbar lordosis, pelvic tilt, flexion of the neck and slight bending of the knees - all of which are necessary to maintain balance in the erect posture when high heels are worn. Some women wearing high-heeled shoes may have a steady state of back fatigue, discomfort and pain from such postural strains, while others may have these symptoms only when they are on their feet a great deal, or when they carry unaccustomed weights. Symptoms from postural strain are accentuated by the alternate wearing of high-heeled and low-heeled shoes. Women are advised to wear slippers and shoes having heels of uniform height, preferably low or medium heels.

Lifts. Often patients who were obliged to wear lifts continuously on their shoes to alleviate hip and knee discomfort prior to adequate niacinamide therapy found during niacinamide-induced recovery of joint mobility that discomfort of hip and knee joints

increased in severity. However, when the lifts were removed, this discomfort disappeared.

Obesity. The excess weight of the moderately overweight patient increases mechanical injury of the weight-bearing joints (hips, knees, ankles, small joints of the feet). The excess weight of the markedly overweight patient causes more severe mechanical injury of these joints and, in addition, during standing and walking the patient has postural strain from balancing his heavy, often pendulous abdomen, and develops associated articular symptoms of fatigue, discomfort and pain in various portions of his back. Adequate weight reduction is part of the treatment of such patients with joint dysfunction, and a prerequisite for this is often the successful resolution of the patient's emotional problems (23) (138).

Painful Feet. A patient with painful feet may adopt awkward bodily postures which subject many joints of the body to excessive mechanical injury.

It is not uncommon to find that considerable foot pain is caused by the wearing of shoes which have unevenly worn heels or projecting irregularities of the insoles. A patient who habitually dorsifiexes his toes while wearing shoes, often develops considerable discomfort of the feet and legs. When such a patient is made aware that he habitually dorsiflexes his toes, he can eventually break himself of this habit, and he will be free from discomfort from this source.

During the course of adequate niacinamide therapy, a patient with joint tilt, dysfunction may develop considerable pain and discomfort in the ball of the foot and in one or more of the four small toes of the feet even though he has continued to wear footgear (shoes, slippers, socks or stockings) which was comfortable previously. When one foot is significantly longer than the other, the foot pain experienced during niacinamide therapy may be more severe in the longer foot, or present only in the longer foot.

As part of the progressive retrograde changes of untreated joint dysfunction, over a period of years many patients develop in the four small toes mild, moderate or marked deformities, consisting of partial flexion of the interphalangeal joints, and partial extension of the corresponding metatarsophalangeal joints; thus, one or more of the four small toes of each foot are "curled" to various degrees. Where there is a significant disparity in the length of the two feet, the "curling" of the toes of the longer foot is the more pronounced than that of the shorter foot. Such "curled" toe deformities are much more common in women than in men, presumably because the higher heels and narrower toe caps of women's shoes are additional factors which mechanically favor the formation of "curled" toes. With niacinamide-induced articular improvement, there is a gradual "uncurling" of the deformed toes, with virtual lengthening of the feet which is particularly prominent on weight-bearing. Consequently, footgear of a size entirely comfortable prior to niacinamide-induced joint reconstitution becomes painfully short, with resultant injury to the feet. When such an injury has taken place, the patient often complains of pain, burning, throbbing and swelling in the ball of the foot. These symptoms usually are most severe on the plantar surfaces of the second, third and fourth metatarsophalangeal joints. Examination reveals redness, swelling, heat and exquisite tenderness to digital pressure on the ball of the foot. There may be swelling, pain and redness of the interphalangeal joints of the four small toes. The skin of the dorsolateral surfaces of the fourth and fifth toes near the interphalangeal joints may be irritated, swollen, painful and reddened from rubbing against the lining of the shoes, and at times there may be, in addition, secondary infection. Callusing of the skin of the ball of the foot, and corns in the rubbed areas on the toes are commonly found.

The patient is advised to stay off his feet for several days, to immerse his lower extremities in hot Epsom salt solution up to the mid-calf region for 30 minutes three or four times a day, and to obtain footgear correctly fitted to his "new" foot size, measured

to his foot size when he is in a standing, weight-bearing. position. At any time the wearing of footgear that is too small will cause a recurrence of this type of foot discomfort.

SOME EXAMPLES OF MECHANICAL JOINT INJURY

CASE U, No.178, female, age 43, housewife, married.

This patient, who had slight dysfunction (Joint Range Index 88.1) without arthritis, complained when first seen that she had had daily, for a number of years, pain, swelling and stiffness in the joints of her hands, more marked at all times in the right hand than in the left hand. She was unable to attribute her discomfort and disability to any specific act which might have injured her joints. Her articular symptoms were always much worse on Wednesdays and Thursdays, and by the following Monday were noticeably better, although she was never completely free from joint discomfort.

Upon questioning, it was found that for many years she ironed every Monday for about five hours continuously. When she was asked to demonstrate her method of ironing, it was observed that she exerted strong and persistent pressure in gripping the handle of the iron tightly with the fingers of her right hand, and exerted a strong downward pressure with her right wrist as she moved the iron back and forth. The left hand grasped the edge of the garment tightly between thumb and forefinger as she stretched the cloth in the course of her ironing. She stated that three or four days after ironing, her chief discomfort in the right hand was in the wrist and in all of the joints of the thumb and fingers. In her left hand, pain was limited to the wrist and the joints of the thumb and forefinger.

Since there seemed to be a causal relationship between the method of ironing and the patient's joint symptoms, she was advised to distribute her ironing through the week so that she would do no more than one hour of ironing on any one day. She was also instructed to use no more than the minimal muscular force necessary to perform her ironing.

After a month of such a program, she was free from articular pain, swelling and stiffness for the first time in many years. For three years she has had no difficulty referable to the joints of her hands and wrists, even though she continues to do the same amount of housework and ironing.

This patient had a post-traumatic pattern of persistent articular pain and disability resulting from repetitive episodes of mild joint trauma occurring every 7 days, with cyclic exacerbations of articular difficulties for 3 or 4 days after joint trauma was sustained.

CASE V, No.452, female, age 61, invalid, married.

When first seen, this patient had extremely severe joint dysfunction (Joint Range Index 52.2) and severe rheumatoid arthritis, as well as a post-traumatic pattern of immediate and delayed articular pain, discomfort and disability resulting from a single episode of mild joint trauma.

She had performed what was for her the unusually difficult task of addressing 20 envelopes for Christmas cards, holding the pen in her right hand. Ordinarily, her husband would have performed this service for her, but he was away on a business trip, and she did not wish to ask anyone else to relieve her of this obligation. When she completed her writing, she experienced uncomfortable cramps, fatigue and unusual stiffness in her right hand, which lasted for about 30 minutes. She was free from further unusual discomfort in her right hand until four days later, when she suddenly experienced severe, persistent articular pain and increased stiffness in the joints of her right thumb, first and second fingers, and, to a slightly lesser extent, in the joints of the fourth and fifth fingers. Her pain, articular swelling and stiffness persisted at a severe

level for four days, with gradual subsidence of the delayed post-traumatic articular syndrome over a period of one month, which corresponded to her first month of niacinamide therapy. At the time of her second office visit, there was no evidence of the delayed post-traumatic articular syndrome.

CASE W. This 65-year-old woman accidentally cut the digitorum profundus tendon of her right forefinger 16 years before the photographs of Figure 35 were taken. At the time of the initial examination her Joint Range Index was 71.5, indicating moderate joint dysfunction.

Since the accident, the right forefinger could be flexed to a limited extent, and was moved during the course of her daily work, but not to a sufficient degree to be useful in the performance of household tasks. Thus, the right forefinger was not exposed to the more severe mechanical joint in-juries of housework and psychogenically induced, sustained hypertonia of somatic muscle. This patient was extremely right-handed, and grasped her various household implements with great force, probably because she did not have full use of her right forefinger.

There was no clinical evidence of impairment of innervation or circulation to the right forefinger. Sensations of heat, cold, pain, light touch, vibration, motion and position were normal in all the digits of the right hand. All the digits of the right hand were equally warm, and of the same color (210).

Because the interphalangeal joints of the right forefinger had been subjected to little mechanical injury, they had no articular deformities. However, the joints of other digits of the right hand were markedly deformed, presumably because of repetitive mechanical joint injury incurred by the tight grasping of household utensils, and by psychogenically induced, sustained hypertonia of somatic muscle. There was marked limitation of movement of the interphalangeal joints of the deformed digits, but not of the interphalangeal joints of the right forefinger.

CHRONIC ALLERGIC SYNDRONIES

Certain food-induced articular and non-articular allergic symptoms which are described below may obscure partially or completely a patient's subjective appreciation of improvement in response to adequate niacinamide therapy, even though objectively satisfactory improvement in joint function is demonstrated by continuously rising values of the Joint Range Index on serial re-measurements of joint ranges. While these allergic reactions usually do not include any significant degree of limitation in ranges of joint movement, they may be responsible for considerable articular pain and discomfort, in addition to other symptoms of bodily discomfort. It is, therefore, of considerable importance in the medical management of a patient with joint dysfunction to distinguish between the symptoms of aniacinamidosis, which are ameliorated in time by adequate niacinamide therapy, and allergic syndromes which are ameliorated in time only by elimination of the offending allergen, or by hyposensitization to the offending allergen.

Although many diverse clinical manifestations of food allergy may occur in persons with joint dysfunction, three syndromes occur frequently in response to the ingestion of an offending food or foods: (a) Allergic Pain Syndrome (223) (167) (221), (b) Allergic Fatigue Syndrome (223) (167) (152) (153), (c) Allergic Mental Syndrome (223) (167) (151) (152) (153) (220) (40) (166) (213) (31) (165). These syndromes are described below. (Rarely, the allergic pain syndrome occurred when there was an active dental or tonsillar focus of infection, and was alleviated when the source of infection was eradicated. Only three examples of such benefit were observed in this series of 455 cases.)

These syndromes may occur separately in various degrees of severity and chronicity, or in any combination, and may be associated with a number of allergic symptoms not specifically included in the description of these syndromes. Clinical manifestations of

these allergic syndromes may appear almost immediately after the ingestion of an offending food material and may continue for a few hours or a few days; or they may appear after a latent period of 12-76 hours following the ingestion of the allergen, and continue for as long as two weeks, gradually decreasing in severity during this interval. The daily ingestion of an offending food or food material produces a more or less steady state of allergic symptoms, with some exacerbation of these symptoms soon after the ingestion of this food.

Clinical proof that a suspected food is responsible for a patient's allergic symptoms is obtained (a) when such symptoms disappear when the offending food material is completely excluded from his diet for a sufficient period of time (2-3 weeks), and (b) when there is a recurrence of the initial pattern of allergic symptoms upon ingestion of the offending food material soon after he has become symptom-free as a result of abstinence from the allergenic food for a sufficient period of time; i.e., before abstinence from the food has been sufficiently prolonged for hyposensitization to have occurred.

(In addition to these three syndromes of allergic food reaction, offending foods have caused in patients with joint dysfunction the following types of allergic symptoms, which could be produced by the ingestion of the offending food, and could be eliminated by complete avoidance of the offending food:

Skin: Hives, angioneurotic edema, chronic pruritus, chronic skin lesions
Mucous membranes: Angioneurotic edema, canker sores.
Eyes: Chronic conjunctivitis.
Head: Cephalgia, including migraine.
Respiratory tract: Sneezing, postnasal drip, vasomotor rhinitis, recurrent sore throats, recurrent colds, sinusitis, asthma.
Gastro-intestinal: Nausea, vomiting, abdominal pain and cramps, heartburn, water brash, diarrhea, bilious attacks.)

While the ingestion of any food material can produce allergic symptoms in allergic persons, certain foods (chocolate, citrus fruits, tomato, pineapple, whole wheat, corn, milk, eggs and nuts) seem to be the most frequent offenders in the production of the allergic syndromes described below.

An oral threshold dose of an offending food is defined as the smallest quantity of that food which, when ingested not oftener than once every two weeks, will produce allergic symptoms in a person sensitive to this food. An oral sub-threshold dose of an offending food is defined as that amount ingested not oftener than once every two weeks which will produce no clinically discernible allergic reactions in a person sensitive to this food. However, if sub-threshold doses of a single offending food are eaten daily by a person who is sensitive to this allergenic food in threshold doses, in a few days or weeks there may be precipitated a clinically obvious allergic reaction, which probably represents the summation of clinically inapparent allergic reactions which have reached an intensity exceeding the threshold for the production of allergic symptoms.

If sub-threshold amounts of several offending foods are eaten on the same day, an allergic reaction to these may occur, even though such foods when eaten separately on different days do not give rise to a clinically apparent allergic reaction. It has been noted that single sub-threshold doses of different offending foods ingested on consecutive days may precipitate a clinically obvious allergic reaction.

In many persons with severe food allergies, the amount of the offending food which precipitates clinically significant allergic reactions is so small that every trace of this food must be eliminated from the patient's diet if he is to have relief from his allergic symptoms.

When an offending food is eliminated from the diet for a sufficiently long period of time, the tolerance gained with clinical hyposensitization may be excellent and apparently unlimited; or it may be moderate and easily broken down, either by too frequent ingestion of the food in small or moderate amounts, or by the single ingestion of an excessive quantity of this food; or, the tolerance may be so slight that it may be easily broken down by the single ingestion of a very small amount of the offending food material.

Whether or not the patient has a personal or family history of allergy, at any time he may become sensitized to any food and have any pattern of food-induced allergic symptoms, which may vary in severity, chronicity and extensiveness from time to time (158) (159) (160).

Transient sensitization to certain foods has been observed in many patients with upper respiratory infections ("colds") who have a continuance of their acute coryza, malaise and lymphadenopathy as a result of a practice widely used in the treatment of "colds," particularly, during the early days of the "cold," namely, the ingestion daily of a quart or more of such liquids as citrus fruit juices, pineapple juice, tomato juice, milk and chocolate milk. When a person with a limited tolerance for these food materials takes these liquids in larger quantities than usual for him, his oral threshold dose is exceeded, and an allergic tissue reaction is produced which resembles that of "infectious colds." Often, this food-induced allergic reaction prolongs "cold-like" symptoms for several weeks. However, when the patient eats his usual diet and takes 8 to 10 glasses of water daily instead of large quantities of the above fluids, this food-induced allergic reaction is avoided and the patient recovers much more rapidly from his "cold."

Cyclic food resensitization is likely to occur when certain foods in season are eaten daily in ordinary or excessive amounts; e.g., tomatoes, citrus fruits, pineapple, strawberries, peaches, melon, corn; and hyposensitization is likely to occur when these foods are not in season, and the patient excludes them from his diet, or limits the amounts ingested. To avoid cyclic resensitization, an allergic patient is advised to vary his diet as much as possible throughout the year, and not to have too frequent or excessive ingestion of any one food (158) (159) (160).

Sometimes a patient with pollinosis will observe during his hay fever season that his reactions to known allergenic foods tend to be more severe, and that certain foods, which he could ingest with impunity at other seasons, give rise to allergic food reactions. Conversely, the ingestion of certain foods during his hay fever season may worsen his symptoms of pollinosis.

Extremes of environmental temperature occasionally increase the severity of the patient's reaction to the ingestion of an allergenic food.

A given food may cause allergic symptoms only when the patient is emotionally disturbed; or, a person who reacts to the ingestion of an allergenic food may react more violently if this food is ingested at a time when he is emotionally disturbed. Many patients suffering from severe allergic symptoms have considerable secondary anxiety concerning their allergic ailment, and often associated psychosomatic symptoms are so severe that they dominate the clinical picture, and the patient is considered to be psychoneurotic.

Excessive ingestion or excessive retention of dietary sodium tends to make the allergic reaction to allergenic foods more severe (99).

In women, a cyclic variation in the allergic pattern has been noted, so that clinical evidence of food allergy may occur only during the two weeks before, but not during the two weeks after, the menstrual period; or, food-induced allergic symptoms may be

present throughout the month, but accentuated during the two weeks before the period (223) (167).

Allergic Pain Syndrome. In certain allergic persons, the ingestion of a threshold amount of an offending food material causes primarily mild, moderate or severe generalized pain in somatic muscle, tendon, periosteum, and periarticular and articular structures. A patient experiencing the allergic pain syndrome avoids all unnecessary physical exertion, since ordinary physical activity causes him pain and discomfort. Physical examination may disclose tenderness to palpation of somatic muscle, tendon, periosteum and periarticular structures. When the blood pressure cuff is inflated during the measurement of blood pressure, the patient may spontaneously complain of severe pain in the muscles of his arm. Somatic muscle is hypotonic and feels flaccid. Active and passive movement of joints may cause articular pain. The pain of this syndrome is usually not alleviated by the ingestion of aspirin, and if the patient is allergic to aspirin, the ingestion of this drug may even be responsible for the initiation and continuance of his allergic pain syndrome. Body massage usually worsens his pain and discomfort. In persons having the allergic pain syndrome, relatively slight mechanical joint injury will evoke severe and prolonged symptoms and signs of the delayed post-traumatic articular syndrome.

Allergic Fatigue Syndrome. In certain allergic persons, the ingestion of a threshold amount of an offending food material causes primarily extreme muscular fatigue, which is often associated with cervical lymphadenopathy (rarely, generalized lymphadenopathy), lymphocytosis and hypothermia (although occasionally there is a moderate elevation in temperature). Physical activity intensifies this allergic fatigue, but prolonged rest does not relieve the patient's symptoms of fatigue.

Allergic Mental Syndrome. In certain allergic persons, the ingestion of a threshold amount of an offending food material causes primarily mental symptoms, including mental fatigue, depression and confusion. The person may complain of disagreeable "mental fogginess or haziness," "a feeling of partial anesthesia," or a "feeling of being drugged." Thought processes are slowed. The patient may have unwarranted irritability, unreasonableness, temper tantrums, loss of memory, inability to concentrate, restlessness, sleepiness (although occasionally insomnia is noted). The patient’s mental inertia may be so severe that he finds it difficult to make decisions about even uncomplicated matters. He vacillates, procrastinates, and has trouble in carrying out even the simplest plans that he has made. He may require long naps during the day and may sleep long hours at night without relief from such mental fatigue. He knows that "something is wrong" with him, and he can describe his pattern of mental symptoms, although usually he is reluctant to do so because such symptoms have been made light of by his family and friends. A patient may refuse to discuss his pattern of allergic mental symptoms with the physician at the time of the initial visit, fearing that such symptoms are indicative of mental disease (insanity). He often complains that "life is not worth living” feeling this way.

The allergic patient with this mental syndrome may be secondarily disturbed because his family and physicians consider him to be a chronic grumbler and complainer. He feels emotionally insecure because he has been unable to obtain therapeutic relief from his allergic symptoms. Often such a person, with the tentative diagnosis of "psychasthenia," "neurasthenia," "nervous exhaustion," "psychoneurosis," or "psychosomatic fatigue," is referred to a psychiatrist, who, after studying the patient, believes that the patient's problems are psychosomatic in origin, not realizing that food allergy has created a somatopsychic disorder, which can be corrected by the removal of the offending food material from the patient's diet, but not by psychotherapy.

A few patients with joint dysfunction have, in addition to the allergic mental syndrome, a primary neuropsychiatric disturbance. In such in-stances, treatment must include

adequate niacinamide therapy, exclusion of the offending food material from the diet and expert psychotherapy.

TREATMENT OF CIIRONIC ALLERGIC FOOD SYNDROMES

Skin testing was rarely used in attempting to identify allergenic foods, since false-negative scratch or intracutaneous skin reactions may be obtained for a given food or group of foods, the ingestion of which causes the patient to experience clinically important allergic reactions, and falsepositive skin reactions may be obtained for food materials, the ingestion of which is clinically well tolerated by the patient (167) (152) (153) (151) (158) (159) (160) (81) (150).

Elimination diets, especially the diets of Rowe (167) (171), were used and modified empirically as necessary in the attempt to rid the patient of his food-induced allergic symptoms. At times, it may be extremely difficult to select a basic elimination diet which will accomplish this. When symptoms due to food allergy are not abated in 7 to 14 days, the patient is probably allergic to one or more foods in the elimination diet. While an elimination diet containing few foods sometimes gives relief from allergic symptoms, the too-frequent ingestion of the small number of foods in such a diet favors sensitization of the patient to any of the allowed foods. When new foods are added to the patient's basic elimination diet after he has been free from his chronic allergic food symptoms for two weeks, the patient should keep an accurate food-symptom diary which permits the physician to assess the patient's clinical reactions to the ingestion of the newly added food materials. If any added food seems to be giving rise to allergic symptoms, its use is interdicted. The patient's elimination diet is liberalized as rapidly as possible by the addition of those foods which by trial he is able to ingest repeatedly without experiencing allergic symptoms. It is possible at any time for an allergic patient to become sensitized to foods that formerly he tolerated well, and when symptoms suggestive of allergic reaction to the ingestion of foods recur, it is necessary to resume the search for offending food materials.

The polypropeptan method (223) of specific desensitization to twelve basic foods was given a limited trial, and good results were obtained in some patients. The food-symptom diary was useful in observing the clinical effects of specific desensitization, and the patient's reaction to the subsequent addition of new foods not included in the basic list of twelve foods. When the ingestion of new foods caused allergic symptoms, and specific propeptans were available for treatment, the patient was desensitized to these foods; when specific propeptans were not available, the use of these foods was interdicted.

The method of individual food-testing advocated by Rinkel and others (159) (155) was not employed.

At times the antihistaminics were employed as palliative measures in the treatment of hay fever symptoms and of certain pruritic skin conditions (hives, contact dermatitis). The chronic allergic food syndromes described in this volume did not seem to respond to treatment with antihistaminic drugs.

While it is tedious and time-consuming for the patient to keep an accurate food-symptom diary, and for the physician to analyze such a diary, this method of clinical investigation has been most helpful in the identification of specific foods causing allergic symptoms, and in the evaluation of the patient's response to elimination of allergenic foods from his diet. Some patients were unwilling or unable to cooperate in keeping a food-symptom diary and in restricting their diet as suggested. About 70% of persons who had symptoms suggestive of chronic allergic food syndromes were willing and able to cooperate in this exacting program.

The diary is kept in a standard stenographer's notebook, with a central dividing line on each page. Each notebook page contains the record of one day only. The diet (including all snacks, condiments and food-tasting) and the time of ingestion of each meal are noted in sequence in the left-hand column of each page. The patient is instructed to be specific in his description of the types of food eaten and, wherever possible, to list the ingredients of such mixtures as soups and salads. In the right-hand column, the patient lists his complaints, including the time of onset, degree of severity and duration of symptoms. A diary which is carelessly kept or has days omitted is not reviewed. It is not considered desirable in most instances to study food-symptom diaries which are kept for less than one month.

Certain additional information included in the diary is of value in the analysis of the patient's allergic and non-allergic symptoms. The patient records his emotional upsets, since these may cause reactions to allergenic foods to seem more severe, or may be accompanied or followed by psychosomatic symptoms. Any unusual physical activity is recorded, since this often actuates a delayed post-traumatic articular syndrome which might otherwise be confused with certain types of chronic allergic food reactions. Women record the days of menstrual flow, so that any pre-menstrual accentuation of allergic or sodium retention symptoms can be detected.

Such a diary gives more objective and accurate information concerning the patient's pattern of symptoms than his verbal impressions of how he has felt for a given period of time. Through the use of the food-symptom diary, it is possible for the physician to analyze accurately the patient's clinical reactions to:

(a) the ingestion of threshold amounts of allergenic foods;

(b) the elimination of allergenic foods from the patient's diet

(c) the re-introduction of allergenic foods after a period of abstinence, to test the degree of clinical hyposensitization to the offending food material, and to detect promptly any clinical evidences of resensitization to such foods; and

(d) the daily ingestion of sub-threshold amounts of allergenic foods for a sufficient period of time to produce summation effects.

In addition to data relative to allergic syndromes, objective analysis of the food-symptom diary yields other clinical information about the patient, and may be helpful in differentiating the symptoms of chronic allergic syndromes, delayed post-traumatic syndrome, sodium retention syndrome and psychosomatic syndromes. A carefully kept food-symptom diary indicates the regularity or irregularity of the patient's living and eating habits; the variety or monotony of his diet; his caloric intake; the relative amounts of protein, carbohydrate and fat in his diet; the quality and quantity of dietary protein; his vitamin and mineral intake; and his caffeine and alcohol intake.

The identification of offending foods is relatively simple when the diary shows days when the patient is entirely free from allergic symptoms, and is relatively difficult when the diary indicates that the patient is never free from allergic symptoms. When an offending food is eaten less often than once a week, the allergic symptoms following the ingestion of this food usually appear after a latent period of half an hour to 72 hours (usually 12-24 hours) and usually last from 4 hours to 4 days. When the patient's diary reveals that he is never without allergic symptoms, the only clues to the identity of the offending food material are obtained by noting variations in the intensity of symptoms. Slight intensification of symptoms usually follows soon after the ingestion of an offending food, and slight diminution in the intensity of allergic symptoms is noted when such offending food material is absent from the diet for a day or more. It is in such instances that the use of elimination diets or polypropeptan therapy is most helpful in alleviating the steady state of allergic symptoms. Once the patient has become

symptom-free, the effects of the addition of new foods can be ascertained from a study of the food-symptom diary.

When analysis of the food-symptom diary suggests that the patient is having food-induced allergic symptoms, recommendations are made that the suspected allergenic food material be completely eliminated in all forms from the patient's diet. The patient continues to keep his food-symptom diary so that the effects of restriction of suspected allergenic food materials can be observed. Specific dietary advice is always given to the patient so that, after exclusion of suspected foods, his diet is adequate in protein, calories and minerals. When milk and milk products are excluded from his diet for any prolonged period of time, suitable calcium preparations are administered to offset the resulting dietary loss of calcium. Patients who habitually use large amounts of salt in the diet or who seem to have symptoms resulting from excessive sodium retention are asked to limit their salt intake.

When a patient is allergic to many foods, usually only a few of the allergenic foods which cause his symptoms can be identified upon analysis of the first month's diary. Even when a few of the offending foods are eliminated from his diet, the subsequent food-symptom diary often shows one or more of the following alterations in the pattern of allergic symptoms:

(a) a lessening in intensity of symptoms, (b) longer intervals of freedom from such symptoms, (c) the elimination of certain allergic symptoms but not of others; e.g., the allergic pain syndrome may be eliminated, but allergic pruritus may persist. Such changes in the patient's allergic symptomatology may be noted usually within two or three weeks after the exclusion of the chief offending foods from his diet, although occasionally benefits may be noted from the exclusion of allergenic foods as early as the third or fourth day. Eventually, when all of the offending foods are eliminated from the allergic patient's diet, he becomes symptom-free, and the food-symptom diary may be discontinued. Should allergic symptoms recur, he is asked to resume keeping the food-symptom diary.

If the offending food is re-introduced into the patient's diet after several months of abstinence, his reaction to the ingestion of this food may be of the original intensity, or less severe, or absent, depending upon the degree of hyposensitization to the offending food which occurred in the time during which this food was excluded from the patient's diet. In most persons, in order to achieve complete clinical hyposensitization to the offending food, it may be necessary to exclude this food for a year or longer. Rarely, even with prolonged exclusion from the diet, there is no demonstrable clinical hyposensitization to an offending food (150) (167) (219).

When it has been demonstrated that a patient has become clinically hyposensitized to a single ingestion of a food which formerly caused allergenic symptoms, he is instructed to have this food infrequently, in amounts limited to average servings, in order not to become resensitized to this food (160) (199). He is advised not to have this food more than once a month for six months; for the next six months, not to have the food more often than once every two weeks; and thereafter, not to have the food more often than every fifth day. If at any time there is a recurrence of symptoms due to ingestion of this food, it must be excluded from the diet to permit clinical hyposensitization to take place again.

Sometimes, a patient wants to find out for himself whether he is really allergic to a given food, or whether it is his "imagination" or an idea of the doctor's. When he ingests the allergenic food before hyposensitization has occurred, he has his usual allergic symptoms. However, he will not have allergic symptoms in response to the ingestion of this food if he has become hyposensitized.

Although suggestion may play a part in the production of the allergic patient's symptoms and in his relief from symptoms following the exclusion of allergenic foods from his diet, the reaction of truly allergic persons, who are markedly sensitive to a given food, is predominantly due to bodily changes produced by the ingestion of allergenic food materials. This becomes strikingly clear when such a patient inadvertently and unknowingly ingests an allergenic food material, and subsequently develops his typical pattern of allergic symptoms (233) (22) (61) (93) (151) (152) (153) (184).

Although a patient may complain that a diet which eliminates certain offending foods is monotonous, analysis of his diet when his choice of foods is unrestricted is likely to show little or no variety in his daily menus. An emotionally well-adjusted person is usually able to tolerate dietary restrictions without developing anxiety, even though essential or favorite foods may be interdicted. Sometimes a person who has developed excessive guilt in response to certain life situations seems to welcome food restriction, since symbolically this constitutes punishment for his real or fancied sins.

Certain patients are unable to cooperate adequately in the investigation and treatment of their allergic food syndromes because of their emotional disorders; e.g., a patient may develop considerable anxiety in response to dietary restriction of important or unimportant foods, perhaps because deprivation of food symbolizes a threat to his security and re-activates old, unresolved conflicts, and he will drop treatment; or, a patient who has secondary gains from the continuance of his allergic symptoms may protest that he will "do anything to feel well," but he impedes in every possible way the efforts of the physician to work out a solution to his allergic problems. Treatment of the chronic allergic food syndromes of such patients will not be successful until the basic emotional disorder has been corrected by psychotherapy (218).

SOME EXAMPLES OF FOOD-INDUCED ALLERGIC REACTIONS

CASE AA. This case history demonstrates the clinical effects of the ingestion at different times of various amounts of an offending food, to which the patient was moderately allergic, and subsequent hyposensitization resulting from abstinence from this food for a sufficiently long period of time.

A 52-year-old widow complained of severe headaches recurring cyclically every Sunday for many years, and occasional milder headaches at other times. These headaches had not been modified by her uneventful "change of life," which occurred when she was 46 years old. Every Sunday morning she awoke with a violent, throbbing bitemporal cephalgia (headache) associated with photophobia, nausea and vomiting. The severe headache persisted for 24 hours, and was succeeded by dull head discomfort persisting for as long as 48 hours. No previous medical measures had prevented the cyclic recurrence of her headaches or had given her appreciable relief from the pain and associated discomfort of this type of cephalgia.

She was asked to keep a food-symptom diary for one month. This record revealed that every Saturday night she ate as many as fifteen pieces of chocolate candy during the course of a weekly bridge game, although at other times during this month she did not eat chocolate. On the basis of her food-symptom diary, it was suspected that chocolate was the chief offending food material. Upon advice, she eliminated chocolate completely from her diet for two weeks, during which interval, for the first time in 10 years, she was free from her usual Sunday headaches and associated symptoms. As a confirmatory test, she re-introduced chocolate into her diet, and reported that approximately 12 hours after the ingestion of 10 pieces of chocolate candy she experienced her usual severe cephalgia with associated nausea and vomiting. Thus, it was confirmed clinically that chocolate was the offending food:

(a) by the absence of her headaches upon the exclusion of chocolate from her diet, and

(b) by the reappearance of her usual severe cephalgia upon re-introduction of a given amount of chocolate into her diet before clinical hyposensitization had taken place.

The patient cooperated over a period of many months in a sequential clinical investigation:

1) to determine the smallest oral dose of chocolate which would cause her usual headache; i.e., the amount of chocolate that was the threshold oral dose for the production of her usual allergic symptoms:

When she had abstained from chocolate for two weeks and was free from her usual headaches during this interval, the smallest amount of chocolate ingested at one time which produced her usual headaches after a latent period of approximately 12 hours, was four squares of a popular chocolate bar.

2) to determine that oral dose of chocolate ingested once every two weeks which was sub-threshold for the production of her allergic symptoms; i.e., the amount of chocolate ingested once every two weeks that was insufficient to cause her headaches:

When she had abstained from chocolate for two weeks and was free from her usual headaches during this interval, she was able to eat three squares of chocolate once every two weeks for three successive two-week periods without precipitating her usual headache.

3) to demonstrate that in time the ingestion of sub-threshold doses of chocolate under certain conditions caused the appearance of her allergic symptoms.

When she had abstained from chocolate for two weeks and was free from her usual headaches during this interval, the daily ingestion of one square of chocolate for four successive days caused no clinical symptoms until the fifth day, when she awakened with her usual severe headache.

For the next two-week period, she abstained from chocolate and was free from her usual headaches during this interval. Then she ate three squares of chocolate on one day, without experiencing any clinically apparent allergic reaction. When she repeated the same oral dose of chocolate four days later, she developed her usual severe headache on the following day.

In this instance, it would appear that eventually the threshold necessary for the production of her allergic symptoms was exceeded as a result of the summation of clinically inapparent allergic reactions following the repetitive ingestion of sub-threshold amounts of the offending food.

When chocolate was excluded in all forms from this patient's diet for one year, during this time she was completely free from headaches, and became sufficiently hyposensitized so that she could eat four or five pieces of chocolate candy daily for weeks at a time without experiencing headaches or other allergic symptoms.

CASE BB. This case history demonstrates the occurrence of the Allergic Fatigue Syndrome and the Allergic Pain Syndrome following the ingestion of an offending food to which the patient was severely allergic, and subsequent hyposensitization resulting from abstinence from this food for a sufficiently long period of time.

This 36-year-old physician experienced for more than 8 years severe and persistent generalized periosteal pain, excessive and persistent fatigue that was not relieved by rest, and recurrent afebrile attacks of swollen lymph nodes. These symptoms at irregular intervals reached such intensity that periodically he had to take to bed for a week or more, until there was some remission in his symptoms.

On two occasions 9 and 10 years ago, he experienced two distinct severe episodes of classic acute infectious mononucleosis. Although his heterophile antibody test was strongly positive during the two acute attacks of infectious mononucleosis, it was negative subsequently. However, for at least 6 years, stained smears of his peripheral blood revealed the presence of atypical lymphocytes resembling those usually found in infectious mononucleosis (154).

He was studied over a period of many years by internists, allergists, hematologists and psychiatrists. Chronic afebrile brucellosis was excluded through a battery of tests (74). Skin testing indicated that he was allergic to a variety of inhalants and foods. Over a period of several years he was desensitized to various pollens and house dust with relief of his seasonal hay fever, but with no relief of his presenting symptoms of pain, fatigue and recurrent swollen lymph glands. The elimination from his diet for several years of a number of foods to which he showed strongly positive skin reactions (milk, eggs, wheat, nuts, lettuce, legumes) did not appreciably alter his chronic illness. It was, therefore, believed that his food allergies did not contribute to his chronic symptomatology.

The psychiatrists doubted that his symptoms were the expression of serious maladjustments to life situations or hypochrondriasis, although they noted moderate anxiety about his health. The consensus of his attending physicians was that he had a chronic recurrent type of infectious mononucleosis. He was advised to "take it easy, to adopt a philosophical attitude" toward his illness, and take it in his "stride."

During the meat shortage in 1944, for a period of several months this patient had a "spontaneous" remission from his illness. He was astonished and delighted to feel well for the first time in more than 8 years. However, he did not realize at the time that this period of freedom from symptoms corresponded exactly to the interval during which he ate no beef. (Previous skin-testing to beef had given a negative reaction both by the scratch and intracutaneous methods.) After several months of a beef-free diet, he ate his first beef-containing meal, and immediately there was a recurrence of his Allergic Pain Syndrome and Allergic Fatigue Syndrome and lymphadenopathy. Following the ingestion of this beef-containing meal, there was for 10 days no appreciable decrease in the intensity of his allergic symptoms.

This patient was advised to abstain from beef except for a test meal of beef to be taken once every 6 months. After 6 months of abstinence from beef, he was symptom4ree until he ingested a beef-containing test meal, which again caused a recurrence of his allergic symptoms, this time lasting only 3 days.

For another six-month period of abstinence from beef, he was symptom-free, until he ingested his next beef-containing test meal, which was followed by an allergic reaction lasting only 36 hours. After the next beef-free and symptom-free six months, the ingestion of a beef-containing test meal caused a recurrence of his allergic symptoms lasting only 8 hours. Finally, after 6 months more of abstinence from beef and freedom from allergic symptoms, the next ingestion of a test meal of beef caused no subjectively discernible allergic reaction.

During the 2 ½ years in which he abstained from beef (save for single test meals of beef every 6 months) there was a progressive clinical hyposensitization to beef, as indicated by a gradual decrease in the intensity and severity of the beef-induced allergic reactions. Future study will indicate whether or not clinical hyposensitization is sufficiently complete so that beef may again be introduced into his diet in moderate amounts at weekly or bi-weekly intervals without causing re-sensitization to beef and a recurrence of this patient's Allergic Pain Syndrome, Allergic Fatigue Syndrome and lymphadenopathy.

CASE CC. This case history demonstrates the occurrence of the Allergic Mental Syndrome in response to the ingestion of an offending food, and the absence of this syndrome upon exclusion of the offending food from the diet.

This 19-year-old college girl had an excellent academic record for her freshman and sophomore years, being in the first 10 per cent of her class scholastically. Early in the first semester of her junior year, she noticed for the first time that she was foggy mentally and forgetful, and that it was difficult for her to concentrate on her studies, as a result of which she fell behind in her required class work. After a few weeks, her mental fatigue became so severe that she frequently overslept in the morning, missing classes. There was no lessening in the intensity of her mental fatigue as a result of extra sleep, and she often felt "drugged" on awakening. Frequently she was so sleepy in the afternoon that she had to take long naps.

In an attempt to overcome her deficiencies in her school work, she gave up all social activities, no longer having "dates" or going to the movies; instead, she devoted all her time to study. She became emotionally upset when she realized that course material that should have been easy for her to master, was not; and that she could not recall things which she had learned and understood well at an earlier time. She was failing in her school work, and had received notice from the Dean's office that she was taking excessive class cuts.

Before Thanksgiving she was advised by the Dean to consult a psychiatrist in order to determine the cause of her recent scholastic inadequacies and the cause of the recent changes in her personality which had been noted by instructors.

When she was first seen, she volunteered that she was afraid she was losing her mind. Her history revealed that during the last semester of her sophomore year she took a course in nutrition and decided to improve her protein intake by adding eggs to her diet, in spite of the fact that previously she had disliked eggs and always avoided eating them. Accordingly, during the first semester of her junior year, she forced herself to eat one or two eggs daily.

Upon questioning, it became apparent that her troubles in college began soon after the introduction of eggs into her diet. In view of this, she was asked to stop the ingestion of eggs and all egg-containing foods. She was also asked to keep a food-symptom diary (which proved to be unnecessary, since within 2 weeks after the exclusion of eggs from her diet, she again felt mentally alert, was free from the disagreeable fogginess and sleepiness, and was able to do her school work easily and efficiently). In spite of her poor scholastic showing during the beginning of the first semester, she was able to complete the first semester of her junior year with a B-plus average.

This patient has not been significantly desensitized to eggs or egg-containing foods after two years of abstinence from these foods.

CASE DD. This case history demonstrates the occurrence of the Allergic Pain Syndrome in response to the ingestion of a number of offending foods to which the patient was severely allergic, and the absence of this syndrome upon exclusion of the offending foods from the diet.

Since the age of 10, this 35-year-old housewife had not been free at any time from generalized subcutaneous edema and severe bone, joint and muscle pain. These symptoms were cyclically increased in intensity during the 10-day interval preceding her periods, and also seemed to be aggravated by weather changes. She did not complain of physical or mental fatigue, and had no mental symptoms save for premenstrnal tension. Her basal metabolic rate was within the normal range. She had been studied and treated by many physicians over a period of many years without obtaining even

slight relief from her symptoms. Most of the physicians thought she had some form of chronic "rheumatism," and in addition that she suffered from hypochondriasis.

Physical examination disclosed that she had moderate joint dysfunction, which responded satisfactorily to the. subsequent institution of therapy with adequate amounts of niacinamide, but her syndrome of subcutaneous edema and pain was not materially affected by this treatment.

The premenstrual accentuation of her subcutaneous swellings and pain and premenstrual tension were controlled by a moderately low-sodium diet throughout the month, supplemented by 1 g of enteric coated ammonium chloride three times a day after meals and at bedtime, which was administered daily for the two weeks preceding her periods. Because her symptoms of pain persisted, even though her Joint Range Index increased satisfactorily over a period of time in response to niacinamide therapy, and even though the premenstrual accentuation of her symptoms was prevented by a low-sodium diet, an allergic cause for her symptoms was sought and found.

Analysis of her food-symptom diary over a period of several months indicated that she was severely allergic to wheat, eggs, pork and nuts. When these foods were excluded from her diet for 3 weeks, she became completely free from subcutaneous edema and bodily pain for the first time in her life that she could remember.

Adequate niacinamide therapy caused satisfactory improvement in the Joint Range Index, but did not alleviate the Allergic Pain Syndrome. Salt restriction alleviated only the symptoms due to the salt-retention syndrome. Exclusion of allergenic foods from the diet relieved the Allergic Pain Syndrome. Thus, in order for this patient to feel well, it was necessary to institute the proper medical treatment for three separate clinical entities: joint dysfunction, sodium retention syndrome and food-induced Allergic Pain Syndrome.

CASE EE. This case history demonstrates the occurrence of the Allergic Fatigue Syndrome in response to the ingestion of a number of offending foods to which the patient was severely allergic, and the absence of this syndrome upon exclusion of the offending foods from the diet.

This 20-year-old male, a college senior, complained for 3 years of persistent physical weakness and exhaustion. He also had at times swollen neck glands. Although he was so tired at times that he was unable to attend classes, he had no difficulty in mastering his course work, and his scholastic record was excellent.

Over a period of several years, studies in the college Health Service gave no positive evidence for active tuberculosis, brucellosis or infectious mononucleosis as a cause of his fatigue. Physical examination showed that he had a slight grade of joint dysfunction, and that his muscles were hypotonic and weak. His joint dysfunction responded to adequate treatment with niacinamide, but his physical fatigue and weakness and his muscle hypotonia did not improve.

A study of his food-symptom diary showed a daily ingestion of chocolate and tomato-containing foods. Clinical proof was obtained that chocolate and tomato were the chief offending substances. Within 10 days after eliminating these foods from his diet, he had complete relief from his physical fatigue and muscle hypotonia. Subsequently, there were no recurrences of his symptoms, save when occasionally he "forgot" and ate the offending foods.

SODIUM RETENTION SYNDROME

Certain patients have complaints of bodily discomfort which disappear when the sodium content of the body is decreased by appropriate therapy, and recur whenever excessive sodium retention recurs. It is believed, therefore, that these symptoms are the result of

excessive retention of sodium in the body, whatever the cause of this may be (216) (144).

It is well known that excessive sodium retention (as well as chloride and water retention) occurs cyclically in women who have premenstrual tension, and that excessive ingestion of sodium in the diet or in medicaments accentuates premenstrual tension. Any or all of the following symptoms and signs may occur in a mild or severe form starting 10-14 days before the onset of the period, and usually subside during the period or immediately thereafter: gradual enlargement, swelling and bloating of the body so that garments become uncomfortably tight; a gain of 2-5 pounds in weight, which is lost soon after the period begins; myalgia, arthralgia, backache, cephalgia (including migraine), nausea, sensations of intestinal bloating, pelvic discomfort, labial itching; emotional instability (including nervousness, touchiness, crying spells, irritability, quarrelsomeness, dopiness and depression); excessive fatigue, inability to concentrate, impaired memory, clumsiness, insomnia, hyperkinesis, erratic behavior, increased sexual desire. There may be noticeable edema of the face and various portions of the body. The breasts are usually enlarged and tender to palpation, and somatic muscle and periosteum are likely to be tender to digital palpation.

In most other clinical forms of sodium retention the symptoms and signs are less severe and less extensive than those found in severe premenstrual tension, and consist chiefly of arthralgia, nervousness, insomnia, dizziness and increased blood pressure (65) (142) (143) (190) (222) (128). Sodium retention of a degree sufficient to cause symptoms may occur in persons who are ingesting excessive amounts of sodium. However, some persons have a significant degree of sodium retention with even a moderate intake of sodium. Reduction of excessive amounts of sodium in the body by appropriate therapy gives complete relief from the above symptoms, and in some persons there may be a decrease in blood pressure as a result of salt restriction.

With excessive sodium retention, there may be an accentuation of symptoms due to coexisting complicating syndromes (the delayed post-traumatic articular syndrome, chronic allergic food syndromes, and psychosomatic syndromes). When the sodium content of the body is decreased by therapy, there is a decrease in the severity of the symptoms due to sodium retention, and usually a decrease in the intensity of symptoms of the coexisting complicating syndromes.

The symptoms and signs of excessive sodium retention (64) (88) (139) are usually controlled when the patient limits the amount of salt in his diet, drinks 8 to 10 glasses of water daily and, when indicated, takes enteric coated ammonium chloride tablets (1 to 3 g, t.i.d. p.c. and h.s.)

Although severe sodium chloride restriction has been known to cause symptoms which are usually alleviated by the administration of salt (175) (28), no patient in this series who was treated for the sodium retention syndrome developed such symptoms.

SYNDROME OF PSYCHOGENICALLY INDUCED, SUSTAINED HYPERTONIA OF SOMATIC MUSCLE

GENERAL CONSIDERERATION OF PSYCHOSOMATIC SYMPTOMS IN JOINT DYSFUNCTION

Either before treatment for joint dysfunction was undertaken or subsequently, most patients included in this study suffered at one time or another from a variety of transient or persistent, mild, moderate or severe symptoms of bodily discomfort, which were interpreted as being collateral to primary mental tension (43) (235) (203) (49). Psychosomatic symptoms occurring during the course of treatment of joint dysfunction often caused the patient much subjective discomfort, and obscured his appreciation of improvement in joint dysfunction in response to adequate niacinamide therapy, even

though satisfactory improvement in joint dysfunction was demonstrated objectively by continuously rising values of the Joint Range Index as determined serially during the course of adequate niacinamide therapy.

In most instances, the existence of psychosomatic illness (where symptoms of bodily discomfort are caused, intensified or perpetuated by mental influence) can be validated when the symptoms of bodily discomfort are consonant with the emotional problems of the patient (235) (50) (110) and disappear upon satisfactory discharge of the inciting mental tension; and when, upon careful clinical investigation, no evidence can be found for co-existing somatic disease which could produce such symptoms (237). In some instances, symptoms of bodily discomfort initiated by mental tensions may persist as habit patterns even when the inciting mental tensions are adequately discharged. In the treatment of a patient with such symptom-producing non-purposive habit patterns, the patient must be re-educated before these mechanisms of habitual behavior can be extinguished (100) (122).

It is not uncommon to find in a person with psychosomatic symptoms the coexistence of clinically significant asymptomatic or symptom-producing somatic disease. Symptoms of primarily somatic disease may or may not be similar to symptoms of a coexisting psychosomatic illness. When the symptoms due to concurrent somatic disease and psychosomatic illness are similar or identical, the relative relief obtained from removal of the psychosomatic component by psychotherapy may be such that the patient temporarily feels greatly benefited. If the patient and physician are satisfied with such a therapeutic result, serious somatic disease may be overlooked until it produces such symptoms and signs that its presence cannot be ignored, and by this time, the somatic disease process may not be amenable to any form of therapy.

While patients differ in the degree of susceptibility to externalization of their mental tensions through psychogenic symptoms of bodily discomfort, any patient may develop psychosomatic symptoms either transiently or persistently if the mental stresses to which he is exposed are for him sufficiently severe, sufficiently prolonged, or sufficiently repetitive (111) (110) (2) (3).

Once psychosomatic symptoms occur, patients differ in their ability to become free from such symptoms, either spontaneously or through directed therapy. It is well known that symptom-producing alterations in visceral function and in somatic muscle tone are the usual accompaniments of many emotional states, such as anxiety, fear, panic, resentment, hostility and rage (27) (241) (133) (55). In acute and subacute emotional states, symptoms of bodily discomfort produced by psychogenic alterations in visceral function often preponderate, while in chronic emotional states, symptoms of bodily discomfort produced by psychogenically sustained hypertonia of somatic muscle preponderate. In acute, subacute and chronic emotional states, the patient's collateral emotional response to the unpleasant sensory concomitants of psychogenically altered bodily function produces a heightening of his total emotional tensions and an increase in the severity, extensiveness and duration of his psychosomatic symptoms (29) (182). When these psychogenic symptoms of bodily discomfort become severe enough, they often serve to deflect the patient's attention from his primary mental tension and anxiety to his collateral somatic dysfunction. Thus, temporarily he may feel relieved, and may not be disturbed consciously by his primary mental tension, although in time he may develop secondarily considerable mental tension and anxiety concerning his continuing psychosomatic symptoms and their possible meaning to his health and his future security. Before instituting treatment of the patient with psychosomatic symptoms, the physician should try to evaluate the part played by the psychosomatic symptoms in the maintenance of the patient's biodynamic homeostasis, and the emotional resources which the patient could muster to deal with his basic emotional problems if his psychosomatic symptoms were prematurely removed by ill-advised psychotherapy.

A patient who is usually well-adjusted may have psychosomatic symptoms only when he is suffering from an acute or subacute tensional situation, but a severely psychoneurotic patient may never be entirely free from reciprocally interacting psychogenic symptoms of bodily discomfort and mental tensions. In some patients the severity, extensiveness and subjective awareness of psychosomatic symptoms may seem directly proportional to the severity of the existing mental stress, while in others no such direct relationship obtains. In some patients, exposure to any degree of mental stress always seems to call forth the same fixed pattern of psychosomatic symptoms and mental tensions. Psychosomatic symptoms may be absent, or present at low levels of intensity, extensiveness and psychic awareness when the patient's chronic psychoneurosis is compensated, and are usually present at high levels of intensity, extensiveness and psychic awareness when the psychoneurosis becomes decompensated. Usually, the more aware the patient is of his psychosomatic symptoms, the less aware he is of his primary mental tensions; indeed, if he is aware of any mental tensions at all, he usually attributes these to his intense concern about his presenting psychosomatic symptoms and their meaning to his health and future security.

A patient with joint dysfunction (with or without obvious arthritic deformities) who also has a compensated psychoneurosis will tolerate a more or less steady state of reciprocal emotional and psychosomatic discomfort which he considers to be normal for him. The continuance of his troublesome symptoms and the secondary gains he derives from his chronic compensated psychoneurosis may in time afford him a considerable degree of emotional security and satisfaction. It is only when his psychoneurosis becomes decompensated that such a patient will develop intolerable anxiety and intolerable psychosomatic symptoms, and when his psychoneurosis again compensates either spontaneously or through psychotherapy, he will revert to his original steady state of tolerable emotional and psychosomatic discomfort, and he may feel that he has been cured and is normal again. Frequently the treatment of psychogenic syndromes of bodily discomfort is rendered difficult by the unwillingness of the patient with such syndromes to cooperate in an investigation of the mental and emotional factors which are etiologically related to his presenting psychosomatic illness.

While it is not the purpose of this volume to describe all types of psychosomatic symptoms observed in the group of patients treated for joint dysfunction, in this section consideration will be given to articular and nonarticular psychosomatic symptoms arising directly or indirectly from psychogenically induced, sustained somatic muscle hypertonia, and appropriate suggestions for the management of this syndrome will be offered.

In planning appropriate treatment for psychogenically induced, sustained hypertonia of somatic muscle, the physician should try to understand the basis of the patient's psychosomatic symptoms m terms of the interactions of endogenous and exogenous operational factors which made the patient the person that he is, predisposing him to his illness, initiating his psychosomatic disorder, and causing his illness to persist (168).

PSYCHOBIOLOCIC STUDY OF THE PATIENT WITH JOINT DYSFUNCTION

In the clinical analysis of the patient's health problems (236) (66) (235) (239) (100) (117) (157), coexisting psychic, somatic psychosomatic and somatopsychic phenomena were regarded as dynamic, interrelated and integrated manifestations of the functioning human psychobiologic unit. However, certain techniques were primarily employed in the study and treatment of psychic aspects of disease, and other techniques were primarily employed in the study and treatment of somatic aspects of disorders. Combinations of these techniques were used to identify, study and treat (a) psychosomatic disorders, in which symptoms of bodily discomfort are collateral to primary mental disorders, and usually disappear when aberrant mental functioning is corrected, and (b) somatopsychic

disorders, in which mental disorders are collateral to primary somatic disorders, and usually disappear when aberrant somatic physiology is corrected.

The clinical study of each patient was performed unhurriedly in order to give the patient adequate time to express his complaints fully, and to give the examiner sufficient time to collect the necessary clinical data, and, upon reflection, to make the necessary clinical correlations, and to evolve a reasonable plan of treatment for the patient. Throughout the clinical study, without appearing to do so, the physician continuously observed and evaluated the verbal and somatic reactions which exteriorized some of the patient's emotional responses during the elicitation of the history, during various procedures of the physical examination, and during the summary of the patient's health problems and the recommended therapy.

As an approach to the understanding of the patient's emotional and psychological problems, during the course of the initial interview, information was obtained, sometimes by indirection, concerning many matters which were independent of joint dysfunction but were often responsible for the evolution and persistence of the patient's presenting attitudes, moods, sentiments, conflicts and psychosomatic symptoms. Such information included data concerning the patient's childhood, family problems, home life, educational background, social background, religious background, emotional background, worries and plans concerning the future, his work experience, adjustments to various life situations (including his illness), the patient's interpretation of the cause and significance of his symptoms and illness, the persons he has known or heard of who have similar symptoms, and any apparent temporal relationship between the occurrence of emotionally upsetting events and the onset of his symptoms. The patient was encouraged to summarize what he considered to be his "good and bad points," and the 'best and worst periods" of his life. An attempt was made to assess his attitude toward his failures and successes, toward his mental and physical handicaps, toward his "sacrifices" for the benefit of other members of his family, and toward ailing members of his family. It was often helpful to know the patient's schedule of activities during an average day and week, and during weekends, holidays and vacations, since he may have symptoms only at certain times: at home, at work, in church, on a vacation, on weekends or holidays, when meeting or visiting certain individuals.

It is important to keep in mind that persons with the more severe grades of joint dysfunction who have psychogenic articular and non-articular symptoms often have repressed resentment, hostility, rage and aggressive-ness which are chiefly exteriorized by localized or generalized sustained hypertonia of somatic muscle (89). In the older age groups particularly, psychogenically induced, sustained hypertonia of somatic muscle is caused by fear of economic insecurity, of losing dominance in a family or business group, of having a "serious" illness (e.g., cancer, strokes, loss of mental faculties), and fear of dying (170).

It was the writer's aim to gather the raw material of the history by haviug the patient tell his story in a natural way, with only such comment or questions from the physician as were needed to indicate that the physician was sympathetically interested in the patient's problems, and to explore those portions of the medical history about which the physician wished to obtain more information. During the elicitation of the history, and subsequently, the greatest care was taken not to suggest to the patient the existence of clinical problems either by interrogation, comment or implication.

It was found that one of the most fruitful sources of information about the patient's emotional makeup was his behavior in the doctor's office. Often, his emotional reactions to the discussion of events, circumstances or persons were exteriorized by his mannerisms, by changes (or lack of appropriate changes) in his facial expression, by alterations in his voice, posture, color, neck artery pulsations, respirations; by aerophagia, by sweating, by crying, by his asides and by his gait. The patient's attitude

toward the physician and his assistant sometimes gave valuable clues to certain of the patient's emotional problems. At times, clues to an emotionally charged situation were obtained during the interview; e.g., when the patient in the rnidst of a sentence "forgot" what he was going to say and couldn't "recall" it; when a patient abruptly terminated discussion of a given subject and was unwilling to resume such a discussion; when a patient made a spontaneous and revealing statement, followed by a prolonged discourse intended to correct any "false impression" the examiner may have received from the patient's initial statement; when a patient asked question after question about non-personal or personal medical matters or digressed, talking at great length about emotionally neutral subjects in order to avoid an emotionally painful topic of discussion; when a patient exaggerated or minimized the importance of certain matters in his life history.

At times, a knowledge of patterns of symptom-language and a knowledge of fundamental dynamic patterns of certain psychosomatic disorders were helpful in interpreting the meaning of the patient's psychosomatic complaints and in facilitating the analysis of his central emotional problem (235).

The interpretation of symbolic body language is a valuable, but not infallible, guide for the physician in the identification of a patient's emotional reaction to some problem which he is facing. For example, psychogenically induced, sustained hypertonia of epicranial muscles which results in headache may indicate that the patient is faced with a situation for which there seems to be no satisfactory solution; increased jaw muscle tension may be the sign of determination to perform some difficult or unpleasant task; painful sustained muscle tension of the tongue and throat muscles may indicate that the person has something he wants to say, but can't; pain in the neck may symbolize the patient's preparedness for defensive or aggressive action; pain in the left pectoral muscle may be present when the person has sustained a loss; pressure in the anterior portion of the chest may indicate that the person is sad, grief-stricken or guilty; vaginismus may indicate a defensive reaction against having sexual relations; pain in the right upper extremity may indicate a repressed desire to strike someone; while unilateral thigh and leg pain may indicate that the person wishes to kick someone.

When one elicits data of a personal nature, allowance must be made (even in a non-psychotic patient) for differences between reality and the consciously or unconsciously revised account which the patient gives the physician. Properly interpreted, such conscious or unconscious revision may be more indicative of the patient's emotional problems, prevailing moods and goal-direction than any "true" statement.

After the history was elicited and rapport established, the patient was routinely asked if he wished to talk about any additional matters. It was found that frequently a patient took advantage of this opportunity to reveal those personal, and often most troublesome problems, which he had refrained from mentioning earlier in the interview.

Next, the physical examination and routine laboratory studies were performed. During the physical examination, no comment was made by the physician which might cause the patient anxiety. At no time during the physical examination was the patient led to believe that the examiner was unduly interested in any one part of the examination, or was giving unusual attention to any one part of the patient's body. The patient's apparent reaction to the physical examination was noted.

When the clinical study of the patient was completed, the findings were related factually in terms which the patient could understand. Care was taken not to suggest to the patient physical, emotional or mental disorders which he did not have. He was told how his health compared with what is judged by present-day standards to be "average good health" for his age and sex. He was given an opportunity to ask questions, and when necessary those points which were not clear to him were amplified and rephrased. When correctable disorders were found, if these seemed to be of sufficient clinical

importance, appropriate therapy was prescribed. When remediless disorders existed, the examiner always tried to apprise the patient of such findings in a manner which would give rise to the least amount of anxiety and, whenever possible, palliative measures were employed to make the patient more comfortable, to retard the progress of his disorder, or to prevent complications of disease (41). A patient with a remediless disorder was often comforted by the thought that even though there was not an efficacious treatment for his disease, medical progress was such that in time new discoveries might offer him or other sufferers a remedy for the correction of his disorder.

The objectives of the recommended program of medical therapy were outlined for the patient, and the expected response to such therapy was described. If special laboratory studies or additional clinical studies were recommended, the reasons for desiring them were explained to the patient.

Clinical study of the patient continued when he returned for necessary re-examinations, and the physician's initial impressions and conclusions concerning the patient and his health problems were modified as necessary upon further reflection, or when new clinical data became available. The clinical management of joint dysfunction was carried on as previously described, and concurrently other health problems which the patient presented were given appropriate treatment.

PSYCHOGENICALLY INDUCED, SUSTAINED HYPERTONIA OF SOMATIC MUSCLE

Although symptom-producing, localized or generalized hypertonia of somatic muscle may be caused by any etiologic agent which maintains the central excitatory state of the motoneurones innervating the somatic muscle region at their discharge level (36) (194), it is most commonly caused by psychogenically induced, sustained hypertonia of somatic muscle. Psychogenically induced, sustained hypertonia of somatic muscle gives rise to protean clinical manifestations, which may occur in persons with or without joint dysfunction, and with or without obvious arthritis. The localized or generalized patterns of symptoms resulting from such sustained hypertonia of somatic muscle at times may simulate well-known somatic disease patterns, although at other times they may not be typical of any known somatic disease. The patient who experiences articular and non-articular symptoms as a result of psychogenically induced, sustained hypertonia of somatic muscle often seeks medical advice because he mistakenly believes that he is seriously ifi with a somatic disease, and often develops considerable anxiety about the possible meaning of his illness (60) (232) (224) (75).

The syndrome of psychogenically induced, sustained hypertonia of somatic muscle may or may not occur in association with other psychogenic syndromes.

Localized or generalized psychogenically sustained postural hypertonia of somatic musculature often symbolizes the preparedness of the human psychobiologic unit for aggressive or defensive action against extrinsic or intrinsic noxious factors, with sulficiently strong concurrent central inhibition to prevent such completion of the required goal-directed action as would permit, at least temporarily, a satisfying discharge of both the prevailing somatic and psychic tensions (215) (241) (122) (133) (55). In this sense, psychogenically sustained hypertonia of somatic musculature is operationally a compromise adjustment of the human psychobiologic unit, and represents part of the dynamic pattern of somatization of unresolved conflicts, repressions, resentments, and indecisiveness. Psychogenically sustained somatic muscle hypertonia may in time become habitual as the adaptive response to even the most trivial threat to the patients emotional security, and may include substitutive behavior of various types, replacing inhibited goal-directed action. Even when the initiating psychic tensions responsible for the creation of the sustained somatic muscle hypertonia have been adequately discharged, the retention of hypertonic muscular habit patterns may result in a steady state of bodily discomfort which the patient in time comes to regard as being normal for him. Such a patient will complain only of

exacerbations of his bodily discomfort when an old emotional or psychic tension is revived, or when he is exposed to a new emotional or psychic stress (25).

Psychogenically induced, sustained hypertonia of somatic muscle, when sufficiently intense, prolonged or repetitive, may cause the following symptoms and physical signs: fatigue, stiffness, aching, soreness, pain, paresthesias, limitation of joint movement, joint traumatization (including the evolution of the delayed post-traumatic articular syndrome), and, rarely, muscle spasm and muscle tremor. The symptoms and signs of psychogenically induced, sustained hypertonia of somatic muscle may vary from time to time in extensiveness, intensity, duration, repetitiveness, and are likely to be more severe when the environmental temperature is low than when it is high. In general, the more severe the patient's psychic tensions are, the more likely he is to experience irradiation of extensiveness, increased severity and increased awareness of symptoms of bodily discomfort and physical signs resulting directly or indirectly from psychogenically induced, sustained hypertonia of somatic muscle. Once symptom-producing, sustained hypertonia of somatic muscle has been initiated by psychogenic influence, it may be maintained through psychogenic influence and/or through self-exciting lower neuronal reflex arcs actuated by stimulation of afferent end organs within the substance of the contracting muscle itself and within the tendinous origins and insertions of the contracting muscle (137) (55) (242).

The validity of the concept that sustained hypertonia of somatic muscle may cause symptoms of discomfort has been established by others who used special techniques of study, including electromyography and procaine injections into the symptom-producing contracting muscles (242) (243) (217). In patients studied by the writer, the presence of sustained hypertonia of somatic muscle was inferred from characteristic symptoms and signs which were present when a sufficient degree of muscular hypertonia was present, and which were absent when this degree of sustained hypertonia disappeared.

COMMONLY OCCURRING SYMPTOMS OF REGIONALLY SUSTAINED HYPERTONIA OF SOMATIC MUSCLE

Skull Muscles (242). A patient with psychogenically induced, sustained hypertonia of the epicranial muscles may complain of sensations of pulling, heaviness, soreness, tightness, "tight band around the head," scalp discomfort on combing the hair, small painful areas of the scalp, crawling sensations, or headache. These symptoms may occur unilaterally or bilaterally, and may be limited to the occipital, temporal, parietal or frontal regions, or to any combination of these regions.

A patient with psychogenically induced, sustained hypertonia of jaw muscles may complain of aching or pain in the teeth, gums, temporomandibular joints, jaw muscles, and may be aware of clicking sounds or full sensations in his ears. He may find it difficult to open his jaws widely. A person with complete upper and lower dentures may complain "even my false teeth hurt," and a person with partial dentures often complains that he is unable to get a comfortable denture. Patients with sustained hypertonia of jaw muscles often have extensive clinical and x-ray studies of teeth, sinuses and temporomandibular joints, which are usually negative.

A patient with psychogenically induced, sustained hypertonia of facial muscles may complain that his face feels swollen, mask-like, frozen, stiff, tender or tight. He may have burning, crawling, or tingling sensations in the face. A patient who frowns constantly may complain of feeling pressure, discomfort or fullness in the region of the bridge of the nose and glabella. Symptoms referable to sustained contraction of the orbicularis oris and orbicularis oculi muscles are described below, under Sphincter Muscles.

A patient with psychogenically induced, sustained hypertonia of tongue muscles may complain that his tongue feels sore, "stiff as a board," tired, or "1ike a piece of raw

meat." Limited to the anterior and lateral aspects of the tongue there may be lingual pain, burning, tingling, abrasions (with or without secondary infection).

Neck Muscles (242). A patient with psychogenically induced, sustained hypertonia of neck muscles may have in the back of his neck, unilaterally or bilaterally, aching, pain, tightness, drawing sensations, pulling or burning sensations, with or without radiation of pain or discomfort upward toward the base of the skull and downward toward the upper thoracic spine. He may have stiffness and limitation of neck movement. With severe posterior neck pain there may be reflexly sustained, symptom-producing contraction of epicranial and facial muscles. Rarely, sustained hypertonia of anterior and posteri9r cervical muscles may cause symptoms suggestive of cervical radiculitis or of the scalenus anticus syndrome.

Sustained hypertonia of pharyngeal muscles may cause throat symptoms of tightness, soreness or dysphagia. Sometimes the patient will complain of pain limited to the region overlying the most lateral portions of the hyoid bone. Sustained hypertonia of intrinsic laryngeal muscles may cause the patient to complain of vocal fatigability, hoarseness, or poor control of voice (21). A patient with psychogenically induced, sustained hypertonia of pharyngeal, external laryngeal and anterior neck muscles may complain of a 'clump in the throat that can't be swallowed," and he may try to relieve his throat symptoms by repetitive swallowing, by clearing his throat or by brief, non-productive coughing.

Chest Muscles. A patient with or without coronary artery disease who has psychogenically induced, sustained hypertonia of chest muscles may complain of heaviness, pressure, or pain in his anterior chest. He may complain of pain or pressure limited to the left pectoral muscles, and report that these muscles feel bruised, although he can recall no antecedent external injury to this region. He may have pain along the insertion of diaphragmatic muscle into the thoracic wall, usually on the left side (240). Respiratory dysrhythmias (including the hyperventilation syndrome) (46) (209) may be associated with such symptoms of chest discomfort.

Abdominal Muscles. Symptom-producing, psychogenically induced, sustained hypertonia of abdominal muscles occurs rarely, and causes soreness, tenderness or a "bruised feeling" in the contracting muscles.

Thoracic and Lumbar Vertebral Muscles. A patient with psychogenically induced, sustained hypertonia of muscles of the thoracic and lumbar spine may complain of stiffness, pain, limitation of movement of the spine and, rarely, radicular pain (180).

Extremity Muscles. A patient with psychogenically induced, sustained hypertonia of somatic extremity muscles may have discomfort which seems to originate in joints, periarticular structures, tendons, muscles, or any combination of these structures. There may be limitation of articular movement, stiffness, awkwardness in the use of extremities, joint swelling and pain, as well as muscular fatigue, aching, soreness and pain. The patient may complain of dysequilibrium in waliiing when sustained hypertonia of somatic muscle is preponderanily localized to the right or left side of the body. When walking, he may complain of hip and knee pain, and of dragginess, heaviness and stiffness of his lower extremities which results from sustained hypertonia of opposing co-contracting thigh muscles. Tight crossing of thighs in the sitting position may produce immediate or delayed symptoms of discomfort in the thigh muscles at the site of muscle compression. A patient in crossing his knees may exert prolonged pressure on the common peroneal nerve of the overlying leg, producing paresthesias in the sensory distribution of the nerve, and the feeling that the ipsilateral foot is heavy; rarely, complete external peroneal nerve palsy may develop from this source. Some patients under emotional tension habitually and unconsciously dorsifiex the toes while wearing their ordinary footgear and develop discomfort in the foot and anterior region of the leg.

Sphincter Muscles. Psychogenically induced, sustained hypertonia of somatic sphincter muscles may cause a variety of symptoms, depending on the sphincter region involved; e.g., sustained hypertonia of the orbicularis oculi muscles may give rise to feelings of eyestrain, fatigue, discomfort, paresthesias of the lids, excessive blinking, and cephalgia. Sustained hypertonia of the orbicularis oris muscle (with or without sustained hypertonia of the masseter muscles) may cause labial sensations of tightness, swelling, pain, and paresthesias (particularly, tingling). Tight apposition of the inner surfaces of the lips against the labial surfaces of the teeth may cause the patient to complain of mucous membrane abrasions, with or without secondary infection. Sustained hypertonia of the urinary sphincter muscles may result in difficulty in starting the urinary stream. Sustained hypertonia of the vaginal sphincter muscles, with or without associated sustained hypertonia of other perineal muscles, may give rise to symptoms of vaginismus, vaginal paresthesias, dyspareunia. Sustained hypertonia of the somatic muscle of the anal sphincter (136), with or without associated sustained hypertonia of other perineal muscles, may cause constipation, sensations of incomplete evacuation of stool, rectal pain, and may be responsible for hemorrhoidal symptoms in certain individuals. Coccygeal pain and discomfort may arise from sustained hypertonia of the levator ani and other perineal muscles attaching to the coccyx.

COMMONLY OCCURRING PHYSICAL SIGNS OF PSYCHOGENICALLY INDUCED, SUSTAINED HYPERTONIA OF SOMATIC MUSCLE

Psychogenically induced, sustained hypertonia of somatic muscle is not regularly associated with small or large pupils, tachycardia or bradycardia, excessive sweating, dryness of the mouth or ptyalorrhea, muscle tremors, muscle spasm, nausea, diarrhea, polyuria, or elevation of blood pressure, although a patient with psychogenically induced, sustained hypertonia of somatic muscle who develops acute anxiety may have these somatic and visceral symptoms and sigus of vegetative nervous system imbalance (55) (133) (26) (241).

In general, with symptom-producing, psychogenically induced, sustained hypertonia of somatic muscle, the patient's sitting or standing posture, gait, body movements and mannerisms may appear tense, jerky, and not smoothly integrated. He may hold one shoulder higher than the other; he may keep one arm close to his body when sitting or walking, or he may hold both arms stiffly by his sides when walking. Occasionally he may walk with a stoop; more often, he walks stiff-kneed, with increased lumbar lordosis, increased dorsal kyphosis, with his neck in partial flexion and his head thrust forward (see page 88). Periodically, he may extend, flex and rotate his neck, and rub the back of his neck as if to get relief from neck discomfort. A patient may change his sitting position suddenly, or move his extremities suddenly from one position to another. Another type of patient may cross his thighs tightly when sitting and may sit rigidly, in a slouched position, with marked flexion of his spine in the thoracic and lumbar regions, without moving for long periods of time. One or both fists may be clenched for long periods of time. Tight grasping of objects (pens, pencils, knitting needles, papers, books) in the hands may be noted in persons with sustained hypertonia of somatic muscle.

The patient's facial expression often tends to be fixed, tense and relatively immobile. Smooth, well-integrated and spontaneous transitions from one facial expression to another do not readily occur, and transient grimacing or tic-like movements may precede changes in facial expression. Each time certain emotionally charged subjects are mentioned, the patient may present a stereotyped facial expression, or may blink frequently. A steady state of jaw muscle tension may be noted in some patients; in others, variations in jaw muscle tension may be noted when the mouth is closed and the patient alternately tenses and relaxes his jaw muscles. The patient may swall9w frequently, and at times rhythmically, once every 30 to 120 seconds, and have the usual consequences of excessive aerophagia (96).

In persons with sustained hypertoma of the orbicularis oris muscles, one may see abrasions on the dental surfaces of the lips, with or without secondary infection. There may be excessive attrition of the teeth; there may be indentations along the lateral margins of the tongue due to prolonged pressure of the tongue against the lingual surfaces of the teeth. In many patients, a leukoplakic line can be seen, usually bilaterally, on the buccal surfaces of the cheeks along the line of closure of the teeth. This may result either from habitual mouth suction, which draws a portion of the buccal inucous membrane within the region of closure of the opposing teeth, or from sustained contraction of the buccinator muscles which push a portion of this membrane within the region of closure of the opposing teeth. Dentures make relatively deep impressions in the supporting mucous membrane as a result of the patient's sustained jaw muscle contraction.

The patient may sigh frequently, and show other types of respiratory dysrhythmia. His voice may be poorly modulated. The rhythm of his speech may be jerky, there may be elision of syllables, and he may stutter (126). He may noisily clear his throat repetitively, or have a recurrent, brief, non-productive cough.

Palpation of somatic muscle in the apparently relaxed patient who has psychogenically sustained hypertonia may or may not reveal increased somatic muscle firmness. In some patients, the very act of palpating somatic muscle causes muscular hypertonicity to disappear for a short time after completion of the palpatory maneuver. In others, palpation increases the imtial degree of hypertonia. Palpation of hypertonic somatic muscle may reveal small, exceedingly tender islands of tissue - trigger spots (217) - and when these are palpated firmly, there is irradiation of pain to the substance of the entire muscle, reflexly to distant muscles, and to the nearest joint. This may be easily demonstrated in persons with habitual hyper tonia of the left pectoral muscles, in whom radiation of discomfort may be to the left shoulder and arm, and to the left side of the neck. Transient psychogenically induced, sustained hypertonia of abdominal muscles, which is usually present only in the recumbent position, may be sufficiently marked to render abdominal examination difficult. Resistance to alternate passive flexion and extension of extremity muscles may be the only physical sign of increased muscle tonus in the apparently relaxed patient who shows no evidence of organic central nervous system disease. The tendon reflexes are usually increased in amplitude, with a short latent period. Rebound contraction is often prominent. Sustained cocontraction in opposing muscles may be of sufficient degree to prevent visible reflex response to tendon tapping, but not palpable reflex contraction. In patients with sustained muscular hypertonia, ankle and patellar clonus, Hoffman and Babinski Sigus were not elicited. Occasionally, swaying in the Romberg position was noted when a patient had sustained hypertonia of somatic muscle, which was relatively greater in one half of the body than the other. Such persons may sway when walking, or may veer n6ticeably to one side.

It may be difficult to examine the palpebral conjunctivae because of marked hypertonia of the orbicularis oculi muscle. Because of sustained hypertonia of the orbicularis oris muscle (and buccinator muscle), lips may be hard to retract with a tongue blade in attempting to expose teeth and gingiva for inspection. In women patients, the introitus may be markedly narrowed by spasm of the vaginal sphincter muscles, and if digital examination is attempted, the patient will have severe pain and discomfort from this maneuver, and pelvic examination will be unsatisfactory. A simple, effective method of causing relaxation of the vaginal sphincter muscles is to ask the patient to relax her perianal muscles, which simultaneously causes vaginal sphincter muscles to relax. Rectal examination may be rendered difficult because of sustained hypertonia of muscles of the anal sphincter and pelvic floor. Spasm of these muscles may cause rectal examination to be a painful procedure for the patient, even though the gloved examining finger is adequately lubricated. Spasm of sphincter muscles may cause hemorrhoidal veins to become prominent.

TREATMENT OF PSYCHOGENICALLY INDUCED, SUSTAINED HYPERTONIA OF SOMATIC MUSCLE

Psychogenic symptoms were exceedingly prevalent in the group of patients studied, and for this reason the writer found it necessary to obtain a working knowledge of psychiatric principles and treatment, through study of available literature (122) (50) (100) (111) (66) (239) (181) (234) (235) (5) (156) (53) (18) (130) (133) (169) (170) (207) (124) (125) (4) (9) (13) (94) (237), and through careful evaluation of the effects of psychotherapy on patients whose emotional disorders were exteriorized through psychosomatic symptoms. Various methods of treatment of psychogenic syndromes were tested and adapted to the special needs of each patient so that he could be helped to become accustomed to dealing more directly, more realistically and more effectively with his problems of everyday living. The ultimate objectives of reconstructive psychotherapy of patients with emotional disorders and psychosomatic symptoms were to enable the patient to have, in time, freedom from his psychosomatic symptoms, the ability to solve his problems of living with greater efficiency and with more emotional maturity, and a sustained feeling of emotional and physical well-being. Sometimes, these therapeutic objectives could be attained only when the patient was referred to a competent psychiatrist for study and treatment. Sometimes, these therapeutic objectives were unattainable whether an internist or psychiatrist managed the patient's emotional disorder (83). Usually, the internist could successfully manage the patient's psychosomatic problems and attain the desired objectives (235) (156). Some patients were helped to resolve their presenting problems and to have relief of psychosomatic symptoms in a relatively short period of time; in other persons, the same degree of therapeutic success was achieved over a period of several years; and in other individuals, no sustained psychotherapeutic progress was maintained, and any benefit the patient had was chiefly from supportive psychotherapy.

It is usually possible to manage most of a patient's emotional problems which are exteriorized through psychosomatic symptoms, as an integral part of the general medical treatment of his joint dysfunction. A patient is most likely to have complete and lasting relief from a psychosomatic syndrome when the emotional tensions which initiated his psychogenic symptoms and signs are corrected by successful reconstructive psycho-therapy. Usually partial or temporary relief from psychosomatic syndromes may occur when the emotional tensions of the patient are lessened by helpful changes in his external environment or by supportive psychotherapy. In treating a patient with psychogenically induced, sustained hypertonia of somatic muscle, it is sometimes possible to alleviate collateral psychosomatic symptoms without improving the patient's primary emotional disorder (83) (see Case II, page 140), and when the patient feels more comfortable physically, he will have relief from his secondary anxiety concerning the meaning of his psychosomatic symptoms. Under such circumstances, his primary emotional disorder is likely to be more accessible to study and therapy.

Some psychogenic syndromes are collateral to aberrant physiology; e.g., athiaminosis (148), aniacinamidosis (206) (214) (127) (32), menopausal syndrome (121) (33), starvation (80), adrenal gland hypofunction (47). In most instances of this sort, when somatic dysfunction is corrected, the patient will have prompt recovery from collateral psychogenic syndromes; when such somatic dysfunction recurs, there will be a recurrence of the collateral psychogenic syndromes (208).

The patient with psychosomatic symptoms is usually unaware that there is a positive correlation between his emotional reactions to troublesome life situations and his symptoms of bodily discomfort, and he is likely to regard his known emotional problems and physical symptoms as representing two distinct and unrelated conditions. He usually believes that he has his emotional problems "under pretty good control" (169), and seeks medical advice for the relief of his symptoms of bodily discomfort. The patient's failure to perceive the reciprocal relationship between his emotional and

psychosomatic problems, and his preoccupation with psychosomatic symptoms seem to represent a type of unconscious adaptive adjustment which he has made to his emotional disorder so that he can maintain emotional homeostasis. Much supportive and preparatory psychotherapy may be required before a patient will be ready to accept reconstructive psychotherapy directed toward the solution of his basic emotional problems. When he attains sufficient insight into the nature of his presenting emotional and psychosomatic problems, he may be enabled to resolve these problems, and when he acquires habitually more mature methods of dealing with his problems of everyday living, he will have no further need for "protective" psychosomatic symptoms, which, consequently, often disappear.

Data concerning the patient's emotional life must be collected and evaluated as objectively and dispassionately as any other clinical data. In analyzing a patient's emotional attitudes and behavior, the internist must learn to recognize positive and negative transference phenomena and to understand their meaning (50) (4) (239). It is relatively easy for a physician to tolerate positive transference reactions as being "natural and proper," and to use them to good therapeutic advantage. However, it is relatively difficult for a physician to tolerate negative transference reactions with equanimity, unless he is prepared to seek the dynamic basis for such emotional behavior, and to manage such negative transference reactions so that they will not unduly hinder attainment of the desired therapeutic goals. Some-times, negative transference reactions are so intense that all attempts at therapy will fail. The physician must also become aware of his own positive and negative counter-transference reactions to a patient, and must learn to modify these as required by the best interests of the patient.

From information elicited during the course of clinical study, the physician can often detect certain basic, repetitive, and emotionally immature patterns in a patient's reactions to various life situations. A patient with emotional disorders and psychosomatic symptoms often has certain prevailing attitudes and derivative defense reactions which cause him to exhibit, without being aware of their existence, certain patterns of emotional behavior which are detrimental to him in his interpersonal relationships. When mental tensions generated directly or indirectly by such pervasive attitudes and their derivative defense reactions become sufficiently severe, the patient may complain of symptoms resulting from psychogenically induced, sustained hypertonia of somatic muscle or other psychogenic syndromes. The patient's awareness of psychosomatic symptoms supersedes his awareness of his primary emotional tensions and produces collateral anxiety concerning the meaning of his psychosomatic symptoms of bodily discomfort.

Before attempting to treat a person with psychosomatic symptoms, the physician should try to understand the background for the development and retention of the patient's emotionally immature attitudes. The physician should appreciate what difficulties the patient is likely to experience in trying to improve these attitudes and gain emotional maturity. Sometimes, by suffering from symptoms or an illness (psychosomatic), the patient may be making the best adjustment he can to a difficult life situation, and when this is so, the physician must realize that the patient may be better off with his symptoms and illness than without them, and in such instances psychotherapy should be chiefly supportive.

Psychotherapy of the patient starts when the patient and physician first meet, and continues throughout the course of treatment of joint dysfunction and associated non-psychogenic syndromes. Often, a patient derives positive psychotherapeutic benefits when his physical and emotional problems are delimited and a broad program of therapy is outlined for him by the physician. Occasionally, during the first visit a patient is able to gain insight into the dynamics of his most pressing emotional problems, and has considerable relief from some of his most pressing anxieties without any directed psychotherapy on the part of the physician other than the sympathetic elicitation of the

patient's history, the performance of a careful physical examination, and the subsequent detailed discussion by the physician of the patient's clinical problems and the proposed form of therapy. Sometimes, during the initial clinical study a patient will have almost immediate, and often lasting, relief from psychosomatic symptoms, without insight into the dynamics of his emotional problems, from the reassurance that he has no serious physical disease and that his symptoms of bodily discomfort are of emotional origin. Other patients seem to be uninterested, or disturbed by the objective analysis of their state of health, and either refuse to accept therapy as recommended, or prematurely discontinue therapy.

The technique of treatment of psychosomatic symptoms as described below is adapted to the specific needs of the individual patient with psychogenically induced, sustained hypertonia of somatic muscle.

During the course of the initial clinical study, the physician introduces the patient to the concept of psychosomatic illness by citing commonplace examples of psychosomatic reactions, selected so that they have no direct or immediate application to the patient's emotional disorder and so that they illustrate patterns of psychosomatic reactions which differ from those experienced by the patient. Usually, the patient accepts the validity of the general concept that emotional experiences may be accompanied by symptoms and signs of bodily dysfunction, and that these symptoms and signs are an involuntary consequence and accompaniment of underlying attitudes. Gradually, the physician modifies the discussion so that concepts of psychosomatic illness and treatment are described as they relate more directly to the patient's health problems. In order to give the patient a new point of departure in thinking of his psychosomatic illness as the exteriorization of his emotional tensions, clinical data obtained during the initial study of the patient (including his own description of his reactions to various life situations) are used to illustrate how his emotional behavior has been conditioned by certain pervasive attitudes and the derivative defenses of such attitudes. When this psychosomatic relationship is revealed to the patient in an objective manner by the physician, often the patient can perceive at once that the explanation of his illness is consistent with his subjective experiences and with reality.

The patient is told that his symptoms and signs resulting from psychogenically induced, sustained hypertonia of somatic muscle are not imaginary, and usually are not indicative of serious somatic disease. His psychosomatic symptoms and signs have physiological, anatomical and psychological bases, which are explained to him in simple terms. When the patient is seen in the physician's office to exhibit regionally sustained hypertonia of somatic muscle, this fact is called to his attention, not to embarrass him, but to make him aware that his sustained muscular hypertonia is objectively demonstrable. He is told that his symptoms and signs of psychogenically induced, sustained muscular hypertonia have deflected his attention from his troublesome initiating emotional tensions to his bodily dysfunction, with the result that he has new anxieties concerning the possible meaning of his psychosomatic symptoms and signs.

It is often useful in the exposition of the symptomatology of psychogenically induced, sustained hypertonia of somatic muscle to illustrate to the patient that considerable muscular and periarticular discomfort and pain can be induced by voluntary sustained contraction of somatic muscle. This is done through the use of the procedure described below, or some variation thereof. The patient is asked to abduct his right upper extremity until it is at right angles to the sagittal plane of the body. The palmar surface of his hand faces the floor. Without changing this position of the upper limb, the patient is asked to flex his wrist maximally and to make a fist. He is then asked to elongate his right upper extremity as much as possible, through sustained muscular contraction. Usually, within a few seconds of such sustained muscular contraction, he will experience discomfort and pain in muscles, tendons and periarticular structures of the wrist region, in the muscles of the forearm, and to a lesser extent in the elbow and

shoulder regions. He will often be astonished that his voluntary muscle contraction can produce such discomfort. During the period of voluntary sustained maximal contraction of upper extremity muscles, the sites of the patient's uncomfortable or painful sensations are tender to digital palpation, and feel tense. When the sustained muscular contraction is terminated by voluntary relaxation of the upper extremity muscles, the pain in the elbow region promptly lessens in intensity, although there may be some residual discomfort, for some time thereafter.

In addition, it can often be demonstrated to the patient that when he fixes his attention on a given anatomic region, he may have awareness of sensations which he would otherwise not perceive. The patient who has been seated for some time is asked whether or not he is conscious of any sensations from his buttocks pressing against the chair. Invariably, his initial answer is in the negative. He is then asked to concentrate his attention on any sensations which he may feel from his buttocks pressing against the chair. Most patients then report that they feel a sensation of increasing pressure on the buttocks, which reaches a maximum level of intensity which is often distinctly uncomfortable.

Typical examples are cited to illustrate that mental reactions can cause changes in bodily function, and, if these psychosomatic reactions are sufficiently persistent, changes in bodily structure. It is explained that persons with psychogenically induced, sustained hypertonia of somatic muscle are characterized by exteriorizing their emotional tensions through muscular contraction, which symbolically indicates readiness to perform certain defensive or offensive acts, together with sufficient concurrent inhibition to prevent execution of these acts. Persons with the syndrome of psychogenically induced, sustained hypertonia of somatic muscle usually harbor various degrees of repressed hostility, resentment, hatred or rage. When these feelings are directed against an individual whom the patient feels he should obey, respect, admire, love, or be grateful to, he develops guilt feelings which increase his tensions and make his symptoms more severe. The patient must understand that it is not unusual or "wrong" to have such mixed feelings. When the physician can verbalize some of the patient's destructive feelings, or when the patient can talk frankly and freely about his specific problems, without fear of censure by the physician, the patient may have relief from his emotional tensions.

Many patients are able to accept without resistance the idea that their somatic symptoms have a psychogenic basis. However, it is not unusual for a patient to exhibit some degree of resistance to the idea that his illness is a psychosomatic one, and the physician must be aware of the degree of such resistance, so that he can more effectively direct the subsequent course of treatment. When such resistance is mild or moderate, it does not interfere with successful treatment of the patient's psychosomatic disorder, since gradually the patient is able to find confirmation in his daily experiences of the psychosomatic nature of his disorder, and has relief from his psychosomatic symptoms when he is able to acquire and utilize habitually more mature attitudes in the solution of his problems of everyday living.

When a patient shows marked resistance to the suggestion that his ill-ness is a psychosomatic one, discussion of this subject is terminated for the time being by the physician with a reiteration of the nature of psychosomatic disorders in general. Subsequently, the treatment of such a patient is more or less limited to somatic aspects of disorders, and any improvement in the patient's emotional status is more or less fortuitous. In time, a number of patients who showed initially marked resistance to the concept of psychosomatic illness "discover" that they have certain symptoms or an increase in severity of symptoms only when they are exposed to situations which cause emotional tensions, and that their symptoms disappear or become less severe when they are not exposed to these types of situations. After a patient has made such a "discovery," he often becomes more amenable to treatment of his psychosomatic

symptoms and underlying emotional disorders, provided that the physician is willing to let the patient take full credit for having made original and informative observations concerning the nature of his psychosomatic problems.

The most substantial relief from psychogenically induced, sustained hypertonia of somatic muscle is afforded by successful treatment of the patient's emotional disorder. However, certain ancillary procedures have been found helpful in giving the patient some relief from his symptoms of psychogenically induced, sustained hypertonia of somatic muscle. The patient may find that his symptoms are lessened when he takes a vacation; when he can interest himself in hobbies, sports, or in civic, social or church activities; or, when there is an external solution to his problems. Patients may be benefited when they are helped to schedule periods of work, exercise, rest and recreation, so that they can expend their physical and emotional energies without developing excessive physical or emotional fatigue. Sometimes, it is necessary to poit out to a patient the deleterious effects of indecision, worry and day-dreaming, and to assist him to establish better habits of thinking. Generalized muscular relaxation can be induced by tepid baths of 20-30 minutes' duration, or by the application of the methods of progressive relaxation (87). The local use of dry heat or the use of hot massive wet dressings applied for 30 minutes several times during the day are helpful in the relaxation of psychogenically induced, sustained hypertonia in certain muscular regions; e.g., posterior cervical region, pectoral muscles, shoulders. Some patients may have relief from symptoms described above only when they do strenuous physical work. In acute tensional situations, the judicious use of medications (e.g., phenobarbital, belladonna, dexedrine, aspirin) for a limited period of time may be helpful.

SOME EXAMPLES OF PSYCHOGENICALLY SUSTAINED MUSCULAR HYPERTONIA AND ITS RESPONSE TO TREATMENT

CASE FF. Pain in the Neck. A 63-year-old manufacturer was recovering satisfactorily from joint dysfunction in response to adequate niacinamide therapy until he suddenly developed, in the back of his neck, severe pain which radiated into his upper thoracic spine. After this pain persisted for a week, he sought medical advice. He could recall no injury to his cervical spine. Physical examination revealed a decrease in the range of lateral rotation of the neck as compared to previous measurements, and tenderness and firmness of posterior neck muscles. When asked if anything was disturbing him, he stated that a few days before his neck pain started, one of his salesmen had promised his best customer delivery of goods at a date which could not be met and at a price that was far too low. The manufacturer was sure that he would lose his best customer, and was furious with his salesman, whom he planned to fire. "To top it all," he said, "the pain in my neck has been so bad I can't even think straight."

The probable relationship between his emotional tensions and the pain in his neck was explained to him, and in discussing his problems, it was suggested that he might meet with his customer and salesman in order to correct the error. This was done, and a satisfactory solution was evolved. The customer accepted the explanation; the salesman kept his job; and the manufacturer lost his pain in the neck. Three months later, the lateral ranges of neck movement had increased to the level of movement which he had before the joints of the cervical spine were injured by psychogenically induced, sustained hypertonia of neck muscles.

CASE CC. Painful Hands. A 50-year-old unmarried female office manager was recovering satisfactorily from joint dysfunction in response to adequate niacinamide therapy, until she developed painful swelling and stiffness of her fingers, which became progressively worse over a period of four months. She had not performed any unusual physical tasks which might have injured her finger joints. Measurement of the ranges of joint movement showed that all her joints had improved excepting her finger joints, which showed decreased ranges of movement. Her finger joints were markedly swollen, and felt somewhat warm to the touch, but were not red.

When asked if anything was upsetting her emotionally, she said she was afraid she might lose her job. Without consulting her, her superior had employed a young college graduate as assistant office manager, and the patient felt that this girl might replace her as office manager. She thought the new worker was cold, unfriendly and efficient, and was annoyed that the girl had already made several suggestions about improving office procedures. As she talked about the assistant office manager, her hands were clenched tightly. When asked what she would like to do to the girl, she said promptly, "I'd like to shake the living daylights out of her." This confession surprised her. When it was indicated that she looked upon the girl as a threat to her economic and emotional security, she realized that this was so. By clenching her hands tightly she was symbolically attacking her assistant, but actually she was injuring her hands by psychogenically induced, sustained hypertonia of forearm muscles. For temporary relief, she was asked to soak her hands in hot epsom salt solution for 30 minutes three or four times a day, and to try to avoid consciously clenching her hands. For more lasting relief, it would be necessary for her to overcome her intense feelings of hostility toward the girl, which came out of her own fear of insecurity. Probably, she was told, the assistant manager also felt insecure in her new position and wanted to please her manager.

A month later this patient reported that her hands gave her no discomfort, and were not swollen, although they still felt a little stiff. She had decided to take an interest in the assistant office manager and had had lunch with her several times. She thought that the assistant was a "swell person." The fact that she had learned that the girl planned to get married and leave the job in about a year undoubtedly had a great deal to do with her apparent improvement in her previously hostile attitude.

CASE HH. Generalized Sustained Muscular Hypertonia. A 38-year-old assistant factory supervisor suffered for years from constant fatigue and from discomfort and pain in his muscles and joints, which had not responded to medical treatment. Physical examination indicated that he had extremely severe joint dysfunction, and severe generalized sustained hypertonia of somatic muscle. He said that he had difficulty at work in getting along with his superiors, but not with his subordinates. He complained that younger men were promoted over his head, but solaced himself with the thought that this was because he had a mind of his own, and "stood up to" his superiors, who were "down on" him for this reason. When questioned about his childhood, he related that his father was frequently drunk, and was always strict with him, punishing him severely for the most trivial offenses. He was an obedient child, but secretly hated his father.

It was pointed out to the patient that the hostility he had originally directed against his father was unconsciously being directed against all persons in authority. The unconscious fear that his subordinates might feel hostile toward him caused him to be over-kind to them. When he showed marked resistance to the explanation that his psychosomatic symptoms were the result of his basic attitude of repressed hostility toward persons in authority, this subject was dropped and treatment for his joint dysfunction was instituted. He had strong resistance to niacinamide therapy, and did not take his medications as directed - which was interpreted as being another expression of resistance to a person in authority - in this case, the physician.

When he returned for a semi-annual recheck examination, he had become much more aware of his hostility toward his superiors, and was gradually succeeding in improving his attitudes toward them. He had his first promotion in years, which surprised him and encouraged him further. He had lost his articular and non-articular symptoms of generalized psychogenically induced, sustained hypertonia of somatic muscle, and had become completely free from his excessive fatigue and symptoms of severe bodily discomfort. His joint dysfunction had not improved because he felt so well that he thought it unnecessary to take medications of any sort.

CASE II. Excessive Aerophagia. A 44-year-old, unmarried traveling salesman complained of belching, passing much gas rectally, bloating, and a feeling that all the food he ate "turned to gas." His symptoms were most severe on weekends, when he was at home with his widowed mother. Not uncommonly during the weekend, he would wake at 2 A.M. with left upper abdominal pain radiating into his left lower anterior and anterolateral chest and lasting for several hours. He would try to get relief by belching and by taking antacids, but had little relief from these procedures. Enemas tended to make him feel faint and gave him severe abdominal cramps. He was sure that he had serious stomach or heart disease, even though serial electrocardiograms, gall-bladder and gastro-intestinal studies per-formed over a period of years were negative. He denied having emotional problems, would not discuss his relationship with his mother, and said that everything in his life was fine excepting for the gas.

In the office, he was observed to have rhythmic aerophagia at 20-second intervals, and to belch about every five minutes. His submental muscles were palpably tense, but he had no other evidence of psychogenically induced, sustained hypertonia of somatic muscle. His distended abdomen was tympanitic to percussion; borborygmi were heard; the large intestine could be outlined by palpation. Fluoroscopy showed a large gas bubble in his stomach, and relatively little movement of the left leaf of the diaphragm with respiration.

The patient was told that symptoms such as he had were usually the result of excessive aerophagia, emotionally induced. He showed such marked resistance to the idea that his symptoms could be initiated by emotional factors that subsequent discussion was confined to an explanation of the dynamics of the production of somatic symptoms by excessive aerophagia, and a description of the method of inhibiting his frequently recur-ring swallowing reflex. He was asked to hold between his teeth, for 20 minutes at a time four or five times daily, a cork which was sufficiently large to prevent him from swallowing. If he salivated during this procedure, he was not to swallow his saliva but to let it drain out of his mouth, catching it in a towel; if he wanted to belch, he might do so, without removing the cork from his mouth.

For one month, he used this method of inhibiting his frequently recurring, rhythmic air-swallowing reflex, and reported that he no longer had trouble with "gas." In the office, at this time he was seen to swallow about once every 10 minutes, and did not belch once during a one-hour period of observation. The patient was pleased to have been "cured" of his trouble, and stated that his "gas" could not have been caused by emotional tensions which were unresolved, since he had the same emotional problems which he had had for years, which could not be relieved in a satisfactory way as long as a "certain person" was alive. He would not discuss this subject further.

Subsequently, he has been seen over a period of several years without any recurrence of his excessive aerophagia. When asked about the status of his emotional problems from time to time in this interval, he says "No change."

(End of Chapter 2. References cited in this chapter are posted at http://www.doctoryourself.com/kaufman11.html)

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CHAPTER 3
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THE COMMON FORM OF JOINT DYSFUNCTION
by William Kaufman, M.D., Ph.D. (1949)

Edited by Andrew W. Saul

(Dr. Kaufman's practical recommendations for case management is summarized in this short chapter. References cited in this chapter are posted at http://www.doctoryourself.com/kaufman11.html *)*

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Coordination of Treatment of Joint Dysfunction and the Four Complicating Syndromes

In previous sections, joint dysfunction and the four complicating syndromes were described as if they occurred separately. Although joint dysfunction may occur alone, it frequently occurs in association with one or more of the four complicating syndromes.

Even though a patient's Joint Range Index has been therapeutically elevated to 96-100 (no joint dysfunction), he may still have one or more of the complicating syndromes, which require successful treatment if he is to feel well.

The treatment of joint dysfunction and the four complicating syndromes is time-consuming by ordinary standards. The initial clinical study of the patient, which is performed in one session, may require as long as six hours. After the initial visit, the patient and physician meet at monthly intervals, and when the patient's problems appear to be resolving satisfactorily in response to therapy, the office visits are scheduled at two-, three- and four-month intervals; each visit may require as long as one and a half hours, depending on the patient's clinical problems. Within this schedule of office visits, it is possible to work out the various problems of the patient with joint dysfunction and the four complicating syndromes without causing the patient to become excessively dependent on the physician. It is necessary to keep accurate and detailed clinical records.

The differential diagnosis of the four commonly occurring complicating syndromes may be relatively easy, or extremely difficult. In some patients, when the four syndromes exist as apparently independent clinical entities, the successful treatment of any one syndrome does not influence the remaining syndromes, and all four syndromes must be treated successfully if the patient is to feel well. In other patients, the four complicating syndromes may appear to be interrelated as primary and collateral conditions, and the successful treatment of the primary syndrome also affords relief from the collateral syndromes. Thus, it may be necessary for the physician to recognize which of the patient's complicating syndromes are primary and which are secondary, and to treat the primary syndrome(s) first. For example, a patient with the chronic allergic pain syndrome may have collateral anxiety about the meaning of his symptoms, which generates psychogenically induced, sustained hypertonia of somatic muscle; this in turn causes the delayed post-traumatic articular syndrome; additionally, the chronic food allergy may cause some degree of excessive sodium retention. The elimination of the offending food from the patient's diet will correct his allergic pain syndrome, and will also relieve his anxiety and collateral complicating syndromes (psychogenically induced, sustained hypertonia of somatic muscle, delayed post-traumatic articular syndrome, and sodium retention syndrome). Treatment in this instance of any or all of the collateral syndromes will give the patient little or no benefit if the chronic allergic pain syndrome remains uncorrected.

Even though the patient's initial complicating syndromes are corrected, he may have at any time a recurrence of these syndromes, or he may develop for the first time any other complicating

syndromes or diseases. Such changes in the patient's clinical status require appropriate study and treatment.

The presence or absence of joint dysfunction can be ascertained from the determination of the Joint Range Index. The presence or absence of the four complicating syndromes may be apparent at once to the physician upon completion of the initial clinical study, or the diagnosis must be tentative, pending further study, including observation of the patient's response to a trial of therapy. The diagnostic conclusions derived from studying a patient by the methods outlined in previous sections may be conveniently summarized in the form suggested below, and must be revised from time to time to describe the patient's current clinical status.

I. Joint Dysfunction:

No joint dysfunction 96-100 Joint Range Index
Slight joint dysfunction 86-95
Moderate joint dysfunction 71-85
Severe joint dysfunction 56-70
Extremely severe joint dysfunction 55 or less

With or without clinically obvious arthritis: Regional or generalized; Hypertrophic, rheumatoid, or mixed

With or without x-ray signs of arthritis: Regional or generalized; Hypertrophic, rheumatoid, or mixed

II. Delayed Post-Traumatic Articular Syndrome

III. Chronic Allergic Syndromes (Pain, Fatigue, or Mental)

IV. Sodium Retention Syndrome

V. Psychogenically Induced, Sustained Hypertonia of Somatic Muscle (With or without other psychogenic syndromes.)

Note: The terms "psychogenic rheumatism" and "psychosomatic rheumatism" (15) (16) (52) (67) (68) (78) (86) (89) (91) (98) (123) (248) are not employed in this classification since it is thought that these terms, as commonly used today, indicate a clinical complex consisting of certain identifiable elements: joint dysfunction, delayed post-traumatic articular syndrome, psychogenically induced, sustained hypertonia of somatic muscle, and, often, the chronic allergic syndromes and the sodium retention syndrome.

The four complicating syndromes may be further classified according to degree of severity (slight, moderate, severe, and extremely severe); according to duration (short, moderate, or long; with or without short, moderate, or long intervals of freedom from symptoms; with or without short, moderate or long intervals of accentuation of symptoms; with or without a steady state of symptoms).

A method for coordinating the treatment of joint dysfunction and the four commonly occurring complicating syndromes makes it possible to study and treat these conditions concurrently. Therapeutic strategy must be flexible enough so that it can be modified as necessary in order to attain the desired therapeutic goals. Every effort is made to find and treat any correctable conditions which may coexist with joint dysfunction and the four complicating syndromes.

At the time of the initial clinical study, the patient with joint dysfunction is given that dosage schedule of niacinamide which is likely to cause satisfactory improvement in his joint dysfunction. When he is re-examined subsequently, the dosage level of niacinamide may be increased, if necessary, to permit further recovery from joint dysfunction to continue at a satisfactory rate.

Psychotherapy starts when the patient and physician first meet, and continues during the course of treatment for joint dysfunction, being supportive, preparatory, or reconstructive, according to the needs of the patient.

If a patient appears to have the delayed post-traumatic articular syndrome, the development of this pattern of symptoms is carefully explained to him, and he is advised how to

as a consequence of psychogenically induced, sustained hypertonia of somatic muscle is explained, and appropriate psychotherapy is administered.

The patient is asked to keep a food-symptom diary, which is examined at monthly intervals. The diary has often been useful in giving clear-cut evidence to the patient of the effects of emotional, allergic, and traumatic conditions on his health. When this diary indicates that the patient's protein intake is inadequate, he is advised to increase his protein intake. When he seems to have chronic allergic food reactions, the offending foods are identified, and he is asked to eliminate them from his diet. If he seems to have the sodium retention syndrome, he is asked to limit the sodium content of his diet and to increase his water intake, and if necessary enteric coated ammonium chloride tablets may be prescribed.

During the course of treatment of a patient who has joint dysfunction and the four commonly occurring complicating syndromes, the patient is told how his illness came into being, why it persisted, and how he can recover from his illness. When he understands the basis of his symptoms, a patient is often able to recognize the cause of symptoms as they occur, and to prevent further recurrences of symptoms. While the patient is not encouraged to deviate from the recommended program of therapy, when deviations occur they serve to instruct both the patient and physician, since they constitute a check on the correctness of the diagnosis and recommended treatment.

Thus, the patient is, in effect, testing in reality the validity of the physician's analysis of his problems, by prematurely dropping adequate niacinamide therapy, by eating offending foods, by regressing to a more immature emotional level, by injuring his joints in the performance of excessively strenuous physical activity, or by ingesting excessive amounts of sodium-containing materials. From such deviations from the suggested therapeutic program, the patient often learns by experience that the recommendations made by the physician are not arbitrary, but are necessitated by the nature of his illness, and thereafter the patient is much more likely to cooperate as directed.

Although the desired goal is the solution of the patient's clinical problems through proper analysis of his illness, and application of corrective therapy, palliative remedies are used when necessary to give the patient relief from his troublesome symptoms.

The patient is always encouraged to live as active and as full a life as is possible, without subjecting his joints to excessive mechanical injury.

(End of Chapter 3. References cited in this chapter are posted at http://www.doctoryourself.com/kaufman11.html)

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Joint Dysfunction 4 Home

CHAPTER 4
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THE COMMON FORM OF JOINT DYSFUNCTION
by William Kaufman, M.D., Ph.D. (1949)

Edited by Andrew W. Saul

(Dr. Kaufman kept meticulous patient records which support megavitamin therapy with niacinamide. This 42-page chapter of statistical analysis contains 53 charts, tables, and graphs, which are not reproduced here. They are to be seen in the original book, sometimes available on the rare used book market.)

Analysis of Certain Clinical Data for the Untreated and Treated Population

In this section, it will be seen from analysis of the Joint Range Indices of the untreated population that joint dysfunction in various clinical grades of severity is of common occurrence, and tends to increase in severity with increasing age. The grouped data show that, in general, the more severe the clinical grade of joint dysfunction, the more likely the patient is to have certain articular symptoms and signs, and the higher his Sedimentation Rate Index is likely to be. In general, untreated females are more likely to have certain articular symptoms and signs, and are more likely to have higher sedimentation rate indices than untreated males. It will further be demonstrated by an analysis of the grouped data that with niacinamide therapy (alone or in combination with other vitamins), there is a rise in the Joint Range Indices of the treated population. In general, the longer the duration of niacinamide treatment, the higher is the rise in the Joint Range Indices of the treated population.

The grouped data are arranged in the following manner:

Series 1. The presentation and analysis of certain data pertaining to the untreated population.

The population groups of Series 2,3 and 4 are composed of selected sub-groupings of the total untreated population who accepted niacinamide therapy for various periods of time, whether or not they adhered strictly to the prescribed dosage schedule of niacinamide (alone or in combination with other vitamins).

Series 2. The presentation and analysis of the Joint Range Indices of 266 male and female patients before niacinamide therapy, and after less than two months of niacinamide therapy.

Series 3. The presentation and analysis of the Joint Range Indices of maxi-mal Joint Range Indices after various periods of therapy (compiled Sep-tember 1, 1947). This series includes the Joint Range Indices of all patients who returned for one or more re-examinations.

Series 4. The analysis of the Joint Range Indices of 367 male and female patients before niacinamide therapy and their maximal Joint Range In-dices after various periods of niacinamide therapy (compiled September 1, 1948). This series includes the Joint Range Indices of all patients who re-turned for one or more re-examinations.

(End of introductory comments [p 146-7] for Chapter 4. Annotated charts, tables, and graphs constitute the next 40 pages [p 148-188] of *The Common Form of Joint Dysfunction*.

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AN IMPORTANT NOTE: This page is not in any way offered as prescription, diagnosis nor treatment for any disease, illness, infirmity or physical condition. Any form of self-treatment or alternative health program necessarily must involve an individual's acceptance of some risk, and no one should assume otherwise. Persons needing medical care should obtain it from a physician. Consult your doctor before making any health decision.

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CHAPTER 5
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THE COMMON FORM OF JOINT DYSFUNCTION
by William Kaufman, M.D., Ph.D. (1949)

Edited by Andrew W. Saul

Some Inferences Concerning Joint Dysfunction

(Dr. Kaufman, writing in 1949, shows remarkable foresight half a century into the future of orthomolecular (megavitamin) medicine. In this chapter, he describes how the lack of a single nutrient can cause diverse diseases; the need for a new way of looking at arthritis, and reviews his treatment and what level of success to expect with it.)

References cited are posted at this link: http://www.doctoryourself.com/kaufman11.html

It has been shown that the clinical diagnosis of joint dysfunction and the clinical classification of the severity of joint dysfunction are made on the basis of an objective criterion, the Joint Range Index, which is the weighted mean of the numerical values obtained upon measurement of 20 specified joint ranges. Measurement of the Joint Range Indices of an unselected, untreated population of 455 ambulatory male and female patients, 4 to 78 years of age, subsisting on the average American diet of 1945 to 1947, demonstrated that joint dysfunction, as defined by a Joint Range Index of less than 96, was almost universal in occurrence, and was present in individuals with or without complaints referable to muscles and joints, and with or without clinically obvious rheumatoid arthritis or clinically obvious hypertrophic arthritis. The decline of the means of the Joint Range Indices for each succeeding 5-year age group was practically linear in the untreated population, indicating that joint dysfunction tends to increase in severity with increasing age, although within any 5-year age group there are individual variations in the numerical values of the Joint Range Indices which can best be seen in Table 1G. Usually, in the more severe clinical grades of joint dysfunction, clinically obvious rheumatoid and hypertrophic arthritis are commonly found. It has been observed that a person less than 40 years of age with a severe or extremely severe clinical grade of joint dysfunction is more likely to have rheumatoid than hypertrophic arthritis, and that a person more than 50 years of age with a severe or extremely severe clinical grade of joint dysfunction is more likely to have hypertrophic than rheumatoid arthritis. However, a person with mild, moderate or severe joint dysfunction may show no evidence of either hypertrophic or rheumatoid arthritis, or a person with slight joint dysfunction may have local evidences of hypertrophic arthritis (Heberden's nodes) and no other clinical evidence of arthritis.

During the first month of adequate therapy with niacinamide (alone or in combination with other vitamins) a patient with joint dysfunction (with or without rheumatoid or hypertrophic arthritis) will have a rise in the Joint Range Index of at least 6-12 points, and thereafter will have a rise of at least 0.5 to 1 point per month of adequate niacinamide therapy, provided he eats the average American diet containing adequate calories and sufficient protein, and provided he does not mechanically injure his joints excessively. **This improvement in joint mobility occurs regardless of the age or sex of the patient, and regardless of whatever other health problems he may have.** Subsequently, with continuously adequate niacinamide therapy, the Joint Range Index of 96-100 (no joint dysfunction) is reached, and **maintenance doses of niacinamide are required** to keep the Joint Range Index at this level.

The only observed exception to the attainment in time of a Joint Range Index of 96-100 with prolonged adequate niacinamide therapy occurs in persons who have ankylosed joints which have not regained any mobility in response to adequate niacinamide therapy. In such persons with one or more ankylosed joints, the rise in the Joint Range Index with adequate prolonged niacinamide therapy is the same as the patterns described above, although in time serially rising values of the Joint Range Index may stabilize at a level below 96, which represents the maximal Joint Range Index attainable by the patient when the ankylosed joints do not regain full mobility in response to prolonged adequate niacinamide therapy, even though all the other joints measured

for computation of the Joint Range Index can be moved through their full ranges; e.g., if one wrist joint is irreversibly ankylosed, the highest attainable Joint Range Index is 90.9. As has been previously noted, some joints which initially appear to be clinically ankylosed, in time regain their full ranges of movement in response to prolonged adequate niacinamide therapy.

Therapeutically induced improvement in joint mobility, as shown by increasing values of the Joint Range Index, cannot be maintained without continuously adequate niacinamide therapy. When adequate niacinamide therapy is discontinued, there is a regression in the Joint Range Index from the therapeutically improved value to the pre-treatment value. When niacinamide intake is reduced from adequate to inadequate levels, the Joint Range Index decreases and stabilizes at a level above the pre-treatment level and below the maximum level therapeutically achieved.

In this study, in the various case histories it has been shown that joint mobility of patients with either hypertrophic arthritis or rheumatoid arthritis improves in response to the administration of adequate niacinamide therapy. In addition, certain other benefits have been observed from this therapy, most of which are not susceptible of objective measurement. In both hypertrophic arthritis and rheumatoid arthritis, these benefits include a feeling of being more alert, more vigorous, tiring less easily, an increased sense of well-being. The patient may lose certain minor digestive complaints such as constipation and abdominal bloating. Aches, pains and stiffness in muscles and joints gradually disappear, and his joints seem to be injured less easily by mechanical trauma. Crepitus becomes less noticeable, and eventually disappears. The physician may note that the patient appears younger, that his color is improved, his skin is more elastic, and that his tongue shows improvement in mucous membrane morphology. Liver tenderness and enlargement may disappear. Hemoglobin levels tend to improve. Joint mobility improves, joint deformities occasionally resolve, and impaired muscle strength tends to improve (54) (141).

Not all patients with rheumatoid arthritis recover at the same rate from the signs and symptoms of rheumatoid arthritis in response to prolonged adequate niacinamide therapy. In the early stage of rheumatoid arthritis (prodromal period), there is prompt resolution of the patient's symptoms and signs. In the intermediate stage of rheumatoid arthritis (active acute rheumatoid arthritis) there is a slower resolution of the symptoms and clinical signs of this disorder, not unlike that described in Case E, page 46. In the late stages of rheumatoid arthritis (advanced chronic rheumatoid arthritis), there may be so much retrogressive tissue alteration in nonarticular as well as articular tissues, that complete functional and structural recovery may not be possible, even with prolonged niacinamide therapy. Resolution of the clinical signs and symptoms of late rheumatoid arthritis is exceedingly slow, and not unlike that described in Case V, page 39.

Especially noticeable in patients with rheumatoid arthritis who are receiving adequate niacinamide therapy is improvement in appetite, with concomitant gain in weight, recovery from many nervous and mental symptoms, gradual disappearance of muscle atrophy, and improvement of muscular strength; usually, also, the anemia is corrected, the sedimentation rate index decreases to the normal range, and subcutaneous nodules tend to disappear.

At the present time, no explanation can be given to account for the biodynamic mechanism of niacinamide4nduced improvements in persons with joint dysfunction. However, in both hypertrophic arthritis and rheumatoid arthritis, articular and non-articular improvements continue for as long as the patient's niacinamide intake remains adequate, and they tend to fade away when inadequate niacinamide therapy is substituted for adequate niacinamide therapy, or when niacinamide therapy is discontinued.

Most writers have considered hypertrophic arthritis and rheumatoid arthritis to be two distinct clinical entities (147) (33) (121) (195) (196) (197) (198) (161) (79) (12). Hypertrophic arthritis has been considered to be a degenerative joint disease, and rheumatoid arthritis has been considered to be a generalized disease of the entire body, of unknown etiology (57) (58) (132) (134) (145) (227) (228) (229) (230) (231) (28) (77) (140). From this work, no proof can be given for or against the theory that niacinamide tissue deficiency disease is a prime mover in the evolution of both hypertrophic arthritis and rheumatoid arthritis. It should be realized, however, that **merely because hypertrophic arthritis and rheumatoid arthritis are different clinical entities, one cannot exclude the possibility that they may be caused by the same etiologic agent, acting in different ways.** For example, in experimental animals, it has been shown that **the lack of a single essential nutriment can produce a variety of dissimilar clinical disorders in different individuals** of the same species. However, without knowledge of the animals previous nutritional history, one might not suspect that the same etiologic factor, lack of a specific essential nutrient, was responsible for each of the various clinical syndromes of the same tissue deficiency disease which is permitted to develop at different rates in different individuals of the same species. For example, "two distinct syndromes of ascorbic acid deficiency have been observed in the Rhesus monkey depending on whether the deficiency was acute or chronic. An acute deficiency was

lesions. A chronic deficiency was characterized by severe gingival lesions and skeletal changes but no rapid decrease in weight" (192). Similarly, marked differences exist between the clinical manifestations of acute and subacute athiaminosis.

When monkeys were made completely deficient in thiamin, an acute athiaminosis was produced, and "death occurred before any outstanding clinical symptoms or marked histological degeneration of nerves set in." When monkeys were given about one-half of the needed thiamin, subacute athiaminosis ensued, and there were "clinical signs of polyneuritis and cardiac failure, autopsy findings of peripheral nerve degeneration and hydropericardium" (115).

Although it may appear from this study that niacinamide has a high degree of specificity in the reversal of the metabolic processes which permit joint dysfunction to evolve, it may well be that a number of other therapeutic agents may influence these metabolic processes in the same direction and to the same extent that niacinamide does. Future clinical studies may indicate that there exist substances other than niacinamide which can produce therapeutic effects which equal or surpass those obtained in response to prolonged adequate niacinamide therapy in the treatment of persons with joint dysfunction. (Editor's note: Vitamin C is one such substance.)

In the treatment of joint dysfunction in the future there may be clinical applicability of the findings of recent studies concerning the metabolism of niacin under a variety of experimental conditions and in different species of experimental animals (238) (178) (176) (177) (90) (69) (70) (44) (45) (112) (120). (In most of these laboratory studies, niacin rather than niacinamide was administered to experimental animals. While there are certain differences in the biologic utilization of niacin and niacinamide (71) (82) (69) (70), there are sufficient similarities to suggest that biologic utilization of niacin and niacinamide for many metabolic purposes might not be dissimilar, and thus many of the findings that hold true for niacin may also hold true for niacinamide.)

In these studies, certain metabolic interrelationships between niacin, tryptophane, protein, amino acids, pyridoxine and 3-hydroxyanthranilic acid have been discovered (201) (202) (188) (186) (179) (173) (162) (129) (101) (102) (103) (72) (92) (76) (42) (24)

(1). It has been found that when a niacin-deficient animal is fed a sufficient amount of tryptophane, the animal is cured of its niacin deficiency, and increased amounts of niacin-containing molecules appear in the animal's urine. For this reason, naturally occurring tryptophane is thought to be a biological precursor of niacin. In the rat, 50 mg. of tryptophane is the equivalent of 1.0 to 1.5 mg of niacin or niacinamide. In the biotransformation of tryptophane to niacin, 3-hydroxyanthranilic acid is an intermediary compound which is capable of replacing tryptophane in the biosynthesis of niacin and niacinamide (129). It has been found that the amount and type of protein the animal is fed determine the amount of niacin or tryptophane needed by the animal to prevent a niacin deficiency disease, and that a naturally occurring protein (gelatin) (20) and certain naturally occurring amino acids (especially threonine) can inhibit or nullify the effect of niacin or tryptophane in the diet; similarly, other naturally occurring materials (especially corn) (247) (205) and certain synthetic molecules (244) (245) (246) may effectively block the metabolic action of niacin or tryptophane. The level of pyridoxine nutrition also influences the metabolic pathways by which niacin and tryptophane are utilized (204) (185) (187) (163) (146) (116) (119) (7) (11).

Many diverse types of investigation in humans and in suitable experimental animals remain to be carried out in order to determine the exact nature of the biochemical, metabolic and morphologic changes occurring as a result of the ingestion of different amounts of niacinamide for short or long periods of time. Such studies could evaluate (a) any differences which might exist in the biochemistry of persons with different grades of joint dysfunction, (b) the effect of adequate niacinamide ingestion on the biochemistry of persons with joint dysfunction who are eating a standard diet and are performing a standard daily amount of physical exercise; (c) any sex differences which might exist in biochemical reactivity to niacinamide therapy; (d) the maximal safe doses of niacinamide therapy which would cause optimal improvement in joint dysfunction; (e) various therapeutic agents which have been shown to be capable of replacing niacinamide in animal studies; (f) various conditions which have been found to enhance the effectiveness of niacinamide in animals; and (g) various nutritional conditions which have been found to inhibit the action of niacinamide in animals.

In addition, it would be desirable (a) to study the effects of continuous niacinamide therapy on the biochemical, metabolic and morphologic properties of articular structures in various animal species including bovine animals which are subject to spontaneously occurring hypertrophic arthritis with increasing age (225); (b) to study the distribution of niacinamide in articular structures of experimental animals through the use of tagged molecules (isotopic and radioactive)

(85) (17) (212) (164); and (c) to produce graded sub-acute and chronic aniacinamidosis in experimental animals and to study articular structures at various time intervals (244).

While such animal studies and specialized chemical and metabolic studies in humans may prove fruitful in elucidating the mechanisms which permit joint dysfunction to evolve in an untreated population, and to be corrected by niacinamide therapy, from a practical point of view it has been demonstrated that the progressive impairment in joint mobility with advancing age, which has been accepted in the past as an inevitable concomitant of the normal aging process, can be corrected or ameliorated by prolonged adequate niacinamide therapy. In addition, it seems not unreasonable to suppose that the evolution of the common form of joint dysfunction can be prevented by adequate niacinamide supplementation of an adequate diet throughout the lifetime of an individual.

(End of Chapter 5, and of the book. 248 references follow in the Bibliography, which is posted at this link: http://www.doctoryourself.com/kaufman11.html)

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Author's Preface

This monograph records certain clinical observations which I have made over a period of years in the course of the private practice of internal medicine. As will be demonstrated by objective measurement, joint dysfunction (impaired joint mobility) was exceedingly prevalent among the patients studied. It will be seen that the common form of joint dysfunction was corrected or ameliorated in time by adequate niacinamide therapy, and recurred in time when adequate niacinamide therapy was discontinued.

While the diagnosis and treatment of uncomplicated joint dysfunction presented few difficulties, the patient with joint dysfunction often was troubled by the articular and non-articular symptoms of four commonly occurring complicating syndromes which required successful therapy concurrently with the niacinamide treatment of joint dysfunction if the patient was to feel well. For this reason, these complicating syndromes and their treatment are described in some detail.

It is hoped that the methods of study and treatment presented in this volume will be of use to other physicians in the medical management of patients who have joint dysfunction alone, or joint dysfunction and one or more of the four complicating syndromes.

I am greatly indebted to Dr. Robert Sterling Palmer in many ways, especially for his critical reading of the manuscript, for his constructive suggestions and for his wise counsel. Thanks are due to Dr. Louis H. Cohen, who read the manuscript critically and gave helpful suggestions. I am grateful to my wife, Charlotte S. Kaufman, for her encouragement and valuable assistance in all phases of this work.

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March 1,1949

Birth Defects & Vitamins
Home

WHAT TOOK THE FDA SO LONG TO COME OUT IN FAVOR OF FOLIC ACID?
by William Kaufman, M.D., Ph.D.
(Reprinted with the kind permission of Charlotte Kaufman)

Folic acid (or folate) is frequently referred to in the news media, so I will make some comments about it.

Folic acid is an artifact of chemical isolation. Folic acid is pteroylglutamic acid. This active molecule is a partially degraded, fully oxidized derivative of the folates. Virtually no folic acid exists in either plant or animal tissues. But the folates do.

Folic acid is an inexpensive chemical with a vitamin-like action. One can buy at retail 250 tablets containing 800 micrograms of good quality folic acid for about $6.00. These tablets contain four times the folic acid in today's RDA's (recommended daily allowance). One tablet costs a little over two cents.

Who is most susceptible to general folic acid deficiencies? Pregnant woman, fetuses, premature infants, and elderly people. Women with a systemic folic acid deficiency can develop in addition to other health problems, pre-cancerous changes in the uterine cervix. In addition. some women (users of oral contraceptive agents or smokers) who do not have a systemic folic acid deficiency can develop areas of localized folic acid deficiency in the uterine cervix. Areas of localized folic acid deficiency on the uterine cervix also may become pre-cancerous. Pre-cancer in both types of women, can become cancer. However, the administration of adequate amounts of inexpensive folic acid can effect a cure of the precancerous areas. Then, perhaps the woman may be able to change her diet to include foods rich in folates and sustain such a cure. But it is often hard for a woman to make a sustained improvement in diet. Poor women simply cannot afford the improved diet. In both such types of women, it would seem wise to use inexpensive, adequate pill-a-day folic acid maintenance therapy in addition to as good a diet as they can afford and get themselves to eat..

A folate deficiency in a pregnant woman may cause a special kind of anemia, a premature separation of the placenta, spontaneous abortion, bleeding, an abnormal fetus including those with a neural tube defect, anacephaly, spina bifida and low weight babies. Not only do these sad events cause misery to the mother, father and family but they simultaneously cause a large drain on medical resources as well as an enormous economic drain on Medicaid and on other sources for financing medical care. It would appear that these complications of pregnancy can be largely prevented by good nutrition and appropriate folic acid supplementation for the entire duration of the pregnancy from conception onward. And, this leads me to comment on the FDA's (initial) rejection(s) of an application for approval of the use of folic acid therapy for the prevention of neural tube defects as being premature.

The FDA is charged with making sure that the drugs they approve for prescription use are both safe and effective for specific therapeutic use.

The FDA has recently publicized a change in policy. It now plans to speed up the new drug approval process. This will enable giant pharmaceutical companies to sell expensive drugs with many side effects much earlier than is now possible, which will result in less careful scrutiny of the safety and efficacy of such new drugs,

Nutritional substances such as vitamins and minerals are not drugs. Folic acid is a vitamin. However, there is a section of the FDA regulations that states that any substance can be considered to be a drug if a claim is made that it can improve function or structure in an individual or prevent illness. Because of this, folic acid was legally characterized as a drug, the sponsor had to subject folic acid to the regulations governing the application of a new drug application.

The FDA (had previously) rejected a new drug applications for the use of folic acid intended to prevent neural tube defects in the fetus of a pregnant woman who had such a tragic event in a previous pregnancy. (For years) they had considered this New Drug Application to be premature. This is a way of saying that the FDA considers the data submitted in the folic acid New Drug Application was inadequate and that the sponsor must spend time, possibly years, gathering more data. *(Editor's note: This is precisely what indeed happened with folic acid. See note below.)* In the meantime, women who have had the misfortune to have had a fetus with a neural tube disorder in a previous pregnancy could not, for a long time, legally be prescribed folic acid with the view of possibly reducing her risk of having another neural tube defect fetus in future pregnancies,

ABOUT THE SAFETY OF FOLIC ACID:
Folic acid has been used for over forty years as a vitamin and has been found safe in the treatment men, non-pregnant women, and in pregnant women who have had folic acid deficiencies, Folic acid has been used to remove pre-malignant lesions on the uterine cervix and thus prevent cancer.

Even a very high daily oral dose (10 milligrams, which is 10,000 mcg) that is 50 times the present RDA (Recommended Daily Allowance) taken by 27 non-pregnant women for four months was safe and there were no adverse side effects. The much lower oral doses commonly used in treatment of folic acid deficiencies are also safe and effective.

There are no folic acid adverse side effects excepting the following:

(1) folic acid in huge doses administered to epileptic persons may block the anti-epileptic action of their drugs and cause them to have an increase in epileptic attacks (this is unlikely to occur with lower doses of folic acid);

(2) it may rarely decrease zinc absorption of zinc but this does not lower blood zinc levels because of decreased urinary excretion of zinc, and

(3) the patient have concurrent deficiency in both vitamin B 12 and folic acid, a condition that requires concomitant treatment with both vitamin B12 and folic acid. Therefore, folic acid alone cannot be effective.

Thus, folic acid is safer than most of the drugs, if not all the drugs, the FDA has approved for prescription use.

ABOUT THE PROBABLE EFFECTIVENESS OF FOLIC ACID IN THE PREVENTION OF NEURAL TUBE DEFECTS IN THE FETUS
While the FDA may (have been) bureaucratically and legally right in rejecting the application for the use of folic acid for the prevention of neural tube defects as being premature, from a humane and practical point of view it is wrong.

Neural tube defects are terrible complications of pregnancy. A mother who has had this calamity happen to her infant in a previous pregnancy is at considerable risk of having it happen again in subsequent pregnancies.

Many published reports in the medical literature indicate that giving such a woman folic acid in sufficient amounts can greatly lower the risk of recurrences of such extremely damaged fetuses. Some other medical reports disagree. A meta-analysis of all these published papers would probably show that there is enough favorable evidence to show that folic acid can reduce the risk of having a fetus damaged by neural tube defects. In view of all the circumstances, the FDA should give this application provisional approval to since folic acid is an exceedingly safe vitamin.

I am now suggesting how such provisional approval could get the FDA the additional data they want and currently not deprive women at risk of having neural tube defects infants of possible freedom from the recurrence of this calamity through the use of folic acid.

This provisional approval should be subject to the following conditions:

(a) that the non-epileptic woman who has had a previous fetus with neural tube defects start the agreed upon dose of folic acid before conception and continue it throughout her entire pregnancy

(b) that she will agree not to indulge in alcohol before conception and throughout her entire pregnancy and if she does, she will inform her physician how much and how often she partakes of alcohol (alcohol will negate folic acid action)

(c) the obstetrician or nurse midwife who delivers the infant will make a full report about the pattern of folic acid oral usage, whether or not alcohol has been indulged in during the pregnancy and the amounts and frequency of intake, and the condition of the infant on birth to the FDA.

The data on controls (women who have had neural tube defect babies in a prior pregnancy and who have become pregnant again but who did not take folic acid during the current pregnancy) should be collected under the direction of the Surgeon General of the U.S. Public Health Service, who could make it mandatory that that all hospitals which supply obstetric care in the United States compile data report the condition of every baby at birth born to a mother who had not been treated with folic acid during her pregnancy but has had a previous pregnancy ending with a neural tube defect infant. This data would give some reliable measure of how great the risk is of having subsequent neural tube defect babies when folic acid treatment was not given during the pregnancy. This information combined with the prospective information reported to the FDA on the incidence of neural tube defect babies occurring in women treated with folic acid, in turn, would make it possible to assess accurately how effective folic acid is in lowering the risk of occurrence of such tragedies.

(Editor's note: FDA did ultimately approve folic acid as preventive for neural tube defects such as spina bifida. It took them almost ten years to do so. In each of those years, at least 1,200 babies were born with neural tube defects. That makes some 12,000 birth defects that FDA failed to prevent because of unwarranted caution over a substance that is vastly safer than any drug that they have ever approved.)

(To order a mint-condition, hardcover copy of the rare, original 1949 edition of Dr. Kaufman's arthritis treatment book, *The Common Form of Joint Dysfunction* (194 pages plus references), please click here.)

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