Analysis of "Classified" Cases of Pulmonary Tuberculosis.

With the idea, above mentioned, of comparing the tuberculin sensitivity in the more severe and the less severe types, an attempt was made to have the pulmonary cases classified on a system described by me⁵ in 1924; but unfortunately only a very small number of cases were so classified amongst the tested patients. The results are given for what they are worth, but it is recognized that the numbers are too small to be satisfactory. All the classified cases were in the third stadium of phthisis, that is to say, suffering from advanced disease. Twenty were of the "recrudescent" or "C" type, twelve of the "initial" or "A" type. The results of the tuberculin tests are given in the following table.

TABLE IV.—*Tuberculin Reactions in "A" Initial and "C" Recrudescent Cases.*

Type of Case.	Total No. of Cases.	Percentages Positive in each Dilution.			
		1 in 10,000.	1 in 5,000.	1 in 1,000.	1 in 500.
"A"	12	16	33	50	50
"C"	20	15	45	65	90

Admitting that the numbers are too small for a conclusive comparison, the tendency seems to be in the direction of more marked reactions in the more favourable "recrudescent" group. The classified cases were separated into fresh groups for consideration from another point of view, according to the classification of Inman, who divided tuberculous cases, in terms of their degree of auto-inoculation as indicated by their temperatures, into "resting febrile," "ambulant febrile," and "ambulant afebrile." Of the 32 patients, 20 were "resting febrile" and 12 "ambulant afebrile." It should be noted that, though the numbers are the same, the cases divided up quite differently from the divisions in Table IV, nearly all the "A" cases being in the "resting febrile" group.

TABLE V.—*Tuberculin Reactions in "Resting Febrile" and "Ambulant Afebrile" Cases.*

Type of Case.	Total No. of Cases.	Percentages Positive in each Dilution.			
		1 in 10,000.	1 in 5,000.	1 in 1,000.	1 in 500.
Resting febrile ...	20	14	38	62	81
Ambulant afebrile	12	16	58	83	100

Again it must be recalled that the numbers are very small; but the figures suggest that the patients sufficiently resistant to hold their temperature in control are also the patients with a sharp power of reaction to tuberculin.

Summary and Conclusions.

It would seem from the above observations that tuberculin sensitivity is at its height in healthy but infected adults, and is still high in those tuberculous persons in whom the disease is taking a relatively benign course, and that it tends to diminish with the gradual deterioration of health consequent on advancing tuberculosis. Whether this fall in sensitivity is the result of the production of antibodies capable of neutralizing tuberculo-toxin, or whether it is due to a gradual loss of the power of breaking down tuberculin into its toxic derivatives remains uncertain. The fact that long-continued tuberculin therapy may lead to a toleration of tuberculin, with a corresponding clinical improvement, supports the possibility of a "neutralization" factor, at least in favourable cases, while the fall of tuberculin sensitivity in the advanced stages of non-tuberculous diseases, as well as in the terminal stages of tuberculosis, speaks for a gradual deterioration in the power to deal with tuberculin or to react to it. It may be that the loss of tuberculin sensitivity is due not to one but to several factors, and that different factors may be operative in inhibiting the

reaction at different stages of the disease. While it appears certain that a very low percentage of "positive" reactions in any given community goes with a marked racial and individual susceptibility to tuberculosis, it would be a mistake to assume that a high percentage necessarily denotes the possession of a good resistance. The fact that tuberculous children tend to react as well as, or better than, tuberculous adults is against this, since children exhibit a greater liability than adults to generalized tuberculous lesions. It should be recalled, in this connexion, that artificially infected guinea-pigs, though doomed to progressive disease and a fatal termination, almost always show a marked tuberculin sensitivity in the third or fourth week after infection.

A good tuberculin reaction, then, is no guarantee that the patient will be able to control his tuberculosis, nor is a high percentage of reactions, even to so small a quantity of tuberculin as 0.1 c.cm. of a 1 in 10,000 dilution, or 0.01 mg., to be interpreted as meaning that the tested group is necessarily resistant to the evolution of the disease.

With regard to the loss of sensitivity during the progress of a tuberculous infection, the findings of Henry Stuart Willis⁶ suggest that, in guinea-pigs chronically infected by inoculation with an attenuated strain, sensitivity is gradually lost, but may be rapidly "whipped up" again by a reinfection. This type of fall in sensitivity probably depends on a "locking up" of the tuberculous foci in the course of spontaneous cure, and is to be distinguished from the "wearing out" of sensitivity in the terminal stages of tuberculosis; the latter being of serious prognostic import.

It is to be noted that no concentrations stronger than 1 in 500 tuberculin were used. The steady rise in the percentages of "positives" with the stronger concentrations justifies the belief that, as found by Happ and Casparis,³ it should be possible to obtain a positive result in every case, no matter how far advanced, if still stronger tuberculin were given intradermally. In such attempts, however, the possibility of dangerous constitutional reactions should not be lost sight of.

The fact that much larger doses of tuberculin can be tolerated without a general reaction by the intradermal than by the subcutaneous route should recommend the Mendel-Mantoux method to those using tuberculin in treatment.

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PHYSIO-THERAPY IN THE TREATMENT OF CHRONIC RHEUMATISM.

BY

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THE term "chronic rheumatism," as used somewhat vaguely to cover a number of conditions affecting the joints, muscles, and other skeletal structures, is unfortunate, because it presupposes that these have a pathology identical with that of acute rheumatic fever, a disease which attacks children most frequently, and whose chief ravages fall on the heart. Certain symptoms characteristic of acute rheumatic fever are indeed present in at least one form of chronic rheumatism, but the facts as a whole do not warrant the assumption of a common origin to all forms of rheumatic disease.

The chief lesson to be drawn from modern investigation of rheumatic conditions is the fact that their causes are multiple, just as their manifestations are various, and that each group of cases must be treated according to its individual requirements. The recognition of the important part played by focal sepsis as an etiological factor was a

considerable advance in knowledge, but it is now realized that rheumatism may result from several kinds of toxæmia other than bacterial. There is, for example, the intestinal type, which responds favourably to a lowered caloric intake of food and to high colon lavage; there is the endocrine type, which benefits by administration of thyroid extract; and there is the gouty type, which can be attacked on chemical lines. In many cases clinical differentiation is difficult or impossible; in others more than one etiological factor is operative.

THE ETIOLOGY OF CHRONIC RHEUMATISM.

The theory to be elaborated in this paper is that chronic rheumatism is an allergic state, the antigens producing it being bacterial toxins, the products of bacterial action, or incompletely metabolized protein derivatives with which bacterial action is in no way concerned. Sensitization to any of these antigens may be progressive or capable of periodic recrudescence over long periods of time. The constriction of the smaller blood vessels which results from this sensitized state leads to devitalization, damage, and finally destruction of tissues which even normally have a poor blood supply—for example, fibrous, ligamentous, and articular structures. Such vaso-constriction has been clearly shown to be an integral part of the rheumatic state, and caused probably by the exhaustion of the endocrine-sympathetic system invariably associated with allergy. In some forms of rheumatic disease substances toxic to the above-named tissues may, in addition, accumulate in them and produce inflammatory changes resulting in disease of the proliferative type—for example, rheumatoid arthritis. When destruction results from lack of nutrition the more slowly progressive or atrophic form of the disease results—for example, osteo-arthritis. The various etiological factors must be considered separately.

Infection.

Infection causing arthritis and other forms of rheumatism may be specific—that is, gonococcal, syphilitic, or tuberculous—and careful examination is necessary to exclude these conditions. In their absence it has been customary to call the case one of ordinary rheumatism, by which a subtle imputation is tacitly made against some form of streptococcus. This organism has never been satisfactorily demonstrated in the joints or other structures of rheumatic patients; its presence has been inferred from the frequent discovery of an obvious infective focus, and the occasional amelioration that has followed its eradication. Furthermore, not only is severe rheumatism often found in persons in whom infection is relatively insignificant or apparently absent, but gross sepsis of long standing may be found in patients completely free from rheumatism. Streptococcal infection is responsible, therefore, for only a certain proportion of cases, and, as one would expect, these conform roughly to a certain clinical type—namely, a proliferative polyarthritis of the smaller joints, which frequently runs an acute febrile course, and results in swelling, deformity, and ankylosis.

Intestinal Toxæmia.

This undoubtedly underlies a definite group of chronic rheumatic cases. Patients in this group usually present a toxic appearance; they are unduly pigmented, their musculature is lax and flabby, they are easily fatigued and habitually constipated. It is impossible to be certain whether the antigen concerned is some abnormal intestinal bacterium, or a normal inhabitant of the gut which has acquired pathogenic characteristics, or some product of protein decomposition. But patients in this group, which includes many suffering from recurrent lumbago, sciatica, perineuritis, and fibrositis, respond most favourably to reduction and adjustment of diet and to high colonic lavage.

The Endocrine Factor.

The clinical resemblance between patients suffering from thyroid disorders and those with certain rheumatic diseases leaves no doubt that the relationship between the two conditions is often a close one.¹ Patients with myxoedema frequently suffer from arthritis, and still more frequently

are subject to vague aches and pains of a fibrositic nature. Their skin, like that of chronic rheumatic patients, is cold and dry, but subject to periodic attacks of excessive sweating. Chronic rheumatic subjects in this group benefit by taking thyroid extract. On the other hand, many of the more acute cases of systemic rheumatic disease resemble in some respects Graves's disease, in which the skin is hot and flushed, and sweating is profuse. It would seem as though the capillary constriction or dilatation is brought about by some disturbance of the endocrine-sympathetic system, upon which the antigen has a primary effect. Less marked is the effect of hypo-ovarian secretion in rheumatic disorders—a fact not explained by the mere excess of weight these patients sometimes have to carry. The late results of ovariectomy and even hysterectomy are serious, and should always be considered before such operations are undertaken. A similar, though usually temporary, disturbance is often encountered at the menopause.

Osteo-arthritis.

This condition, as a result of the doubt recently thrown upon the theory that it is infective in origin, has come to be regarded as a disease *sui generis*. It attacks, for the most part, the larger joints of older people, and is more common in males than in females. The immediate pathology would appear to be a simple necrosis of the tissues concerned, following prolonged reduction of local blood supply. The disease often remains stationary, and then, after a latent period, progresses. Allied to it, and often occurring coincidentally, is true gout. The close relationship of gout with asthma and allied skin affections, and its paroxysmal nature, support the theory that it is anaphylactic in origin, being due to specific hypersensitivity to certain nucleo-protein containing foodstuffs.

Some Predisposing Factors.

It is now necessary to consider what are the factors which predispose to the production of the allergic state. Among these climate has an important place. Stimulating and invigorating climates tend to produce in the people that live in them the greatest degree of physical and mental fitness.² Chronic ill health, particularly rheumatism, may, however, result from attempts to avoid the various discomforts that are necessarily associated with such climates. Sedentary lives, lack of exercise, badly heated and ventilated rooms, and faulty dietetic habits are the harbingers of constipation and of sepsis. Inadequate and deleterious products accumulate in the tissues; the skin, wrapped up in clothing, is denied its natural stimulation by sunlight and fresh air,³ and fulfils only inadequately its various physiological functions.³ In such circumstances inclement temperature, humidity, and climate become the masters and not the servants of the chronic rheumatic subject. Individual idiosyncrasies in relation to certain localities are also met with, just as in asthma.

All subjects of chronic rheumatism are easily fatigued, and their condition is invariably aggravated by prolonged mental and physical strain. The underlying factor is probably exhaustion of the endocrine-sympathetic system, and here the analogy with thyroid disorders is again apparent. A structure strained by work or exercise will be the first to show this rheumatic tendency—as, for example, in coal-heaver's shoulder or tennis elbow. A fracture which would heal quickly and completely in a normal person will leave pain and stiffness in the rheumatic subject, and the immobilization necessary for its treatment will further aggravate the condition from which he is suffering. Rheumatism is often found in various forms in different members of a family, and a tendency is transmitted from generation to generation.

TREATMENT.

The treatment of rheumatism resolves itself into two problems: (1) the arrest and cure of the disease; (2) the correction of its results.

In streptococcal cases it is important to remove any obvious sepsis without delay, but with care, especially in subacute cases, to avoid a severe reaction, such as might follow, for instance, the wholesale extraction of teeth in

pyorrhoea. Preliminary protein shock treatment is of advantage in such cases. In many patients removal of obvious sepsis is not followed by amelioration of symptoms—a fact which may be explained on the assumption that the organism is still present in various parts of the body in sufficient numbers to produce recurrent resensitization. In the absence of obvious sepsis, the teeth, tonsils, appendix, gall-bladder, and other possible sources of infection should be allowed to remain *in situ*, and attention directed to increasing the patient's general resistance, and to preventing further immobility of the invaded structures. While valuable time is being wasted in a vague search for some hypothetical source of infection, permanent stiffening, adhesions, and other damage may ensue which could have been prevented if treatment had begun earlier.

It is supremely important, particularly in cases of septic origin, accurately to gauge the acuteness or chronicity of the condition—that is to say, the resistance of the patient and his reaction to treatment. For whereas in acute cases treatment involves not only specific measures and good nursing, but absolute rest, it is yet important to commence active treatment as early as possible with the object of preventing further extension of damage in the tissues concerned. It is often most difficult to decide when active treatment may be initiated, but valuable assistance may be obtained from the blood sedimentation test. This test, though in no way specific, depends upon the increased rate of sedimentation of red blood corpuscles which occurs, especially in inflammatory and exudative conditions. If a high reading is recorded the case may be regarded as acute, and palliative measures adopted accordingly. If the reading is within or only slightly above normal limits the case may be regarded as chronic and demanding immediate active treatment. Readings taken at intervals throughout the course of the disease give an accurate index of progress under treatment and of prognosis.

Physio-therapy and Spa Treatment.

Treatment of rheumatism on purely physical lines is administered at various spas under such dignified names as "hydrology" and "balneology." Sometimes a chemical constituent of the water, such as sulphur or potassium, is claimed as a therapeutic omnibus. Sometimes a radioactive substance is found, though its presence may be demonstrable in quantities to appeal only to the homoeopathist. Again, the water may issue from the ground under pressure, and the bubbles from liberated gases claimed to possess peculiar therapeutic properties. Yet these spas undoubtedly do good, and it is important to decide what are the beneficial therapeutic measures common to them all. Briefly they appear to be as follows: (1) the use of heat generally, with the production of a temporary artificial pyrexia, and, locally, combined with massage, movement, and manipulation; (2) stimulation of the skin; and (3) elimination of waste products.

The baths employed in spa treatment for the purpose of applying heat may consist of hot water at varying temperatures, or of hot and cold water alternated; of water vapour of varying density, humidity, and temperature; and of dry hot air. A condition of hyperthermia quickly follows the immersion of the body in a hot bath because loss of heat by evaporation is prevented. In the much hotter dry air of the Turkish bath the body temperature rises hardly at all, because the amount of evaporation is considerable. Vapour baths occupy an intermediate position, and, on the whole, their use has met with the best results in rheumatic cases. Heat produces a general vascular dilatation with transudation of fluid into the tissue spaces. Possibly, also, at normal or subnormal temperature, deleterious substances enter into chemical combination with the tissues and may be dissociated from them only when pyrexia is induced. Such has been shown to occur with lactic acid,⁴ and some rheumatic symptoms, particularly pain, may be due to the excess of acids locally. Deviation of the acid base equilibrium in the acid direction is, however, not constant in rheumatic diseases. In acute rheumatic fever, high temperature, accompanied by profuse sweating, may be regarded as a healthy reaction to the disease and Nature's method of

eliminating acids and other harmful products. The subject of chronic rheumatism suffers from subnormal temperature and an inactive skin, in which the functions of elimination and oxidation are in abeyance. The beneficial effects of a vapour bath may be due to the fact that it produces both an artificial pyrexia and increased sweating.

Stimulation of the Skin.

It is a common clinical observation that the skin of the rheumatic subject is deranged. It has, for example, a pungent odour, and the sweat glands do not function properly. Lewis,⁵ who in his recent observations throws much light on the subject of the reaction of the skin to various stimuli, describes a triple response comprising local dilatation of minute vessels, widespread arteriolar dilatation, and increased permeability, resulting in transudation of fluid into the tissue spaces. He draws attention to the remarkable similarity of the reactions produced when the skin is stimulated and when it is injected with histamine. This similarity he explains by the liberation from the skin of some histamine-like substance, to which he has given the name H-substance. He shows, further, that when the stimulus is applied to the heated skin this substance is liberated diffusely over a wide area, and all the vessels are involved in its removal.

There is no reason to suppose that this H-substance is different from that liberated in conditions of extensive tissue damage and producing "surgical shock." The general extravasation of plasma into extravascular tissue spaces, symptomatic of this condition, tends to wash away injurious substances, and thus acts essentially as a protective mechanism. The skin of the normal subject, especially when he takes sufficient exercise, receives enough daily stimulation to evoke this mechanism. If, then, we assume that the skin of the rheumatic subject is at fault we have a ready explanation of the good results obtained by spa treatment, and of the fact that it matters little what form of skin stimulation is adopted.

The most satisfactory results are obtained when substances producing skin irritation are added to the hot baths in which rheumatic patients are immersed. Sometimes these materials, which include pine, menthol, turpentine, etc., are so irritant that before immersing the patient it is necessary to cover the sensitive parts with vaseline. When the patient is taken from the bath, the temperature and duration of which are regulated according to his condition, he is covered in hot blankets and allowed to sweat profusely for one or two hours. The treatment is strenuous and should only be carried out after a careful clinical examination of the patient.

Elimination of Waste Products.

Every cell in the animal organism requires water, not only to assist in its constant metabolic changes, but to carry away the waste products of metabolism. This action of water is particularly important in rheumatism, but it is astonishing how little water many rheumatic patients drink. In the group attributable to alimentary toxæmia washing out the large bowel by high-colon lavage often effects excellent results. The treatment should be undertaken only by skilled persons, otherwise the tube will tend to curl up in the rectum and no fluid pass into the pelvic fold. The process should be repeated until clear water is returned, and an even pressure of about two pounds should be maintained; occasionally antiseptics—potassium permanganate, for example—may be added to the water with advantage.

Local Treatment.

Here again heat is the main essential. The objectives, however, are different and a greater heat intensity is usually required. Inhibition of muscular movement in the affected limb tends to retard the normal blood flow essential for the physiological exchange of oxygen and carbon dioxide and the removal of waste products. Heat helps to produce the required hyperæmia. Furthermore, tissues expand under the influence of heat and become more malleable. There are many conditions in which muscular

fibres are found to be in a state of spasm, movement of any kind being accompanied by pain. Such is the case in true lumbago. If such muscle fibres happen to be traversed by nerves, as, for instance, in the lower cervical region, these nerves become trapped and neuritis results. In such conditions the tissues when heated become more amenable to the influence of massage and movement. The principle underlying the treatment of all chronic rheumatic conditions is the same—namely, to soften the tissues by heat, and, later, to follow this by massage and movement. Force should not be used in the early stages, and then only gradually applied in accordance with the needs of the particular condition. Nerves are sometimes forcibly stretched under an anaesthetic, but even when immediate relief appears to have been achieved, adhesions resulting from such drastic treatment often reproduce the condition even more severely than before.

Methods of Applying Heat.

Heat is commonly applied by conduction. A water fomentation or a dry pad, electrically or otherwise heated, is employed. The temperature at which the sensation of heat gives place to pain is in the neighbourhood of 115° F., and it is therefore not possible to exceed this temperature at the skin surface. If the part is in any way inflamed even this degree of heat cannot be applied. As, however, heat applied by conduction does not penetrate to any appreciable extent, being carried away by the superficial circulation, its use should be confined to the treatment of inflammatory conditions of the skin and immediately subjacent tissues.

Secondly, heat can be applied by radiation. The rays of the violet end of the visible spectrum are converted into heat directly on the skin surface and have very little penetrative power. As the wave-length increases, the rays, before being converted into heat, are able to penetrate to an increasing extent, the luminous and particularly the red waves being employed when a penetrative heating effect is required.⁶ In the infra-red region the heat rays again diminish in penetrative power, and are consequently of less value for this purpose. Radiation, though not a good means of applying heat for the end in view, is better than conduction.

Diathermy is used when it is required to concentrate heat in deeply situated tissues. The modern diathermy apparatus produces oscillations of a very high frequency, varying from 800,000 to 1,000,000 per second. The diathermy current has no ionizing effects in the tissues, and as nerve endings cannot appreciate stimuli repeated with a frequency of more than 10,000 per second, it cannot produce sensations, painful or otherwise. A much stronger current can therefore be used than could otherwise be tolerated. This current, passing rapidly to and fro, generates heat in the tissues themselves. The temperature depends on the grouping of these tissues in relation to the path of the current, and on the relative richness or poverty of their blood supply.⁷ All of them will, however, be heated to a certain extent. Various precautions have to be taken so as to eliminate the possibility of burns. The pads must be placed at right angles to each other, the parts treated lying directly between them, so that the current may traverse them directly. Such details as the amount of current, the length and frequency of exposures, and the position and type of electrodes can be gauged only as the result of experience.

The value of electrical currents, other than diathermy, in the local treatment of chronic rheumatic diseases is doubtful. It is unlikely that the redistribution of tissue ions caused by the passage of a direct current has any therapeutic effect. Also it is difficult to ascribe any useful purpose to ionic medication; drugs, such as iodine, thus introduced into the system are carried away by the superficial circulation before they can penetrate to the required depth. Beneficial results are sometimes obtained by the use of alternating currents in very chronic cases, and are due probably to their tonic effect upon the wasted muscles, and not to any action upon the disease itself. Sinusoidal baths are perhaps the most useful for this purpose.

SUMMARY.

An attempt has been made to summarize the various aspects of the treatment of "chronic rheumatism." Such treatment must necessarily follow a complete investigation in all cases, and must proceed along systematic lines. Drugs should be used, but not abused, particularly in the relief of pain. Members of the phenazone and exalgin groups, and salicylates, are the most valuable. Iodides probably owe their reputation to their effect in cases associated with endocrine disturbance, but are not so helpful as thyroid extract. Stock vaccines and other protein injections act by producing protein shock and are useful in certain cases. Autogenous vaccines would not appear to have any special advantages. It is suggested that chronic rheumatism is an allergic state produced by a number of widely different antigens in a susceptible subject. For this susceptibility the habits and necessities of modern civilization, especially inadequate stimulation of the skin, are largely to blame. Physio-therapy owes much of its success to the rectification of these errors.

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THE DISEASE KNOWN AS MINERS' NYSTAGMUS.*

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FOR close upon a century coal miners have been known to suffer from ocular trouble associated with their work; in 1831 C. Turner Thackrah wrote in reference to colliers:

"Their eyes, from swelling of the lids, appear small, and are affected with chronic inflammation and intolerance of full light, and many, after a few years' trial, are obliged . . . to leave the mine."

Nystagmus as a definite disease was first described by Decondé in 1861, but little attention was given to the question until about 1875, when reports, though still somewhat isolated, began to appear in British and Continental medical journals, and were followed by a prolonged and heated discussion as to the causation of the oscillation of the eyeballs. This controversy is still unsettled, and will be carefully avoided in this paper, which proposes to deal with "the disease known as miners' nystagmus whether occurring in miners or others, and whether the symptom of oscillation of the eyeballs be present or not," as notified in the schedule of the Workmen's Compensation Act of 1906 on July 30th, 1913. It may be noted that the earlier observers regarded the disease as a local myopathy of the elevator muscles of the eyes or the result of excessive accommodation, whereas the modern tendency is to refer it to a general fatigue of the whole oculomotor system, or a general neurosis with special manifestations in the oculomotor apparatus.

Since 1907, when miners' nystagmus was added to the schedule of industrial diseases in the Workmen's Compensation Act of 1906, the number of notified cases has steadily risen, and when the definition of the disease was altered in 1913 the Home Office statistics showed a sharp rise in the rate of incidence of nystagmus from 0.16 to 0.26 per cent., and the latter rate has been maintained since. These numbers refer to cases of invalidity from the disease, and must not be confused with the rate of prevalence of nystagmus in miners. Oscillation of the eyeballs, it has been estimated, may be found in about 25 per cent.

* Read at a meeting of the Midland Ophthalmological Society, December, 1928.