by sleeplessness, anaemia, dyspepsia, and so on. But even then a true diagnosis and sound advice will do much, coupled with suitable remedies and change of air and scene; but the key to success still lies in the proper management of the patient's mental state. To grapple with this and the various causal factors at work requires all our tact, courage, and patience.

Many cases will, however, defy this rational line of treatment, even at the hands of the most experienced, when attempted at home. Adverse circumstances are too strong for them, and the doctor's efforts are more than counterbalanced by influences outside his control. It is then that isolation proves so valuable, with or without a course of the so-called Weir Mitchell treatment; and I feel that in bringing to a close my remarks upon the treatment of neurasthenia I cannot do better than give you a brief account of my own experience, extending now over many years, of the Weir Mitchell treatment.

This treatment, as you are aware, is a combination of isolation away from home, rest in bed, overfeeding, massage, and electricity. The one item in this list likely to produce a lasting mental effect is the isolation; and although Weir Mitchell himself incidentally speaks of this as giving a valuable opportunity for "moral suasion," he lays no great stress upon it from that point of view, while some of his followers openly deprecate "preaching," and insist on relying solely on the physical processes.

The great French physician, Dejérine, on the other hand, has evolved a system in which isolation with rest in bed and what he calls "persuasion" play the principal parts; overfeeding is used only in cases of emaciation, massage and electricity are discarded. Dejérine rejects suggestion as formerly used by Charcot and others because it in no way enlightens the patient's intelligence, nor does it help him to exercise his own will; the "persuasion" which he substitutes for suggestion means such rational explanation and demonstration to the patient as will communicate enough understanding of the matter to enable him to co-operate intelligently in his own cure.

My own experience, independently worked out and extending now over many years, goes to show that the point of chief importance is mental treatment administered under the most favourable conditions, of which the first essential is isolation under the doctor's control. The mental treatment is, in fact, a sort of education with encouragement. The plan adopted should not be too rigid; each case needs to be separately considered and treated on its own merits—one will require stern insistence, another gentle coaxing. By countless varying methods the treatment is always directed to the one end of leading the patient away from the constricted, self-centred attitude of mind in which attention is absorbed in narrow personal feelings, and substituting for this a roused or restored interest in wider affairs of life, which will in turn endow him with a new and larger and perfectly healthy self. To this main object the various helps of rest, over-feeding, "passive exercise" or massage, electricity, etc., are, when used at all, regarded only as subordinate accessories. And I may add, in conclusion, that the number of lasting cures secured in this way year by year strengthens my conviction that the theory is true and the practice sound.

Clinical Remarks
ON
TUBERCULOUS CHLOROSIS.

BY ALEX. JAMES, M.D.EDIN.,
CONSULTING PHYSICIAN TO THE EDINBURGH ROYAL INFIRMARY.

WHEN we meet with a case which presents in a more or less marked degree all the ordinary appearances of chlorosis, and which yet on examination of the blood reveals the number of red corpuscles and the percentage of haemoglobin to be practically normal, we are very likely to find in it a history of past or present tuberculous disease. This condition, often occurring in young women, is one which long ago Trousseau recognized and called false chlorosis or tuberculous anaemia; and although in recent times, when blood examination has become more of a routine procedure, the co-existence in tuberculous disease of an anaemic appearance with a practically normal blood count is quite recognized, it seems to me that in cases apparently of chlorosis this possible association of tuberculous disease often passes for long unrecognized. Inasmuch as the recognition of such cases is important from the points of view alike of diagnosis, etiology, pathology, and treatment, I believe that the following are well worth recording.

CASE I.

A. H., aged 16, a French polisher, was admitted to Ward 31, April 9th, 1907, as a case of chlorosis. She complained of shortness of breath, palpitation, and swelling of the ankles, and stated that she had been ill for three weeks.

History.

Her family history was not very good. Her father had died, aged 35, from Bright's disease; her mother is alive and well. Of a family of four, two brothers had died, causes unknown; one sister was alive and well. Her surroundings at home seemed to be satisfactory; at work, however, she had been in a room with many others, and the air, she said, got very close. As regards previous illness, she gave a history only of suppurating glands in the neck at the age of 6 or 7. They were quite cicatrized. Her present illness, she said, began about three weeks before admission. With some pain and discomfort in the feet she noticed swelling, which the doctor told her was due to dropsy. The pain gradually ceased, but the swelling remained until her admission. She also noticed palpitation and breathlessness, and stated that she had been getting thinner.

State on Admission.

Height 4 ft. 10 in., weight 6 st. 3 lb. Her development and muscularity were poor. Some oedema of both ankles was present, and her appearance was one of pallor and extreme anaemia. The temperature showed slight irregularity.

Circulatory System.—The pulse was usually about 90 or 100. She had complained of shortness of breath, faintness, and palpitation. As regards physical signs, little that was abnormal could be detected. The heart was not markedly enlarged, the sounds were all closed, and, in spite of her pallor, the *bruit de diable* was not well marked. The red blood corpuscles numbered 5,200,000, haemoglobin 70 per cent., white corpuscles 7,187. A differential count gives polymorphs 57 per cent, lymphocytes 39 per cent., basophiles 3 per cent., eosinophiles 1 per cent.; the opsonic index was 0.9.

Respiratory System.—The patient had no cough, but gave a history of coughs coming on from time to time. Some weeks earlier the cough was very troublesome, and she suffered from pain in the chest on coughing and breathing. On careful examination of the lungs, slight shrinking of the left apex with a slightly impaired percussion note was made out. On auscultation, nothing was detected except slight harshening of the breath sounds. With the screen, the x rays afforded corroboration of the physical signs, for the left apex lighted up much less distinctly on inspiration than did the right. The urine was pale in colour, showing no trace of urobilin; and as regards the integumentary system, all that had to be noted was that there existed slight oedema of both ankles.

In this patient, then, we had presented all the appearances of chlorosis, and yet a practically normal blood count. The differential count of the white corpuscles showed, as was to be expected, a relative increase of lymphocytes, and the opsonic index, for the estimation of which I have to thank Dr. Ian Stewart, was within normal limits. Dr. Ian Stewart also tested in this patient the effect of tuberculin inoculation on the opsonic index, and found a rise on the third day, without any previous fall. All this may be regarded as indicating that there is at present no active tuberculous mischief going on. But the evidence of the old tuberculous neck glands, and the condition of the left apex undoubtedly point to the presence of tuberculous disease, whilst the occurrence from time to time of cough, expectoration, and chest pain, make this all the more manifest. The case is therefore one of tuberculous chlorosis.

CASE II.

Constance H., aged 18, domestic servant, was admitted to Ward 33, on December 18th, 1905, complaining of breathlessness, palpitation, stomach pain, and swelling of the legs, and stating that she had been ailing from this for the last two years.

History.

Her family history was not very good; her father died of Bright's disease, her mother in childbed. She had one sister alive and healthy, and one brother healthy; but of her other three brothers, one had Bright's disease, another had some form of paralysis, and another had died from consumption. She had been in service for three years, and as regards food and home surroundings had been well placed.

Previous Illnesses.—When she was 2 years old she had disease of the bones of the left foot. According to her account the bones were scraped, and the condition healed. At the age of 14, after vaccination, she seems to have developed a scaly skin disease, for which she was treated in the skin wards of the Royal Infirmary for some weeks. She left the infirmary improved, but the condition was very tedious, and did not completely disappear for a year or two after she left.

Present Illness.—This seems to have begun about two years ago. She and her friends noticed that she was getting very pale, the lips especially. On climbing a stair she had breathlessness, palpitation, and pain over the heart; she had also headaches. At this time also her digestion troubled her. She had stomach pain and vomiting, and at times what she vomited resembled coffee grounds. In spite of dieting, and pills for the bloodlessness, she never felt strong.

State on Admission.

She appeared a well-nourished girl 5 ft. 5 in. in height, and over 10 st. in weight. She was very anaemic, the face, lips and gums showing marked pallor, and she had slight oedema of both ankles. The temperature was normal.

Circulatory System.—The pulse was about 70. She complained of breathlessness, palpitation, and pains over the heart on any exertion. She was giddy when she held her hands above her head. Examination of the heart revealed evidence of slight dilatation, but the sounds were closed in all the areas; there was a slight *bruit de diable.*

Haemopoietic System.—The lymphatic glands and spleen were normal. Blood examination showed red blood corpuscles, 4,900,000; haemoglobin 95 per cent.; white blood corpuscles, 9,000. The film shows a proportionate increase of lymphocytes.

Respiratory System.—She had had occasional coughs, but gave no history of haemoptysis. On physical examination all that could be made out was a shrinking of the right apex margin with harshening of respiratory sounds there.

Alimentary System.—For some time past she had been complaining of atonic dyspepsia, pain after taking food, with occasional vomiting. She was habitually constipated. The abdominal organs were all healthy.

Urinary System.—All that need be noted here is that the urine was of rather low specific gravity and rather pale.

This, then, was a second case, admitted as chlorosis, in which on account of the high red corpuscles and haemoglobin estimation, we were led to look carefully for evidence of past or present tuberculous mischief. As will have been seen, this evidence was forthcoming.

As regards the course of these cases of tuberculous chlorosis, there is no doubt that though more tedious than ordinary chlorosis, they yet with treatment recover fairly well. But an interesting point is that with renewed feelings of health and vigour, and with great, often very great, improvement in their appearance, there is practically no improvement in the blood count. Indeed, I have had several cases which, on leaving the infirmary looking and feeling well, had an even smaller number of corpuscles and percentage of haemoglobin than on their admission. Such was the case with the first patient, for on leaving the infirmary her red blood corpuscles were 4,300,000, and haemoglobin 70 per cent. This naturally leads to the question, What is the real blood condition in those cases? Here we enter into the realm of theory, but the idea which naturally comes into our minds is that there is really an oligaemia—that is, a diminution in the total amount of the blood. On this theory we can quite understand how, on recovery, we get associated with increased volume of blood improvement alike in the appearance and in the nutrition and vigour of the patient, and yet that the haemocytometer and haemoglobinometer show little or no change.

This theory is also interesting because it recalls the old view that in those likely to become phthisical a relatively poor growth and development of heart and vascular system may be recognized. To this view I have always felt inclined, and it has been specially interesting to me to find, as have other observers, that skiagraphic examination in phthisical patients has often revealed a distinctly small heart.

Trousseau not only drew attention to the existence of this tuberculous chlorosis, but emphasized the fact that great care should be exercised as regards its treatment, inasmuch as the administration in such cases of large doses of iron might cure the anaemia, but was not unlikely to be followed by haemoptysis, and in time an acute and rapidly fatal phthisis.

This is perhaps an old-fashioned notion, and that grand old man, Trousseau, acknowledged that it was even in his own day. In his lecture on the subject he, however, stoutly affirms its truth, mentioning as conditions which also require equally careful handling *fistula in ano* and leucorrhoea in phthisical subjects. All this is, of course, a side-issue; and except to say that I am also old-fashioned enough to believe that what Trousseau has said is in the main true, and even to add two other conditions to his list, namely, enlarged neck glands and appendicitis in the phthisical, I shall do nothing more at present than report a case which bears out Trousseau's statements as regards the effects of iron in tuberculous chlorosis. As will be seen, it is different from the other two in that the blood count was really below the normal, but in many important respects it corresponds to the type of tuberculous anaemias.

CASE III.

J. F., aged 17, by occupation a silver-chaser, but lately a worker in the slaughter-houses, was admitted to Ward 31 on October 31st, 1905, as a case of anaemia, and complaining of shortness of breath on the slightest exertion, and headaches.

History.

His family history was not good. He was the youngest of a family of thirteen, of whom eight were alive. Of those who were dead, at least two died of consumption. His home surroundings and food conditions were good. As a silver-chaser he was exposed to bad air, but lately in the slaughter-houses he had always been in the open air, although exposed to weather and draughts.

Previous Illnesses.—About eleven years ago he had some inflammation at the base of the left lung. Six years ago he was treated in the infirmary for anaemia. Three years ago he had cough, expectoration, and haemoptysis, and two years ago he was a patient in the Victoria Hospital for Consumption, Craigleith, for six months. Shortly after leaving there he noticed bloodlessness beginning again, and this had got much worse during the last month.

State on Admission.

He was about 5 ft. in height, and his weight (7 st.) was fairly good. He was very pale and anaemic.

Circulatory System.—He complained of dyspnoea on the slightest exertion, also of palpitation, with occasional pains over the precordia. Examination of the heart revealed no marked enlargement, but a systolic murmur was heard over all the areas, especially over the pulmonary. The *bruit de diable* was marked.

Haemopoietic System.—The spleen and lymphatic glands were normal. Blood examination reveals: red blood corpuscles, 3,500,000; haemoglobin, 45 per cent.; white blood corpuscles, 5,000. A differential count showed: Polymorphs, 71 per cent.; small mononuclears, 23 per cent.; large ditto, 5.5 per cent.; eosinophiles, 0.5 per cent. The red corpuscles showed slight poikilocytosis, and they did not stain well.

Respiratory System.—He had very little cough or expectoration, and repeated examinations of the sputum showed no bacilli. Examination of the lungs revealed evidence of shrinking at the left apex posteriorly. The digestive system was practically normal, as also the urinary, the urine showing no appearance of urobilin. The opsonic index, as ascertained by Dr. Ian Stewart, was 1.12, and after inoculation with TR a slight negative phase was noticed, not sufficient, however, in Dr. Stewart's opinion, to warrant the diagnosis of tubercle, but yet more marked than would be expected in a healthy person.

After-History.

After some 7 weeks' treatment in the ward, with rest, fresh air, good food, and arsenic, he showed great improvement. He acquired a good colour, and his nutrition and general vigour increased, so that he was able to take his share actively in the ordinary work of the ward. With all this, however, it was noteworthy that his blood count showed practically no change.

He was sent to the convalescent home, but there, after a few days, he developed a cough, and spat up a large quantity of blood. He was at once sent back to the ward, and there we found him presenting again all the appearances of great anaemia, and with some dullness and crepitations at the left apex. From this condition he rapidly recovered, only, however, as strength returned and pallor disappeared, to suffer again from haemoptysis. He died a few weeks ago, apparently from anaemia and debility, and for the last eight or nine months of his life his condition was very much like that of haemophilia—that is to say, as soon as he felt well and developed a good colour, he had haemoptysis. Dr. Leslie Lyall, who saw him during the last months of his life, informed me that iron always brought this condition about.

Lastly, as regards treatment in those cases of tuberculous anaemia. As already stated, Trousseau held that iron was to be avoided, and that arsenic and general treatment by hydrotherapeutics, salt-water baths, etc., were good. In the main I agree with this, for I look upon the condition as one which occurs in individuals who, as the result of hereditary or acquired causes, have given indications that they possess that low resistance power to the

tubercle bacillus which is best described by the old-fashioned phrase "the tendency to consumption." In what way and to what extent this blood defect may be salutary as regards tuberculous lung disease, we can only conjecture. My own idea is that it may be by inducing an air hunger, and so stimulating lung function and nutrition. Anyhow, when we reflect that the quality of the blood is quite good, we can understand that treatment to improve the health generally rather than the blood specially is what is required.

THE AUTOMATIC RHYTHM OF THE HEART.

By ALFRED M. GOSSAGE, M.D.Oxon, F.R.C.P.Lond.,
PHYSICIAN TO OUT-PATIENTS, WESTMINSTER HOSPITAL, AND EAST LONDON HOSPITAL FOR CHILDREN.

THE prolonged controversy during the last quarter of a century as to the origin of the automatic power of the heart to beat rhythmically has received marked stimulation during the last few years. Leaving aside the earlier hypotheses, one of which attributed the beats to impulses sent from the central nervous system, while another regarded distension of a cardiac chamber by blood as the exciting cause of its systole, there are left two opposing theories, both of which recognize that the automatic power of the heart lies in itself, and is quite apart from the central nervous system or the circulation of the blood. The researches of Gaskell, Engelmann, and others have given us certain facts which it is the province of the theories to explain, although these facts are sometimes lost sight of in the heat of discussion. These facts are based, of course, on the examination of vertebrate hearts in general; and it is the discovery that they are also true of human hearts which constitutes the important advance in clinical knowledge that has followed the application of physiological methods by Mackenzie[1] and Wenckebach[2] in this particular branch of practical medicine. The theoretical explanation of these facts is relatively unimportant although it is of great interest.

In considering any theory it is necessary to assume that the heart possesses certain properties in order to account for the phenomenon of its rhythmical beat, but many of these properties are also possessed by the undifferentiated protoplasm of the lowest forms of life. In the first place it must respond to stimulation, a property which is really divisible into two: (1) excitability, and (2) in this muscular organ, contractility. Since the heart is capable of beating when separated from all external stimuli, it must possess its own stimulus which excites it to contract. Experimentally it has been found that an artificial stimulus is conducted in all directions in the heart from the point stimulated. Consequently the heart owns the further property of conductivity. Like all muscle it also exhibits tone, and during life is never completely flaccid. Thus the heart has these five properties: a stimulus of its own, excitability, conductivity, contractility and tonicity. The point at which theoretical controversy arises is over the question, "In what anatomical components of the heart are these various properties seated?" In the heart we find a special kind of muscular tissue, nerve cells and fibres and connective tissue with blood vessels, etc. It is evident, therefore, that the foregoing properties must be situated either in the nervous or the muscular elements. Some observers attribute them almost entirely to the first, whilst others attribute them absolutely to the second. It is, of course, possible that they may be divided between the two tissues, and it is necessary, therefore, to consider each property individually and to weigh the evidence before assigning it to the one or the other.

Contractility, or the power of contracting, is evidently a function of the muscle fibres, and does not need further discussion. Muscle fibres do not contract unless they are stimulated, and in order to receive the stimulus they must be excitable. Ordinary striped muscle may be excited through its nerve fibres, and it has been contended that both it and the cardiac muscle fibres can only be excited through nerve fibres. The cardiac muscle cells are surrounded by a very close network of non-medullated nerve fibres, as can be demonstrated by modern methods of staining.[3] We now know also, contrary to what was previously believed, that, in mammalia at any rate, a quiescent heart may be made to respond with a contraction to each stimulus sent to it by the accelerator nerve.[4] It has been found impossible to eliminate by means of poisons the possible action of the accelerator nerve endings in cardiac muscle without seriously injuring the muscle itself. On the other hand, nerve fibres, when separated from their cells of origin, degenerate and in time become functionless, and there is no reason to suppose that the cardiac nerve fibres differ from others. Although new methods of staining have shown that ganglion cells are more numerous in the heart than was at one time supposed, yet no ganglion cells have been found in the apex of the frog's ventricle; and if this part be separated from the rest of the heart, the nerve fibres may be assumed to degenerate in a few days and become functionless. It has been found possible to keep such an apex preparation for twenty-one days or more in a condition in which it will respond by a contraction to a direct stimulus. Further, it has been found that certain stimuli, such as ammonia or weak acids, excite ordinary skeletal muscular tissue, but not nerves; while others, such as glycerine, excite nerves, but not muscle. The apex of the frog's heart is excited by ammonia and weak acids, but not by glycerine.[5] It is thus evident that the cardiac muscle possesses the property of excitability as well as contractility, quite independently of the nerves with which it is surrounded.

It has already been pointed out that if the heart be stimulated artificially at any point, the stimulus is conducted in all directions from the point stimulated. This may be explained in three ways. It was at one time suggested that the stimulus excited nerve endings which transmitted it to the ganglion cells, which in their turn excited the muscle tissue, but there is no convincing evidence of any such reflex action, and the regular progression of the contraction wave from the spot stimulated weighs strongly against any such hypothesis. A direct conduction of the stimulus may occur through the muscle tissue or by means of the all pervading plexus of nerve fibres. Although nerves have the power of conducting stimuli in both directions, the terminations of nerves are not the same at each end. It is only one end which is connected with a responsive tissue. Practically, therefore, effective stimuli which produce tangible results only pass along nerve fibres in one direction. In the heart, however, stimuli pass in all directions—as readily from ventricle to auricle as from auricle to ventricle, a phenomenon which is somewhat difficult to explain if the conduction be through nerve fibres. In favour of the neurogenic theory it is contended that facts derived from the study of isolated nerve fibres are not applicable to a nerve plexus, for a nerve plexus is a very complex structure whose properties are little known. Engelmann[6] attempted to solve the problem by the study of the rate of conduction in the heart, which he found to be 300 times less than the rate of conduction in the frog's motor nerves and to be remarkably influenced by bleeding, which has but small influence on the rate of conduction in nerve fibres. Here, again, it has been contended that arguments drawn from isolated nerve fibres cannot be applied to the nerve plexus in the heart; and Carlson,[7] working with the heart of *Limulus*, where the heart nerve fibres can be isolated, found the rate of conduction in them eight to ten times less than in the motor nerves of the same animal.* A stronger argument against the neurogenic theory is afforded by Engelmann's[8] zigzag experiments, which showed that a stimulus was conducted from end to end of one piece of cardiac muscle tissue, which had been cut into an irregular zigzag shape and in which every nerve fibre had probably been cut across at least once.

During a contraction the heart is refractory to further stimulation, and this refractory period has been shown to be due to the destruction, or at any rate the great diminution, of its contractility, excitability, and conductivity. It is the contraction that brings about this change, since a stimulus that is ineffective in producing a contraction does not alter these properties. After a contraction it can be shown that contractility, excitability, and

* It is to be noted that in this experiment the nerve fibres were separated from the ganglion, and that in another place (*Amer. Journ. of Physiol.*, xiii, 1905, p. 217) Carlson states that separation from the ganglion results in depression of conductivity. The evidence of depression relied on, however, is that after removal of the ganglion a local stimulation of the heart is often followed only by a local contraction not spreading all over the heart. The local character of this contraction might be explained by the depression of excitability and contractility which, as Carlson has shown, follows removal of the ganglion.