on a corrected cast of the foot. In very severe and neglected cases, which are stiff and painful—that is, have not a bony ankylosis—it is wise to arthrodesis both subastragaloid and mid-tarsal joints, thus imitating Nature's method of spontaneous cure.

As regards exercises, those done on tip-toe are bad, because they aggravate the shortening of the tendo Achillis. The tibialis anticus and sole muscles require cultivation by lifting marbles, pulling towels, etc. It is then necessary to re-educate the heel-and-toe walk, as revealed by cinema analysis to be the normal.

THE BLOOD SEDIMENTATION RATE IN PULMONARY TUBERCULOSIS ITS VALUE IN THE MANAGEMENT OF THE PATIENT

BY

HILARY ROCHE, M.D.MELB., M.R.C.P.LOND.,

T.D.D.WALES

MEDICAL SUPERINTENDENT, MONTANA HALL, MONTANA,
SWITZERLAND

Though it is generally accepted that the sedimentation rate of the red blood corpuscles is of definite value in the prognosis of pulmonary tuberculosis, the importance of this test as a guide to the regulation of rest and exercise does not yet appear to have received due recognition. This paper suggests the value of repeated estimations of the blood sedimentation rate (B.S.R.) in the above connexion.

Just as repeated recordings of the temperature and pulse rate are essential in pulmonary tuberculosis, so must estimations of the B.S.R. be repeated for the intelligent application of the information provided. Monthly tests are usually sufficient. During three years I carried out some 729 estimations of the B.S.R. on 244 patients. I have always employed the Westergren method, by which 1.6 c.cm. of blood is drawn into a 2 c.cm. syringe already containing 0.4 c.cm. of a 3.8 per cent. sterile solution of sodium citrate. All apparatus should be clean and dry, and the citrated blood, previously mixed by shaking and inverting, should be sucked up into the Westergren tube a few seconds after withdrawal. With platinum needles (size 16 or 17) frequently sharpened and having a flat bevel of medium length, no difficulty has been experienced in venous puncture. In the great majority of cases it is sufficient for practical purposes to read, at the end of the first hour only, the height in millimetres of the clear plasma above the red cells. Until the readings are complete the apparatus should be kept in a constant temperature of approximately 65° F. Cold retards the rate, warmth increases it.

Since altitude has the effect of diminishing the total mass of blood, there is an apparent increase of the red cells. This seems to modify the sedimentation of the cells in such a manner as to render the rate slower. All my estimations have been carried out at an altitude of 5,000 feet above sea-level. I have investigated the B.S.R. in but twenty apparently healthy individuals, and have never found a higher figure than 3 for the first hour in men and 4 in women. The usual figure is 2 in either sex. I assume a rate of under 4 to be normal in men and under 6 normal in women. It is desirable to avoid an estimation a few days before, during, or a few days after menstruation. Readings of from 4 to 15 in men and 6 to 15 in women I regard as representing a slight increase of the B.S.R. From 15 to 30 is a medium increase, from 30 to 50 a marked increase, and over 50 a very marked increase. This grouping is entirely personal and arbitrary. Low rates are generally regarded as of good prognostic

significance, though in emaciated patients with very advanced disease relatively low readings are almost invariable. The most likely explanation for the latter is that in cachexia the blood shows diminution of the fibrinogen and a lowered concentration of the serum protein. Increase of fibrinogen and serum globulin in the blood plasma is probably the most important factor in the production of an increased rate. In some individuals, more usually in women and most commonly in patients of a "nervous" temperament, it occasionally happens that the temperature will not quite settle within the usual limits of normality, and yet the B.S.R. is normal, or very nearly so. This may be apparent after the patient has had a more or less prolonged period of rest. While the temperature record might cause doubts as to the presence of activity, the B.S.R. in such cases confirms the physician's opinion, formed from other sources of information, that the extremely slight rise of temperature may be disregarded. When it is decided to allow these patients to move about and take exercise the temperature will usually settle to normal. From time to time normal readings occur in patients with a positive sputum. From the practical point of view the majority of such patients, particularly if the readings are consistently normal, may be regarded as little more than "carriers."

My experience of the B.S.R. in prognosis is that repeated estimations undoubtedly help in making more accurate the forecasts based on all the other available data. Prognosis will depend largely on the nature of the disease, the patient's resisting powers, the economic factor, the patient's temperament and character, and the response to any special treatment. Persistent rates in the "medium" group, or unstable rates, will tend to make the prognosis more or less guarded according to the varying significance of the other factors in each case. The persistence of "marked" or "very marked" increases in the rate over a prolonged period (six months or longer) generally indicates a bad outlook, even though such patients may remain afebrile for several weeks or months at a time.

BLOOD SEDIMENTATION RATE IN REGULATION OF REST AND EXERCISE

In pulmonary tuberculosis relapses, such as a rise in temperature and other signs of increased activity, an haemoptysis, or a pleurisy, etc., are commonly encountered. Prior to their onset the patient's temperature (including exercise reactions), resting pulse rate, general condition, and appearance may have been quite satisfactory, and even the exercise tolerance may have been high. In the absence of any special therapeutic means to prevent them, these relapses are apt to be regarded as unavoidable developments of the disease. This interpretation is undoubtedly true of a certain number of cases, but there is a not inconsiderable proportion of patients who may be spared such disappointments if the physician will, even in the presence of normal temperatures and pulse rates, greatly limit their activities until the B.S.R. has dropped to within the "slightly increased" group. The degree and duration of such limitation will vary with each individual case according to clinico-pathological, psychological, and other factors. In young patients with recent histories I generally prefer to wait until the B.S.R. has reached single figures before beginning exercise, particularly if the other factors suggest prudence.

As the B.S.R. is largely an index of the activity of the disease, its use in the regulation of the patient's activities would appear to have a rational basis, provided that it is interpreted with due regard to all the other evidence. The advantages of its use as a control over one's judgement in prescribing rest and exercise—some-

times a difficult question to decide—are its objectiveness for physician and patient, and its freedom from influences liable to upset the pulse and temperature. The necessity for every possible *objective* control seems obvious, particularly where graduated exercise forms a prominent part of the treatment. Experience in such cases as the following has caused me to adopt B.S.R. estimations as a guide in the regulation of exercise:

1. Male, aged 38. Tuberculous disease (largely fibrotic) of the right upper lobe, left upper lobe, and upper two-thirds of left lower lobe. Temperature and pulse rate within normal limits; B.S.R. 32. Graduated exercise was begun after the first fortnight. Three weeks later the patient was walking about three miles daily. "Colour" then appeared in the sputum, and the same evening the temperature rose half a degree above normal. An haemoptysis of about 10 oz. occurred during the night, and was followed, for the next few days, by a moderate rise of temperature. This settled to normal within three weeks. B.S.R. a fortnight after haemoptysis was 38. The patient was not allowed up for meals or exercise for a further three months, in spite of normal temperature and pulse rates. During this time sputum gradually diminished in amount and cleared up entirely, the patient began steadily to put on weight, and the B.S.R. dropped to 4. Graduated exercise was begun, and on his departure ten weeks later the patient was walking up to four miles a day, B.S.R. being 3. When last heard of, eighteen months after discharge, arrest of the disease had been maintained.

2. Male, aged 24. History of small haemoptysis six weeks prior to admission, but no constitutional disturbance. Radiography showed scattered infiltration of both upper zones. Neither radiography nor physical examination suggested any "breaking down" of the lesions. Patient was ambulant afebrile, with normal pulse, and general condition apparently excellent. Sputum was positive; half a drachm daily. B.S.R. on admission was 21. After one week's rest graduated exercise was begun. At the end of one month he was walking two miles a day; B.S.R. 20. Walking was increased to three miles. One week later haemoptyses (8 oz. each) occurred on two successive days, without any previous warning. Aspiration spread to the right lower lobe followed. Sputum increased for a month, and then gradually decreased. Temperature settled after two weeks, pulse after one month; B.S.R. three weeks after haemorrhage was 30. No walking exercise outside was allowed for three months. B.S.R. had then settled to 5. Graduated exercise was begun again. After a further three months he was walking up to five miles a day; B.S.R. 3. The patient left sanatorium with disease apparently arrested, and was well twelve months later.

In both of these cases it is probable that had the patients not been allowed to begin graduated walking exercise until the B.S.R. had approached normal, the relapse might in each instance have been avoided. The initial period of rest might have shortened the length of sanatorium treatment, and the patients been spared the disappointment of a "set-back." Even if only a small percentage of cases can be saved from relapses by means of the stricter control obtainable by repeated B.S.R. estimations I shall still feel that the method has justified itself. Moreover, the general morale of a sanatorium in which the "relapse" percentage among the "up" patients is low is obviously better than that obtaining where patients, after reaching various grades of exercise, are obliged, as a result of a "set-back," to return to their beds. From October 31st, 1930, to October 31st, 1931, of 117 tuberculous patients whose activities were regulated with due regard to the B.S.R., only four "up" patients suffered temporary relapses while under sanatorium supervision.

OTHER PRACTICAL APPLICATIONS OF THE TEST

A patient with normal temperature and pulse rate may, while under treatment, complain of being easily tired or in a vague way of "not feeling fit," and it is often difficult for the physician to decide whether the origin

of the symptoms is psychological or not. A normal, or nearly normal, B.S.R. would provide a strong indication of a mental origin, while a definitely increased rate, as compared with previous readings, would suggest caution and some restriction of the patient's activities. Patients who have had active disease sometimes return with some mild constitutional disturbance—perhaps loss of weight, anorexia, lassitude, etc.—but with a more or less normal temperature and pulse rate, and an absence of any definite information from physical examination and radiography. Here again the B.S.R. may be of value.

In artificial pneumothorax treatment effective collapse producing clinical improvement is always accompanied by an improvement in the B.S.R. If a patient with effective collapse develops rising sedimentation rates, even without any change in the temperature or pulse rate, one must be on the look out for fresh activity—usually the reactivation of old lesions in the contralateral lung, if there is no evidence of fluid on the side of the pneumothorax. Physical examination in these cases is often unsatisfactory, and in the early stages of activity x-ray evidence may be uncertain, especially if old lesions are present. The immediate importance of an increase of the B.S.R. (which in such cases may well be estimated once a fortnight) is in its calling for rest and extremely careful observation. The following case illustrates a rise in the B.S.R. which served as the first and only definite objective indication of fresh activity in the contralateral lung during the maintenance of an artificial pneumothorax:

Male, aged 26. Right artificial pneumothorax for extensive disease of the right upper lobe. Radiography showed two very small areas of coarse mottling in the left upper zone. There was slight impairment of percussion, but no adventitious sounds audible, in the left apical region. Good collapse was obtained with cessation of sputum and of all constitutional symptoms. The patient made excellent progress under sanatorium supervision. On discharge, after eight months, he was walking eight miles a day. The B.S.R., not estimated on admission, was 2 after the pneumothorax had been well established. He returned four months later, but was not under sanatorium supervision. Against instructions he indulged in strenuous exercise, and a few weeks later routine examination showed the B.S.R. to be 15. Radioscopy neither showed the presence of any fluid on the pneumothorax side nor suggested any extension or activity of the lesions in the contralateral lung. Physical examination was negative. He complained of not feeling as fit as usual and had lost 4 lb. in weight. This was attributed to over-exercise and late nights. He was advised to reduce his exercise by half, to retire early to bed, and to pay careful attention to the temperature record. He returned one week later when the temperature rose to 101°. Fine moist rales were audible at the left apex posteriorly, and a radiograph showed evidence of slight recent extension of the disease in the left upper zone. Positive sputum appeared a few days later. The patient responded completely to rest, temporary partial re-expansion of the collapsed lung, and sanocrysin.

A rise in the B.S.R. may occur before the onset of fever, haemoptysis, pleurisy, etc., and may be the first warning sign of such increased activity or complication. On the other hand, in some patients, particularly those in whom the rate is already appreciably increased, a further definite increase may not be noticed until after the fresh activity or complication is manifest. The use of the B.S.R. may also eliminate the necessity of frequent temperature readings. Provided that the prescribed exercise is not exceeded, it is unnecessary to take "exercise" temperature readings in patients with persistently good sedimentation rates, and once the latter appear to be stabilized at a satisfactory level only very occasional "resting" temperatures are required. This divorce of the patient from his thermometer is, in most cases, of definite psychological value.

The test may further be of assistance in deciding the length of the treatment required and the permissible extent of future activities. Wingfield and Goodman¹ have suggested that the test should prove of great value to the physician in the out-patient department, the dispensary, and in private practice, in pondering over such difficult questions as "Is this patient holding his own or not?"; "Am I justified in putting the patient to the trouble and expense of a more drastic form of treatment than I am giving at present?" Trail² is of the opinion that the B.S.R. should prove of value in assessing the length of home treatment required after the patient leaves the sanatorium. With these points of view I am in entire agreement. Moreover, repeated estimations will, in my experience, provide useful information in deciding as to the patient's future activities as regards occupation and exercise.

Finally, comes the question of after-care in cases of pleural effusion. All authorities are agreed that the majority of cases of sero-fibrinous pleurisy are due to the tubercle bacillus. It is also established that within a few years an appreciable number of these cases develop active tuberculosis of the lungs. Attention to the sedimentation rate during convalescence from pleural effusion should help the physician both to determine the length of

convalescence desirable and to regulate the patient's activities. Patients who have had a pleural effusion should be warned to return for examination if at any time symptoms suggestive of pulmonary involvement or of toxæmia appear, and, on such occasions, a sedimentation estimation should always be included in the routine examination.

CONCLUSIONS

The blood sedimentation rate is of proven value in the management of cases of pulmonary tuberculosis.

The technique is very simple. Readings at the end of the first hour are usually sufficient.

Regular and repeated estimations are essential.

It is strongly urged that the information provided by such estimations should be carefully considered when prescribing rest and exercise, particularly in patients whose temperatures and pulse rates are within normal limits. It is the writer's opinion that attention to this point will tend to minimize the risk of relapse.

REFERENCES

- 1 Wingfield, R. C., and Goodman, R.: The Rate of Sedimentation of the Red Blood Corpuscles in Pulmonary Tuberculosis, *Lancet*, October 16th, 1926.
- 2 Trail, R. R.: A Study of the Sedimentation Rates in 252 Cases of Pulmonary Tuberculosis, *Tubercle*, May, 1929.

ESSENTIAL HYPERTENSION: A REVIEW OF 100 CASES *

BY

ROBERT MARSHALL, M.D., F.R.C.P.I., D.P.H.

PHYSICIAN, ROYAL VICTORIA HOSPITAL, AND ULSTER HOSPITAL FOR CHILDREN AND WOMEN, BELFAST

The following paper is the result of an attempt to trace the after-histories of a group of persons who were in-patients in the Royal Victoria Hospital, Belfast, during the years 1926-30, and in whom a diagnosis of essential hypertension had been made. Cases of gross disease of the kidneys and of gross arterio-sclerosis have been excluded. The cases are presented in the form of tables, with commentary.

TABLE A.—Males, 42; average age, 59.3. Females, 58; average age, 53.3. Total cases, 100; average age, 55.6.

	1926	1927	1928	1929	1930
Males	4	14	5	9	10
Females	6	8	13	10	21
Deaths	2	8	4	2	3
Average duration of life after leaving R.V.H.	3 years' 3 months	2 yrs	11 months 4 months	7 months	
Did not report	2	3	3	2	3

TABLE B.—Age Distribution

	20-30	30-40	40-50	50-60	60-70	70-80	80-90
Males	1	0	3	19	15	3	1
Females	2	4	13	22	14	3	0
Deaths: Males ...	—	—	—	3	5	—	—
„ Females	—	2	3	3	3	—	—

Tables A and B require no comment other than the statement that the figure opposite the entry "Deaths" refers to the number of patients for each year who are now known to be dead. The higher death rate in females differs from the findings of Blackford, Bowers, and Baker¹ (70 per cent. in males and 39 per cent. in females), and those of Paullin² (48.7 per cent. in males and 9.2 per cent.

* Chairman's address, Belfast Division, British Medical Association, December 10th, 1931.

in females). Inquiry into occupation revealed nothing; the men followed twenty-seven different vocations, and the women were almost all married and engaged in housework. No one was employed in the manufacture or sale of alcohol, and in only eight cases could an "alcoholic" history be obtained.

TABLE C.—Family History of Cardio-vascular Disease

*Parent died of "stroke"	9
Parent died of "heart disease"	7
Sister or brother died of "stroke"	3
Sister or brother died of "heart"	2

* In one case both parents.

The above figures, too, are in contrast with those of Blackford, Bowers, and Baker, who found a family history of cardio-vascular disease in 33 per cent. of their cases.

TABLE D.—Previous Illnesses

Scarlet fever	17	1 pneumonia	7
Measles	13	Typhoid	6
"Rheumatism"	12	Gonorrhoea	2
Influenza	10	Syphilis	1

Table D confirms the observations of Nuzum and Elliott,³ who found typhoid fever and syphilis relatively rare precursors of hypertension. Councilman,⁴ Thayer,⁵ and Barach⁶ have stressed the importance of typhoid infection. Of the seventeen cases with a history of scarlatina, three had transient albuminuria, and one ultimately developed azotaemic nephritis.

In interviewing the patients who attended for re-examination I inquired whether they had been subject to palpitation or had easily excitable hearts in early life, as it has been suggested that it is the people who have "D.A.H." in youth who develop hypertension in middle life; I could not find that this applied to the patients under review.

TABLE E.—Principal Symptoms

Headache	62	Hemiplegia, monoplegia, or aphasia	12
Dyspnoea	42	Epistaxis	12
Digestive disturbances	30	Praecordial pain	11
Visual disturbances	19	Insomnia	11
General weakness	19	"Paraplegia"	3
Palpitation	15	? Syncopal attacks	3
Vertigo	15	Head noises	1