not be possible accurately to date the forms younger than the fully developed schizonts ready to rupture. In all the younger forms the nuclei were larger but much less numerous and the cytoplasm more abundant, the staining reactions remaining the same. The schizonts, which were ovoid or bluntly lobose in shape, were not quite so large as in the previous stage, but a large example would measure about $50\ \mu$ by $36\ \mu$ in the long and short diameters. This would probably represent a late fifth-day form.

Forms 92 Hours Old.—The schizonts were considerably smaller than the previous form, measuring about $31\ \mu$ by $26\ \mu$ in their longer and shorter diameters. They tended to be ovoid in shape, but lobose forms or forms constricted in the middle were already appearing. The blue cytoplasm was coarsely granular and the nuclei were much less numerous than in the previous stage. As in the cases of *P. cynomolgi* and *P. vivax*, there was no cellular reaction to the presence of the parasitic bodies in the liver tissue in any of the three stages described.

Comment

In comparing the various stages described with those found in *P. cynomolgi* and *P. vivax* it will be evident that the pre-erythrocytic forms of all three species are closely similar. Points of difference are the larger size of the mature schizont of *P. falciparum*, the smaller size of the merozoites, and the much greater number of these in the schizonts. The full maturity of the schizonts in less than six days proves that schizogony in the pre-erythrocytic forms of *P. falciparum* proceeds much more rapidly than in either *P. cynomolgi* or *P. vivax*.

The general impression gained, however, is that the three species must be considered closely related and that the genus *Plasmodium*, as exemplified in these three species whose essentially complete life cycles are now known, is a compactly knit entity the members of which conform closely to the generic pattern.

Summary

For the first time the existence of a pre-erythrocytic stage in the life cycle of *P. falciparum* has been demonstrated and the forms at three stages of development are briefly described.

We express our great indebtedness to many helpers who have assisted at various stages in the carrying out of this successful experiment. Our special thanks are due to Mr. C. Naunton Morgan, who performed the open operation on the liver with remarkable skill and celerity, to Dr. C. Langton Hewer, who gave up valuable time to administer the anaesthetic to the volunteer, and to the staff of the Hospital for Tropical Diseases for their assistance and care throughout the experiment. Dr. W. D. Nicol, physician superintendent of Horton Hospital, has earned our gratitude by granting the most ample facilities for the initial infection of the mosquitoes at Epsom and their subsequent use on the human volunteer. Mr. W. Cooper, chief technician, Miss Maryon, and Mrs. P. Lee gave invaluable and skilled assistance and spared neither time nor trouble in many tedious technical operations. The one indispensable actor in the piece was the human volunteer, Mr. C. H. Howard, who not only cheerfully, but on his own initiative, offered himself for this experiment and thereby helped greatly to advance scientific knowledge on an important aspect of malaria.

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REHABILITATION AND RESETTLEMENT OF THE TUBERCULOUS*

BY

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In all matters concerning the resettlement and rehabilitation of the tuberculous three factors are of paramount importance. The first is that it is impossible to be sure that a tuberculous person has completely recovered from his disability; the second is that there are no means of assessing a tuberculous person's capacity for work except by trial and error; and the third is that when the disease is active it is usually infectious. These three factors differentiate the problem of other disabled persons from that of the tuberculous and make it necessary to have special schemes to meet the requirements of the latter group. I propose to examine in more detail the three factors with special reference to resettlement and rehabilitation.

1. Uncertainty about Recovery

It is not easy to find reliable statistics on the relapse rate of those who have been treated in sanatoria. There are many reports on the post-sanatorium mortality rate which are helpful, but these do not indicate the amount of chronic invalidism amongst the tuberculous population. Here are some conclusions taken from studies of after-histories of patients.

Bashford and Scott (1936) in their report on the health of 3,755 Post Office workers state: "Of those who incur pulmonary tuberculosis not more than 50% are able to return to work even after prolonged periods of treatment, and of those who return there has been a further wastage of about 48% as a result of recurrent pulmonary tuberculosis, or other form of ill-health, by the end of ten years, the heaviest wastage having occurred in the first six years."

Tattersall (1949), in a five-year follow-up of sputum-positive cases, found that 10% of the "recovered" cases deteriorated after an average period of six years as "recovered." He suggests that a patient whose working capacity is reduced by phthisis is not always a short-term social liability, and that it is doubtful if there is any justification in discharging from supervision any tuberculous person who has had a positive sputum.

Such information, although emphasizing the need for special measures for rehabilitating the tuberculous, is not particularly encouraging, and it would be as well at this point to inquire why the tuberculous relapse and die. A satisfactory answer to this query cannot be given; all that can be said is that certain conditions predispose to activity of the disease. Which of these conditions is the most important varies from individual to individual. Under-nutrition, overstrain, anxiety, acute respiratory infections, insufficient rest, and certain occupational conditions are factors that influence the state of the lesion, and the facts may be summarized in a brief but vague way by saying that anything that lowers the resistance of the body to infection will increase the possibility of a breakdown from tuberculosis. This is really begging the question, as resistance is a term which cannot be defined. The inability of the body to rid itself of the tubercle bacillus is well known, and he would be a bold man who said that in any arrested

*Read in the Section of Occupational Health at the Annual Meeting of the British Medical Association, Harrogate, 1949.

case of tuberculosis no live tubercle bacilli were to be found in the body. Careful examination of even calcified lesions often reveals the presence of living bacilli, and so long as they are there it is possible for activity to develop.

The experience of two great wars and studies of the mortality figures of tuberculosis in relation to environment have shown that when the standard of living falls tuberculosis rises. Thus the first principle in the resettlement of the tuberculous is that the standard of living of tuberculous persons must be kept high. The mortality rates during the last ten years in countries like Denmark, Sweden, and the U.S.A., where the tuberculosis death rates actually fell during the war years, show clearly the relationship of the national standard of nutrition to tuberculosis mortality rates, and recent figures published in *Tubercle* (1948) reveal a close connexion between protein intake and tuberculosis mortality. It is therefore essential in any tuberculosis resettlement scheme to be sure that a good standard of nutrition is maintained. Housing, food, and clothing are items that must take a prominent part in aftercare, and it is possible that in the effort to provide suitable work insufficient attention has been paid to these equally important items.

It is not difficult to appreciate the advantages which the village settlement affords with regard to post-sanatorium medical supervision and provision of the most favourable environment for tuberculous persons, but there are many who cannot or will not be admitted to these institutions. For these it is proposed that the necessary medical supervision and the opportunity for rest, nourishment, and regulated life shall be provided by the night sanatorium. This institution should accommodate from 30 to 50 tuberculous persons who have completed or nearly completed their sanatorium treatment and are fit for three or more hours' industrial employment, preferably in special factories under the Disabled Persons Employment Corporation.

Priority of admission will be given to positive cases, and particularly to those who have unsatisfactory homes or no homes at all. It is anticipated that night sanatoria will enable patients to be discharged from institutional treatment at an earlier date than if they had to return home, and they will permit the discharge of patients who are now retained in sanatoria owing to home conditions. In this way they will relieve the bed situation without increasing the nursing shortage.

For the patient the night sanatorium provides a safe means of returning to industrial work by lessening the break between the rural environment of the sanatorium and the crowded conditions of the city dwelling. It also enables the patient to continue treatment in an environment that he appreciates and is generally longing to return to whilst under treatment in the country.

Rehabilitation is not merely a matter of providing suitable work for the disabled. The unstable condition of many tuberculous workers demands routine medical examination, including radiography and a careful search for the tubercle bacillus. This is particularly necessary after catarrhal colds or influenzal symptoms. Even in long-term arrested cases a yearly check is most desirable. This means close co-operation between resettlement schemes and the chest clinics of the regional hospital boards, or rehabilitation centres will need to have their own clinics attached to the industries. Careful record-keeping at chest clinics will be necessary if the value of rehabilitation schemes is to be judged, for at present there is no statistical evidence that persons at village settlements do any better in the long run than clinically comparable cases under good domiciliary conditions,

particularly if an equal amount of money and care is spent on them.

2. Assessment of Capacity for Work

That overstrain can cause a quiescent lesion to become active has been recognized for many years, and if such activity is not treated a serious breakdown in health will occur. At present only by giving a man a certain job is it possible to determine if he is capable of working. The practice, therefore, is to begin with short hours on light work, and, if the man remains healthy and shows no signs or symptoms of active disease, to increase the amount of work periodically. This method is unscientific, and, although some valuable pioneer work has been done by Brieger at Papworth, we are still a long way from solving this important problem of rehabilitation. It is necessary for the physiologist, the biochemist, and the psychologist to pool their services for research into this matter.

It can be stated that certain occupations are unsuitable for tuberculous persons, and on this point I would like to emphasize that practically all outdoor jobs are unsatisfactory for the tuberculous on account of the fatigue and exposure they involve. Other occupations that are contraindicated are the dusty trades and those involving irritating fumes, and especially those harmful dusts containing silica, as well as trades demanding work in conditions of high relative humidity or extremes of temperature. Heavy muscular work and high-pressure team-work are also undesirable. These restrictions, based on observation of the behaviour of tuberculous persons who have tried working under such conditions, limit the range of employment to be recommended in a rehabilitation scheme. At Papworth and Preston Hall the following industries and occupations have been carried on with successful results: printing, woodwork, clerical work, leather work, fancy goods manufacture, light engineering, and tuberculosis nursing.

Of course a condition other than the man's physical fitness has to be considered, and that is his technical ability to do the work. Where a man has to change his occupation it is usually necessary to give him a long course of instruction before he can be of any economic value. At Preston Hall a scheme has been developed by which the man can not only be trained to do a particular job but can, if he wishes, be fully apprenticed to a trade, so that eventually he becomes a skilled workman with a comprehensive knowledge of his subject. Such training is essential for young men, but it is not usually acceptable to the more elderly. The incidence of tuberculosis is steadily rising in the older age groups in males. This will probably complicate resettlement schemes, as these elderly persons do not take kindly to village settlement life and are not keen on training for a new job, although their previous occupation is often not very suitable. It is probable that the Remploy factories of the Disabled Persons Employment Corporation will be a great help to these people in the future.

The amount of work tuberculous persons can do even when their disease is arrested is usually less than that done by normal persons, and the rate at which they work is often slower. If they are employed on sanatorium staffs three tuberculous persons are needed to do the work that could be done by two normal persons. The only way to speed up production by tuberculous persons is to put them in charge of machines that do the work almost automatically and require the minimum of energy expenditure. Large amounts of capital are required to carry this out successfully and establish a productive industry. Failing this, the employment of the tuberculous is apt to develop into the nature of handicraft work which has little or no prospect

of providing a livelihood. In fact, over-concentration on handicraft work is one of the great obstacles to successful rehabilitation schemes. Unless the handicraft work is directly related to the type of work in which the patient will ultimately be trained, it is largely a waste of time and may easily create the invalid complex which prevents the man having the confidence to accept training in a trade by which he can be eventually self-supporting.

3. Danger of Infection when Disease is Active

There are two schools of thought on the infectivity of tuberculosis. One school believes that the development of active disease is determined mainly by the degree of inherent or native resistance, other important factors being the age at which primary infection occurs and the magnitude of the dose of the primary infection. If the primary infection is overcome it is thought that small reinfections tend to raise the general resistance to the disease so that active disease can occur only if the reinfecting dose is very large, and, as this is unlikely except under very close contact, it is argued that exogenous infection, other than the primary infection, plays only a small part in causing active disease in those already infected. Relapses are considered to be due to lowering of the resistance, which allows a spread of the lesion sometimes from a sudden bacillaemia arising from rupture of a tubercle into a blood vessel.

The other school puts much greater stress on the importance of exogenous infection and regards exposure even to small doses of the bacilli as dangerous. Although the evidence is by no means complete, it is probable that inherent resistance is the most important factor and that after the primary infection has been overcome only large and often-repeated exogenous infections are of any danger. If this is true it has a considerable bearing on the planning of rehabilitation schemes. It means that the tuberculous and non-tuberculous can be employed together without undue risk, provided the non-tuberculous have overcome their primary infection, are adequately nourished, have a good standard of living, and work under hygienic conditions. Tuberculosis will spread among them if any of these conditions are neglected. In other words, the soil is of more importance than the seed in preventing the spread of infection.

Even if such conclusions are correct it will be extremely difficult to apply them; for the general public have a great fear of tuberculosis, and we have to accept the fact that tuberculous persons are usually resented by their fellow workers, who always blame the known case for the development of the disease in any contact, whereas the fresh case may be entirely due to exacerbation of an old focus and have nothing to do with contact at all. Therefore, until more is known of the incidence of infection among the population and a less fearful attitude towards tuberculosis is established, it is wise not to have open positive cases in normal industry except in special circumstances that will satisfy the demands and calm the fears of the management and other employees.

Another difficulty that arises from the infectious nature of the disease is the possibility of products of the industry carrying the infection. Here again the danger is more imaginary than real, except where children are concerned, but there is evidence that woollens, furs, and books can retain the bacillus for a number of days. It is therefore unwise to teach tuberculous persons to make woollen or fur toys and children's play-mats, for, although these can be adequately sterilized when made under supervision, there is no such safeguard when the goods are made at the patient's

home and sold privately. No fear of spreading the infection by polished wood or metal goods need be entertained, and there is no need to sterilize the usual products of printing, leather, or wood. But it is not good policy to employ tuberculous persons on any work connected with the preparation of food, and this includes the picking of fruits and gathering salad plants, although here again the risk has been exaggerated through repetition of unproved statements on the danger of infection.

Some day, when we have the courage to act on our convictions, this bogey of infection will be dispelled by making people realize that it is the inherent resistance to the disease that really matters once the primary infection has been overcome. If the public is to be educated along these lines we must begin by scrapping most of the pamphlets on the danger of infection and publish new ones based on recent advances in the pathogenesis of the disease.

Finance

The greatest difficulty of all in rehabilitation and resettlement is that of finance. It is best to be frank and recognize at the outset that the average tuberculous worker is a poor financial proposition to the employer unless there is capital to provide the special conditions under which he can work with safety and efficiency. In the Spero works in London, where an average of 62 mostly sputum-positive tuberculous persons are employed under sheltered conditions, there was a loss of 1,980 working days owing to sickness during 1947.

Although some of the persons employed in this special factory are severely disabled, the figures give an indication of the high liability involved in employing tuberculous persons without attention to living conditions. Nevertheless it is worth while providing sheltered employment for these people, who would otherwise lounge about the streets and their homes, living under the degenerating influence of enforced idleness. But in order to employ such precarious labour heavy financial assistance is needed to maintain a sufficiently high standard of living.

To enable him to live, a disabled tuberculous person can obtain the necessary financial assistance from various sources, depending on his clinical status. Whilst he is a patient his treatment will be free and he will be entitled to national health insurance benefit and a grant up to 20s. a week for any productive work. During post-sanatorium training and rehabilitation he may receive board and lodging, national health insurance benefit, and the grant up to 20s. per week for his productive effort. The Ministry of Labour and National Service has authority to contribute to the cost of the person's rehabilitation, and approved persons in training centres get a grant of 28s. per week for a maximum period of three years; they also receive free board and lodging if residing in a hostel in the village settlement.

Some of the larger local authorities have accepted financial liability for the maintenance of persons undergoing rehabilitation at industrial settlements as part of their obligations under Section 28 (3) of the National Health Service Act. It is possible, therefore, in such circumstances to assure the training and resettlement of a tuberculous person provided the contributions from the authorities mentioned continue. Where such assistance is not forthcoming it is difficult to arrange for adequate rehabilitation. A serious obstacle may arise in the development of rehabilitation schemes if local authorities take advantage of the permissive clause in Section 28 (2) whereby they may recover charges from a person receiving aftercare services, which it is presumed includes rehabilitation, having regard to the person's means.

Any suggestion of a means test at the stage when a subject is about to begin a course of rehabilitation will cause many to refuse to accept such services. Many chest physicians believe that rehabilitation is a part of treatment, and if this is free then rehabilitation should also be free. It is hoped that those responsible will realize that the harm that will be done by application of a means test and the collection of small sums from the disabled can never be compensated by the financial gain to public funds.

Summary

Three difficulties complicate the rehabilitation of the tuberculous: (1) it is impossible to be sure that a tuberculous person has completely recovered from his infection; (2) there are no means of assessing the tuberculous person's capacity for work, except by trial and error; and (3) persons with active tuberculosis are usually infectious.

Each of these difficulties is discussed, and suggestions are made for overcoming them. The financial problem is perhaps the most difficult to solve.

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PROSTATIC OBSTRUCTION*

BY

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Over a period of eight years 2,192 patients were admitted to my wards with symptoms due to non-malignant disease of the prostate, and of these 1,960 were submitted to prostatectomy, with an overall mortality from all causes, whether attributable to the operation or not, of 3.01%. In private cases the mortality was 1.96%. The following Table gives a detailed report on these results.

Results of Treatment of 2,192 Cases of Prostatic Obstruction (Non-malignant). 1,960 Cases Submitted to Prostatectomy, With a Mortality from All Causes of 3.01%; 44.9% Admitted with Acute Retention

	No. of Patients	Percentage of Total	No. with Acute Retention in Each Group	Mortality
Perurethral prostatectomy ..	1,347	61.4%	510 (37.8%)	41 (3.04%)
Suprapubic prostatectomy ..	613	27.9%	291 (47.5%)	18 (2.93%)
One-stage ..	363		143	12
Two-stage ..	250		148	6
Suprapubic cystostomy† ..	183	8.3%	135 (73.8%)	13%
No operation ..	49	2.2%	—	—

A patient aged 90 had a perurethral prostatectomy successfully performed. There was a consecutive series of 150 prostatectomies without a death.

† A number of these cases will be suitable for prostatectomy later.

Causes of Death following Prostatectomy

Cardiac failure ..	25	Malignant endocarditis ..	1
Coronary thrombosis ..		Cerebral abscess ..	1
Pulmonary embolism ..		Haematemesis ..	1
Uraemia ..		Cerebral tumour ..	1
Clot retention ..	8	Tetanus ..	1
Cerebral thrombosis ..	5	No records available ..	5
Shock and collapse ..	7		

During this period it was evident that doctors tended to send their good-risk cases to the voluntary hospital and their poor-risk cases to the municipal hospital. A surgeon working only at a voluntary hospital has therefore an

unfair advantage so far as results are concerned. In the series here recorded the cases were admitted to both voluntary and municipal hospitals and to a nursing-home, and it is thus possible to judge the results of prostatic surgery carried out on a cross-section of the community.

The operations were performed by various routes—the perurethral, transvesical, and retropubic.

Acute Retention as a Result of Prostatic Obstruction

A man apparently in good health may suddenly and painfully be made aware that he suffers from a prostatic obstruction by the development of an acute retention, for which the doctor may be asked to see him for the first time. This apparent misfortune may be a blessing in disguise by directing attention to the need for radical treatment. The doctor's decision regarding the immediate treatment may profoundly influence the subsequent course of the illness. He has the choice of several methods of procedure, and I give the three best in order of preference: (A) Injection of morphine $\frac{1}{4}$ gr. (11 mg.) and immediate transportation of the case to hospital; (B) catheterization; (C) suprapubic aspiration.

(A) There is no doubt in my mind that this is the best course to adopt. The patient is immediately placed under the best conditions, and any procedure can be carried out with strict asepsis.

(B) If the patient is living in the country far from a hospital or is unfit for removal for any reason, then catheterization is permissible. The passage of a catheter should be regarded as of the same importance as a major operation. The dangers of catheterization are: (i) Trauma of the mucous membrane of the urethra, with the risk of opening venous sinuses; this may be followed by rigors and sepsis. (ii) Introduction of infection. (iii) Rapid decompression of the bladder with its attendant risks of suppression of urine and haemorrhage, particularly when an acute retention is superimposed upon a pre-existing chronic retention. (iv) Failure of catheterization.

The avoidance of trauma is of paramount importance. In the ordinary way the beak of the catheter loses its lubricant in the first part of the urethra and passes along the remainder unlubricated, and is apt to cause trauma. This difficulty can be overcome if the technique described below is carried out, and, moreover, failure of catheterization will be very rare indeed.

FIG. 1

*Read in opening a discussion in the Section of Surgery at the Annual Meeting of the British Medical Association, Harrogate, 1949.