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REPORT ON THE WHO/SPC REFRESHER COURSE ON TUBERCULOSIS

Nouméa, New Caledonia
17 July - 11 August 1964

by

Robert Marks, M.D.
WHO Consultant

S. C. Wigley, M.D.
SPC Consultant

and

J. C. Tao, M.D.
Regional Tuberculosis Adviser
WHO Regional Office for the Western Pacific

World Health Organization
Regional Office for the Western Pacific
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CONTENTS

1. INTRODUCTION

The first WHO tuberculosis refresher course for assistant medical officers in the South Pacific island territories was held in Suva, Fiji, from 14 January to 6 February 1959. Before closing, the participants and the faculty expressed the hope that a similar course would be organized at some future date. Plans were therefore made to organize a second course in 1964, although this time it was agreed that the South Pacific Commission would be a co-sponsor. The course was held in Noumea, New Caledonia at the Headquarters of the Commission, which provided all the administrative services required. A list of the participants is given in Annex 1.

Dr. Guy Loison, the Executive Officer for Health, South Pacific Commission, was appointed as Director of the Course and Dr. J.C. Tao, WHO Regional Adviser in Tuberculosis, served as operational officer. Dr. R.H. Marks, Chief, Tuberculosis Branch, Department of Health, State of Hawaii, United States of America, and Dr. S.C. Wigley, Tuberculosis Specialist, Medical Services, Territory of Papua and New Guinea, served as consultants.

The course was officially opened by Mr. W.D. Forsyth, Secretary-General of the South Pacific Commission on 17 July 1964. Lt. Colonel Anraedt, Director, the Gaston Bourret Hospital, Noumea, welcomed the participants on behalf of the High Commissioner of the New Caledonian Government. Dr. J.C. Tao presented a statement on behalf of the Director of the WHO Regional Office for the Western Pacific and Dr. Guy Loison reported on the preparations made for the course. Dr. R.H. Marks and Dr. S.C. Wigley presented statements on the general principles of tuberculosis control.

2. OBJECTIVES OF THE COURSE

The main objectives of the course were:

(1) To give the participants an intensive review of all aspects of anti-tuberculosis work with special emphasis on prevention, case-finding and chemotherapy.

(2) To introduce to the participants essentially practical, realistic methods of control applicable to the working conditions in the participants' respective territories.

3. CONTENTS OF THE COURSE

Every important aspect of modern tuberculosis control was covered in the course (see Annex 2). To make the contents more comprehensive and interesting, lectures were interspersed with demonstrations, practical training, field trips, discussions and film projections.

3.1 Lecture - discussion

Each lecture period was divided into two parts. In the first, a formal lecture was given and the second was spent on questions and free discussions. Over forty recent publications from various leading study centres in the field of tuberculosis were distributed to participants, usually on the day prior to the discussion of the subject concerned.

There was no formal presentation of lectures. The speakers introduced the selected subject freely on the basis of a prepared outline. Each day, one of the participants was selected, according to a pre-arranged schedule, to serve as the rapporteur for that particular day. After the discussion of a broad subject was completed, a summary report was prepared by the rapporteurs concerned in consultation with the discussion leaders. A summary report on the whole course is given in Annex 3. This arrangement enabled the participants to take an active part not only in the discussions, but also in summarizing the conclusions.

3.2 Demonstrations and practical training

Considerable time was spent in demonstrating and practising techniques related to tuberculin testing, tuberculin reading, the reading of chest X-ray films, BCG vaccination and laboratory examination of sputum for acid-fast bacilli. The facilities of the School of Medical Services, the Gaston Bourret Hospital, and the Pasteur Institute, Nouméa, were utilized to the fullest possible extent and the medical officers-in-charge of these services co-operated most enthusiastically. At the end of the course, all participants were well acquainted with the above techniques and were able to perform them with confidence.

3.3 Field visits

The following field visits were arranged:

(1) Tuberculosis wards, Gaston Bourret Hospital
(2) Tuberculosis Sanatorium at the Col de la Pirogue
(3) The Leprosarium at Ducos
(4) The thermal baths at La Crouen
(5) The case-finding and BCG vaccination activities conducted at Nakety
(6) Touaourou Village

3.4 Film projections

The following films were shown:

(1) "Physiopathology of Tuberculosis"
(2) "Dynamics of the Tubercle"
(3) "Sputum Examination"
(4) "Mass Chest Radiophotography Service"
(5) "Physiopathology of Chronic cor pulmonale"
(6) "Preparation of Medium for the Cultivation of Tubercle Bacilli"
(7) "Spontaneous Pneumothorax - Mechanism and Management"

In addition to the above, over 200 micro X-ray recordings showing fundamental procedures in chest roentgen interpretation, pulmonary infections, radiological considerations in the diagnosis and treatment of pulmonary tuberculosis compiled by the workers of Chicago, Illinois, United States of America, were presented. (These slides were produced by the Micro X-ray Recorder, Inc., 3755 W. Lawrence Avenue, Chicago 25, Illinois, United States of America.)

3.5 Special topics for discussion

Two morning sessions were allotted to subjects of special interest. A number of topics were brought up for discussion either by the participants or by the resource personnel. The following are some of the subjects considered:

(a) non-specific tuberculin sensitivity,
(b) methods of teaching the public,
(c) epidemiology of tuberculosis, and
(d) disposal of the chronic spreaders of drug-resistant organisms in the community.

3.6 Country report

Prior to the opening of the course, each participant had been requested to submit a summary giving information on the general background, the extent of the tuberculosis problem, and the tuberculosis control activities in his country. Two days were spent on the individual country reports to permit a thorough discussion of the conditions in each territory. Future co-ordination between territories and the World Health Organization was thoroughly discussed.

3.7 Evaluation and follow-up

Halfway through the course each participant was asked to complete an evaluation questionnaire. This evaluation was repeated at the end of the course and discussed in an open evaluation session. The answers to the questionnaires were unsigned in order to ensure that a frank appraisal was made.

It was interesting to note that during the first evaluation two participants thought the presentation of topics not so satisfactory, one considered the topics not applicable to his local problems and the other one did not feel he had had an adequate opportunity to express views or raise questions. In the second evaluation almost all participants found the topics discussed, the presentation and the usefulness of the course very satisfactory. All participants expressed the wish that a similar course should again be arranged by the same sponsors in 1967 or 1968.

The participants were informed that as they had been granted fellowships from WHO and the Commission to attend the course, they would receive, at six and twelve-month intervals, follow-up forms to be filled in. They would be asked to give as much information as possible about their work, how the course had helped them and how they were able to apply the knowledge gained in their work.

3.8 Future co-ordination

The participants were informed that the course should be considered as the preparatory phase for the operation of a co-ordinated tuberculosis control programme in the South Pacific island territories. They were free to write to the consultants and the operational officer, about any technical problems they might face.

The group was informed of the WHO/UNICEF assistance being given to the tuberculosis programmes in Western Samoa, French Polynesia and the New Hebrides. It was suggested that their Administrations might be interested in the services of the members of the WHO Regional Tuberculosis Advisory Team (an epidemiologist, a bacteriologist, a statistician, a public health nurse and an X-ray technologist), which would visit the area in 1966. If the territories, other than the three mentioned above, wish to extend their activities in BCG vaccination, case-finding and domiciliary chemotherapy for tuberculosis, the possibility of organizing a joint project using one of the territories as a central supply centre, might be considered. This arrangement would greatly simplify the shipment of UNICEF supplies and equipment. It would also result in economies as equipment could be shared.

4. ADMINISTRATIVE ARRANGEMENTS

4.1 Interpretation and translation

The Commission assigned two interpreters/translators to the course for its entire period. In view of the participation of several French-speaking discussion leaders and two participants who spoke only French, this assistance greatly facilitated the discussions.

4.2 Finance

The Finance Officer of the South Pacific Commission acted as WHO Representative in connection with the payment of WHO commitments on-the-spot. This arrangement worked out exceedingly well.

4.3 Travel

Participants arriving at Noumea were met at the airport by the Director and/or the Operational Officer of the course. All arrangements in connection with return travel were made by the Travel Officer of the South Pacific Commission.

4.4 Transportation

Transportation for the participants and consultants to and from the airport was provided by the South Pacific Commission, and during field trips by the French Government.

4.5 Accommodation

All the participants were lodged in Wing 7 of the South Pacific Commission building where the facilities provided were extremely satisfactory. The meeting room was spacious and equipped with facilities for simultaneous interpretation. An adjacent room was used for film projection. Participants were free to use the recreation room and the library housed in the same building. Four separate offices were provided for the consultants and the operational officer.

5. ACKNOWLEDGEMENTS

The writers of this report wish to acknowledge with gratitude the great help they received from many persons.

The Secretary-General of the South Pacific Commission, Mr. W.D. Forsyth, took a great interest in the preparation and the conduct of the course. He gave much valuable advice and a great deal of encouragement and support throughout the course. He personally conducted the opening ceremony and the closing session. His unfailing courtesy, wide experience and sincere collaboration did much to ensure that arrangements worked smoothly.

The support given by Dr. Orsini, the Director of Health Services, New Caledonian Government, was most valuable. From the very beginning he made available the services of members of his staff for lectures and demonstrations. Our thanks are due to Dr. Jean-Claude Carré, Specialist in Pneumo-Phthisiology, Gaston Bourret Hospital, Dr. Guy Desmoulins, Director, Pasteur Institute, Noumea, and Dr. Jacques Mauvais, Specialist in Electro-Radiology, for their excellent lectures and demonstrations. Mr. Porche, Chief of Department of Education, made available Dr. Jacqueline Exbroyat, Chief, School of Medical Services and to them also we are grateful. We are also indebted to Mr. B. Hébert, Second Commissioner for France with the South Pacific Commission who, during the preparatory stages of the course, did so much to have effective liaison established between the Government and the Commission concerning a good many administrative matters.

The assistance of Mr. F.C. Thorburn, Finance Officer, Mr. H. Beer, Chief, Services and Maintenance, Mr. S.M. Drummond, Record and Travel Officer, Mr. I. Boyd, Assistant Finance Officer, Mr. T.B. Halbert, Services Officer, Miss N. Horan, Senior Accountant and Mme. Margaret Dalebroux, Secretary to the course, was invaluable. A heavy load of duty fell upon Miss S. Exbroyat, Secretary, Health Section, which she discharged with ability and never-failing courtesy. Mme. D.J.Wright and Mme. G. Barrau rendered a splendid service in interpretation.

Last but not least, tribute should be paid to the participants whose interest and co-operation were outstanding. It was indeed a great pleasure to meet them and we hope to be able to collaborate more closely with them in the future.

ANNEX 1

LIST OF PARTICIPANTS, RESOURCE PERSONNEL AND STAFF OF THE WHO/SPC REFRESHER COURSE ON TUBERCULOSIS

Nouméa, New Caledonia
17 July - 11 August 1964

1. PARTICIPANTS:

Dr Joji Arakaki,
Director, Koza Hospital,
Goya, Koza-shi,
Okinawa, Ryukyu Islands

Madame Liliane Bernut,
Infirmiére,
Hôpital de Nouméa
Nouméa, Nouvelle Caledonie

Dr John Kalsakau,
Médecin Assistant,
Hôpital Francais,
Port Vila, Nlles-Hébrides

Dr Ngas Kansou,
Assistant District Director of Medical Services,
Medical Services Department,
Truk District,
Moen Island, Truk
Eastern Caroline Islands, TTPI

Dr Kila Wari Luis,
District Medical Officer,
Public Health Department,
Toringay, Manus, TPNG

Dr Yasuski Miyagi,
Naha Hospital,
Naha-shi,
Okinawa, Ryukyu Islands

Dr Faga Titifanna Panapasa,
Assistant Medical Officer (A)
Tamarua Hospital,
Suva, Fiji

Dr Lanu Penaia,
District Medical Officer,
Safotu District Hospital,
c/o Health Department,
Apia, Western Samoa

Dr Faanoa H. Pine,
Tuberculosis Control Officer,
Medical Department,
G & EIC

Dr H.D. Tafatu,
Assistant Medical Officer (Tuberculosis)
Niue Hospital, Niue

Monsieur Marcel Thibaudet,
Assistant Médical pour la lutte Antituberculeuse,
Institut de Recherches Médicales Papeete,
B.P.30, Papeete, Tahiti,
Polynesie Francaise

Dr Minosu Francisco Ueki,
Tuberculosis Control Officer, Palau,
Medical Department, Palau District,
Koror, Palau,
Western Caroline Islands, TTPI

Dr Saleki T. 'Uhila,
Medical Officer,
Mua Dispensary,
Tatalamotonga,
Tonga Islands

2. RESOURCE PERSONNEL:

2.1 Full-time

Dr Robert H. Marks,
Chief, Tuberculosis Branch,
Department of Health, State of Hawaii,
Honolulu, Hawaii, USA

Dr J.C. Tao,
Regional Tuberculosis Adviser,
WHO/WPRO,
Manila, Philippines

Dr Stanley C. Wigley,
Senior Specialist (Tuberculosis),
Public Health Department,
Port Moresby, TPNG

2.2 Part-time

Miss P. Attneave,
WHO Public Health Nurse,
c/o Chief, Condominium Director of Medical Services,
Port Vila, New Hebrides

Dr Jean-Claude Carré,
Specialist in Pneumo-phthisiology,
The Gaston Bourret Hospital,
Nouméa, New Caledonia

Dr Guy Desmoulins,
Specialist in Biology,
Director, Institut Pasteur
Nouméa, New Caledonia

Dr Jacquelin Exbroyat,
Chief, School Medical Services,
Nouméa, New Caledonia

Madame H. de Hollanda,
Health Education Officer,
South Pacific Commission,
Nouméa, New Caledonia

Dr Guy Loison,
Executive Officer for Health,
South Pacific Commission,
Nouméa, New Caledonia

Dr Jacques Mauvais,
Specialist in Electro-radiology,
The Gaston Bourret Hospital,
Nouméa, New Caledonia

Dr Akio Tanaka,
Statistician,
Regional Tuberculosis Advisory Team,
c/o WHO/WPRO,
Manila, Philippines

Miss Ellen Wilhelmsson,
Public Health Nurse,
Regional Tuberculosis Advisory Team,
c/o WHO/WPRO,
Manila, Philippines

3. STAFF:

Dr Guy Loison,
Executive Officer for Health, SPC,
Director of the Course

Dr J.C. Tao,
Regional Tuberculosis Adviser, WHO/WPRO,
Operational Officer for the Course

Mlle S. Exbroyat,
Secretary, Health Section, SPC

Mrs D. Wright,
Interpretor/Translator, SPC

Mrs G. Barrau, Interpretor/Translator, SPC

Mr F.C. Thorburn, Finance Officer, SPC

Mr H. Beer,
Chief, Services and Maintenance Section, SPC

Mr S.M. Drummond, Record and Travel Officer, SPC

ANNEX 2

THE PROGRAMME OF THE WHO/SPC REFRESHER COURSE ON TUBERCULOSIS

Nouméa, New Caledonia
17 July - 11 August 1964

Friday, 17 July

08.30 Registration (Wing 7, SPC)
09.30 Inaugural Meeting (Central Hall, SPC)

- Opening speech, Mr W.D. Forsyth, Secretary-General, SPC
- Message from Dr I.C. Fang, Regional Director, WHO/WPRO, delivered by Dr J.C. Tao
- Address of the High Commissioner, New Caledonia Government, delivered by Dr Anraedt
- Report on the preparation of the Course - Dr G. Loison, Director of the Course
- Speech - Dr R.H. Marks, Consultant, WHO
  Dr S.C. Wigley, Consultant, SPC

11.00 Introduction to the Course (Wing 7) - Dr J.C. Tao
14.00 Development of present knowledge about tuberculosis - Dr S.C. Wigley
16.00 Brief review of the pathogenesis of tuberculosis - Dr J. Carré

Saturday, 18 July

08.30 Community tuberculosis case-finding - Dr R.H. Marks
10.15 Community organization for tuberculosis case-finding - Mrs H. de Hollanda

Monday, 20 July

Diagnosis of Tuberculosis

08.30 Introduction - Dr R.H. Marks
09.00 Clinical Diagnosis - Symptoms, physical examination, blood sedimentation rate, bronchoscopy, etc. - Dr J. Carré
10.45 Tuberculin testing - preparation, techniques, interpretation - Dr S.C.Wigley
14.00 Tuberculin testing - factors influencing results of testing - Dr R.H. Marks
14.45 WHO-recommended techniques of tuberculin testing - Dr J.C. Tao

Tuesday, 21 July

08.30 Demonstration and practice of tuberculin testing on schoolchildren - Dr J. Carré
Dr J. Exbroyat
Miss E. Wilhelmsson
Miss P. Attneave

Wednesday, 22 July

08.30 Tuberculin testing - Value in a tuberculosis control programme - Dr R.H. Marks

Wednesday, 22 July (cont'd)

10.15	Discussion on tuberculin testing
14.00	Importance of recording and statistics in a tuberculosis control programme - Dr A. Tanaka
15.45	WHO-recommended records and forms for use in a tuberculosis control programme - Dr A. Tanaka

Thursday, 23 July

08.30	Bacteriology of tuberculosis - Dr G. Desmoulins
10.15	Examination of tubercle bacilli - Techniques - Dr G. Desmoulins
14.00	Importance of bacteriological diagnosis of tuberculosis - Dr R.H. Marks
15.45	Open discussion on the laboratory diagnosis of tuberculosis
20.00	Film - Sputum examination

Friday, 24 July

08.30	Demonstration and practice on tuberculin reading - Dr J. Carré Dr J. Exbroyat Miss E. Wilhelmsson Miss P. Attneave
1545	Statistical analysis of the results of tuberculin testing - Dr A. Tanaka

Saturday, 25 July

08.30	Non-specific tuberculin sensitivity - Dr J.C. Tao

Monday, 27 July

08.30	Radiological examination of the chest - Dr J. Mauvais
10.15	Differential diagnosis of pulmonary tuberculosis - Dr R.H. Marks
14.00	Principle of photoflourography and demonstration of techniques - Dr J. Mauvais
20.00	Films - Mass chest radiophotography service - "Physiopathologie du coeur pulmonaire chronique" (Physiopathology of chronic cor pulmonale)

Tuesday, 28 July

Treatment of Tuberculosis

08.30	Factors influencing treatment of tuberculosis - Dr J. Carré
10.15	Demonstration of tuberculosis cases -Dr J. Carré (Tuberculosis Ward, Gaston Bourret Hospital)
14.00	Management of tuberculosis on individual basis - Dr S.C. Wigley

Wednesday, 29 July

08.30	Group A :	Demonstration and practice of laboratory diagnosis of tuberculosis - Dr G. Desmoulins
	Group B :	Reading of X-ray films - Dr R.H. Marks
14.00	Group A :	Reading of X-ray films - Dr R.H. Marks
	Group B :	Demonstration and practice of laboratory diagnosis of tuberculosis - Dr G. Desmoulins

Thursday, 30 July

08.30	Group A :	Demonstration and practice of laboratory diagnosis of tuberculosis - Dr G. Desmoulins
	Group B :	Reading of X-ray films - Dr R. H. Marks
14.00	Group A :	Reading of X-ray films - Dr R. H. Marks
	Group B :	Demonstrations and practice of laboratory diagnosis of tuberculosis - Dr G. Desmoulins
20.00	Film - Preparation of culture medium	

Friday, 31 July

08.30	Hospital vs domiciliary chemotherapy - Dr R.H. Marks
10.15	Hospital vs domiciliary chemotherapy - Dr S.C. Wigley
14.00	Problems of domiciliary chemotherapy - Dr S.C.Wigley

Saturday, 1 August

08.00	Visit to the Tuberculosis Sanatorium at the Col de la Pirogue

Monday, 3 August

08.30	Open discussion on domiciliary chemotherapy - Dr J.C. Tao
14.00	Supervision and community organization for domiciliary chemotherapy programme - Dr G. Loison

Tuesday, 4 August

08.30	Introduction to Prevention of Tuberculosis - Dr J.C. Tao
	BCG vaccination
09.00	Efficacy studies - animal and human - Dr S.C. Wigley
10.15	Factors influencing the results of BCG vaccination - Dr S.C. Wigley
14.00	Vaccine - preparation, supply and storage - Dr S.C. Wigley
15.45	Selection, coverage, assessment of programme - Dr S.C. Wigley
16.00	Visit to the Leprosarium, Nouméa, New Caledonia - Dr G. Desmoulins
20.00	Meeting of the Medical Association of New Caledonia - Dr G. Loison, President

1. General discussion of the problems encountered by physicians in the treatment and prophylaxis of tuberculosis
2. Film - "Pneumothorax spontané" (Sponteneous Pneumothorax - film produced by Professor Fréour, France)
3. Role of Voluntary Associations in Tuberculosis Control - Dr Molet, President, Tuberculosis Association of New Caledonia

Wednesday, 5 August

Chemoprophylaxis

08.30	Animal and human studies on chemoprophylaxis of tuberculosis - Dr R.H. Marks
10.15	Indications and programming - Dr R.H. Marks

Wednesday, 5 August (cont'd)

14.00 Education and organization of the public on preventive measures against tuberculosis - Dr G. Loison
15.30 Specificity of X-ray diagnosis of pulmonary tuberculosis - Dr J.C. Tao

Thursday, 6 August

08.30 Control of tuberculosis - general principles - Dr J.C. Tao
10.15 Control of tuberculosis in a developed territory - Dr R.H. Marks
14.00 Control programme for a less developed territory - Dr S.C. Wigley

Country Reports

15.30 Dr F.T. Panapasa (Fiji)
16.15 M. M. Thibaudet (French Polynesia)

Friday, 7 August

08.30 Retesting of children vaccinated in June, 1964 - Dr J. Exbroyat

Country Reports (continued)

08.30 Dr F.M. Pine (Gilbert - Ellice Islands Colony)
09.30 Dr J. Kalsakau (New Hebrides)
10.15 Dr D.H. Tafatu (Niue)
10.45 Dr Y. Miyagi (Ryukyus)
14.00 Dr Kila Wari Luis (Territory of Papua & New Guinea)
15.00 Dr M.F. Ueki (Trust Territory of the Pacific Islands)
15.45 Dr S 'Uhila (Kingdom of Tonga)

Saturday, 8 August

08.30 Field visit - Thermal baths at La Crouen and Nakety Mission (East Coast of New Caledonia) (case-finding, BCG)

Monday, 10 August

08.30 Post-vaccination tuberculin allergy study - Dr J. Exbroyat
11.00 Analysis of results - Dr J.C. Tao

Country Reports (continued)

14.00 Dr L. Penaia (Western Samoa)
15.45 Mme L. Bernut (New Caledonia)
16.45 Dr R.H. Marks (Hawaii, U.S.A.)

Tuesday, 11 August

08.30 WHO/UNICEF Assistance to National Tuberculosis Programmes - Dr J.C. Tao
10.30 Epidemiology of Tuberculosis - Dr J.C.Tao
11.00 Closing session

- Dr G. Loison, Director of the Course
- Representative of participants
- Mr W.D. Forsyth, Secretary-General, SPC

SUMMARY OF DISCUSSION ON THE WHO/SPC REFRESHER COURSE ON TUBERCULOSIS Noumea, New Caledonia 17 July - 11 August 1964

CONTENTS

1. THE DEVELOPMENT OF PRESENT KNOWLEDGE ABOUT TUBERCULOSIS

Much valid information about tuberculosis had been accumulated over the centuries before the mycobacterium tuberculosis was discovered by Koch in 1882. Causation by living organisms had been speculated upon and the concept of contagiousness had been accepted. Tuberculosis is now recognized as a disease of the human organism as a whole. This view sees tuberculosis as a disease which accompanies human life from the first implantation of the bacillus, through varying stages of resistance and susceptibility. These factors are partly genetically determined, partly age-conditioned and partly acquired.

The application of bacteriology to tuberculosis, including the use of present-day staining techniques and cultural methods, has resulted in a simplified, effective, as well as cheap, method which fulfills the imperative need in many developing countries. The development of the tuberculin skin test has proved helpful, although there are difficulties in its interpretation, particularly in the tropical countries. The continuous search for specific tuberculins for application to human tuberculosis control programmes should bring forth more knowledge before long.

In respect of prophylaxis, advances in knowledge in two areas must be considered: namely, BCG vaccination and chemoprophylaxis. It is considered that the use of the vaccine has been fully vindicated. The place of both of these prophylactic measures in community control of tuberculosis and the operational difficulties associated with the successful application of the procedures must be recognized.

The first major advance in our knowledge of tuberculosis was made by Robert Koch. The second was the development of the vaccine of Calmette and Guerin. The third was the discovery of effective drug therapy by Waksman, Lehman, and the group responsible for the discovery of isoniazid, or INH. The first established that tuberculosis is an infectious disease and indicated its importance in public health. The second laid the foundations for specific biological prophylaxis, and the third provided us with the means to heal the disease.

Effective drug therapy dates from the years 1944 to 1951 and the three drugs developed then, streptomycin, PAS and INH, remain the best available today. Spectacular as the effects of these drugs have been, the major advance in our knowledge of the management of patients is the confirmed opinion that provided drug therapy is adequate, it is unnecessary in most cases to keep patients at rest in hospitals. Management under ambulatory conditions, with no restrictions on activity, neither affects the patient adversely in terms of recovery from his disease, nor does it expose his contacts to a greater risk of infection than that undergone by the contacts of hospitalized patients. The advances made possible by this information provided by the Tuberculosis Chemotherapy Centre at Madras could well be described as the fourth major achievement in our knowledge of the disease.

It is clear that a lot is known about tuberculosis, but there are still many problems to be solved in relation to fundamentals, such as the tuberculins, the mycobacteria, biological prophylaxis, drug

therapy, and the peculiar problems of different communities. These are problems in detail only which will be solved soon. The most urgent need now is to secure the active and continuing co-operation of the lay individuals in communities in the control of the disease. This may be the most difficult of all the tasks ahead. To achieve this co-operation could well be the fifth major achievement in the fight against the disease, and perhaps the final one.

2. CASE-FINDING IN TUBERCULOSIS CONTROL PROGRAMMES

A "case of tuberculosis" may be defined as a patient in whom the diagnosis is established beyond reasonable doubt. Although all of these persons may be potential disseminators of disease, the patient with a bacteriologically positive sputum smear is the most dangerous one from the community point of view, and it is this patient who is the prime target in a case-finding programme.

It is recognized that certain other categories of persons may in fact also be potentially dangerous. These include those who have only radiological evidence of pulmonary disease and those, particularly children and adolescents, who display a strong reaction to tuberculin test. In communities possessing ample resources, this latter group could well be the additional targets of a case-finding programme and, possibly, subsequent treatment programmes, but in communities of limited resources their priorities are much lower than those of the first category of patient - the patient with a positive sputum smear.

The prime object of case-finding is therefore to find cases of tuberculosis which are infectious so that they can be rendered non-infectious and of no danger to their fellows. Case-finding is important in two areas:

(a) amongst those persons who consult a physician because they have symptoms, or for some other purpose, and

(b) amongst the apparently healthy members of the community.

In the first instance, case-finding is practical at the level of individual medicine, and the avenues for its exploitation are many. They include:

(a) hospital in-patient and out-patient populations,
(b) attenders at rural health centres,
(c) attenders at ante-natal clinics, and
(d) attenders at infant welfare clinics.

If this pattern of activity is practised, a substantial portion of the population will be examined each year, and most importantly, with little extra cost to the services concerned.

In the second instance, case-finding is involved in community-wide examinations. These can usefully be combined with other services and should be done only on selected groups. If these community-wide

activities are to be successful, however, they must cover at least 75 per cent. of the relevant populations. It may be necessary in certain communities to introduce legislation to enable the tuberculosis control services to achieve this end. In the case-finding programme, it is essential to have facilities for tuberculin testing, bacteriology and, if possible, also X-ray examination.

In summary, the principles which govern mass case-finding programmes in a community are as follows:

(1) The programme must be community-wide and involve at least seventy-five per cent. of the selected population if it is to be regarded as successful.

(2) Facilities must be available for the full investigation of persons suspected to be suffering from tuberculosis.

(3) Treatment facilities must be adequate; we must be prepared to treat all patients found to be suffering from the disease.

(4) The success of a case-finding programme should not be measured by the number of persons examined, but by the number of infectious cases discovered and subsequently adequately treated. Community-wide case-finding should not be started unless a great majority of the known cases with symptoms can be provided with adequate treatment.

(5) Treatment must be provided free of charge.

(6) Case-finding programmes should be integrated into the general health framework of the community at all levels.

(7) Meticulous attention must be given to preparing the community for participation in the programme. This involves an explanation of the aims of the programme, and the careful encouragement of group co-operation.

3. DIAGNOSIS IN TUBERCULOSIS

To accept a case of tuberculosis as a patient with positive bacteriological findings is probably taking too narrow a view of the question. From experience, many of these persons emerge in fact from a group of people with positive radiological findings without positive sputum, or even from that group of individuals whose only evidence of tuberculous infection is a positive tuberculin test, although this is a rarer category.

Ideally, three prime criteria should be satisfied in making a diagnosis of tuberculosis, namely:

(a) a positive tuberculin test,
(b) positive bacteriological findings, and
(c) positive X-ray findings.

It may sometimes not be possible to satisfy all of these criteria. A positive bacteriological test is almost invariably diagnostic. But a combination of the first and third criteria might sometimes be acceptable, even though repeated bacteriological examinations may prove to be negative.

The diagnostic importance of the positive tuberculin skin test should not be neglected. Outside of a very few well-recognized patients it is unlikely that the diagnosis of tuberculosis can be accepted without a positive tuberculin reaction.

Although individuals with positive X-ray findings and negative bacteriology may be potentially infectious, the patient with a positive sputum on smear examination is invariably the most dangerous. In communities of limited resources priorities in treatment should always be given to this group. As resources improve, consideration could be given to those with positive X-ray findings and negative bacteriological findings.

The importance of the answer to the question lies in the matter of registration. It is desirable to register all who need attention, in order to:

(a) control the patients,
(b) control their contacts, and
(c) to provide statistical material for the evaluation of programmes in any one time or over a period of time for comparative evaluations.

3.1 Clinical diagnosis

When the modes of presentation of the disease are considered, they may display a bewildering variety in clinical patterns. However, in this complex picture there are certain smaller patterns which may be diagnostic of tuberculosis, even if it is impossible to detect or isolate the causative organism of the disease. Such syndromes as phlyctenular conjunctivitis, erythema nodosum, effusions on serious surfaces, particularly in young persons, must be noted. These syndromes may well be "post-tuberculous" phonomena and their presence in a patient should lead to the suspicion of tuberculosis as the etiological agent.

The importance of cereful history-taking and a complete physical examination, were considered essential in order to discover the extent of tuberculous disease and, possibly, other corrective abnormalities.

3.2 Tuberculin and tuberculin testing

It is realized that diagnosis rarely rests on the result of tuberculin test alone, although it is a most valuable method, not only when used on a community-wide basis, but also at the level of individual medicine. Its use should never be omitted in South Pacific practice, despite all that has been written about non-specific reactions to tuberculin and the effects of BCG vaccination in reducing its diagnostic significance.

A positive response merely indicates infection, whether immediately or remotely in the past cannot as a rule be deduced, except that in the

case of infants and very young children a positive reaction usually indicates a recent and active infection. The younger the child the greater is this possibility, and in infants it amounts to certainty.

Various methods of introducing tuberculin were discussed. After consideration of the criticisms applicable to the various methods, it was concluded that the Mantoux skin test, in which a measured amount of tuberculin is introduced into the skin with a syringe and needle, supersedes all other methods of testing, and for research and epidemiological purposes it is paramount.

It was found that factors relating to exposure to light and heat, adsorption onto glass, particularly in high dilutions and most particularly in partially filled ampoules, would have a deleterious effect on tuberculins leading to variable and unpredictable losses of potency of the material.

The most widely used tuberculin now is the purified protein derivative (PPD RT23), with the stabilizing agent Tween 80 despite certain minor difficulties encountered in the measurement of the size of the reaction. The vital importance of RT23 with Tween 80 lies in the fact that there is a sufficient supply of this standardized tuberculin available to enable making valid comparisons of tuberculin tests on a wide scale for a long time. The material could become a universal indicator if it were accepted by all countries and territories.

It was also agreed that the standard dose of RT23 with Tween 80 recommended by WHO should be used.

In the considerations of techniques the "used site" phenomenon was mentioned, and it was suggested that the sites of injection for serial examinations in individuals should be rotated.

It was recommended that the tests be read after seventy-two hours. Measurements of induration alone were valid in reading the test.

A justification could be made for assuming that infection with pathogenic tubercle bacilli could be inferred from strong tuberculin sensitivity and non-infection from weak reactions. However, the efficiency of the test in tropical countries is reduced by the difficulties inherent in separating these reactions clearly. In the marginal area between strong and weak reactions lie a group of susceptible people who can be denied BCG vaccination if the limit of test positivity is set too low, and a group of infected people who can be denied proper investigation if the limits are set too high. It was suggested that the recommendations of the WHO Expert Committee on Tuberculosis could well be applied to a community programme. Namely, that in tropical areas:

(a) a reaction of 0 - 5 mm indicates in all probability that the person is not infected with pathogenic bacteria;

(b) a reaction of 10 mm or more indicates in all probability that the person is so infected; and

(c) a reaction between 5 and 9 mm indicates that a person might have been infected.

Opinions about what to do with this last group will vary with local experience. This group might be vaccinated with BCG vaccine without harmful effects, bearing in mind that it might contain a few persons who have been infected with pathogenic bacteria.

The interpretation of the test in those vaccinated with BCG vaccine was considered. Here again the interpretation could well be influenced by personal experience with regard to the duration and the degree of skin test conversion rates following BCG vaccination.

It was concluded that:

(1) The general requirement of the test in any community is uniformity; this is desirable also on a global scale.

(2) The test is most valuable in community work and as a diagnosis measure in individual medicine.

(3) It has a most important place in diagnosis in:

(a) infants and children,
(b) in the examination of contacts, and
(c) in the mass examination of apparently healthy communities where it serves a useful purpose in reducing the number of other examinations which need to be done.

(4) It has its greatest importance in areas of low prevalence of tuberculosis as demonstrated by epidemiological studies.

(5) The importance of meticulous records was stressed in respect of:

(a) the immediate information they give with regard to epidemiological and diagnostic situations, and
(b) enabling remote comparisons to be made in communities both geographically and in time.

The discussion revealed that there was a lively appreciation of the need for accuracy in performing the test. The importance of using leak-free syringes and sharp needles and of accurate measurement of the test dose of tuberculin by watching the scales on the barrel was stressed.

Although it might be necessary in certain circumstances to cleanse the skin prior to testing, as a general rule it is unnecessary to do so when testing on a mass scale is undertaken. Flaming of the needle after each injection was considered to be adequate.

The flexor surface of the left forearm was considered to be the best site for testing in view of the ease with which the test can be done and in the interest of uniformity and ease of reading.

Important factors which may influence the results of testing are:

(a) the possibilities of deterioration in the potency of the tuberculin solutions resulting from, exposure to light and heat, from an adsorption of tuberculins in high dilution,

from age, from errors which might occur in the preparation of the solutions leading to a wrong dosage of tuberculins, and from the use of unsatisfactory syringes and techniques in testing;

(b) individual variations amongst readers, the effects of trauma, and the time interval between testing and reading; and,

(c) the response of the individual and the variations due to constitutional state of the person, the degree of hydration, age and the effects of concomitant therapy for illness such as the steroids.

The criteria to be met for diagnostic methods useful in mass case-finding amongst an apparently healthy population were accuracy, simplicity, speed and economy. In all respects the tuberculin test meets these requirements as it is simple, and workers, particularly non-professional workers, can be readily trained to do it and to read it accurately.

The importance of accurate records was discussed by a statistician who also demonstrated statistical techniques designed, among other things, to select standard readers for a control service, and method of the preparation of a standard histogram.

3.3 Bacteriological examination for tubercle bacilli

Diagnosis of tuberculosis is the result of convergence of proofs from many disciplines - clinical, biological, bacteriological and radiological. Each may lead to error in diagnosis. Bacteriology is no exception. It, however, offers the one major proof of diagnosis by the demonstration of the bacillus. The methods of bacteriological diagnosis were reviewed, namely:

(a) the demonstration of the bacillus by smear examination,
(b) demonstration by culture, and
(c) demonstration by animal inoculation.

3.3.1 Demonstration of the bacillus by smear examination

The materials available include sputum, pus, exudates or secretions, cerebral spinal fluid, urine, etc.

The material is either examined directly or after concentration if the bacilli in the specimen are few in number. The method commonly used is the standard Ziehl-Nielsen technique.

3.3.2 Demonstration by cultural methods

The standard Lowenstein-Jensen medium was described. It is fairly easily prepared. It has a short shelf life (roughly about three months) beyond which it should not be used for culture purposes.

Liquid media are used more for study of organisms than for the isolation of bacterial proof. In general terms, the organism require further plating on solid media for complete examination of positive cultures, liquid media are liable to greater risks of contamination than are solid media, containers are prone to leak during transport and to spilling during handling, and their use exposes those who handle them to greater risks of accidental infection. However, the lyophilized medium recently introduced by Dr. L. Sula seems to show the same sensitivity as the Lowenstein-Jensen medium and the contamination rate is no greater than that of solid medium.

The material should be treated prior to culture with sodium hydroxide to eliminate microbial associates, which could confuse the issue by over-growth on the medium. A minimum of two tubes should be inoculated for each specimen.

The growth rate of human tubercle bacilli in optimal circumstances is fairly rapid, occurring somewhere between the eighth and the twelfth day, and positive cultures are readily recognized at four to six weeks. They have a characteristic appearance and in the examination of the culture atypical colonies should be ignored. Typical colonies should be examined for the acid-alcohol fast properties of the bacilli. Plates should be kept in an incubator at least two months before being discarded and reported as negative.

3.3.3 Animal inoculation

The guinea pig is used and material for examination must be treated with sodium hydroxide or by antibiotic materials to rid the specimen of microbial associates. The early death of the guinea pig is usually due to intercurrent infection. After tuberculin testing, the animal is sacrificed at two to three months and a search is made for tuberculous lesions in the regional glands, the reticulo-endothelial system and in the lungs. Confirmation is made by microscopy and the demonstration of typical bacilli showing acid-fast qualities. For control programme, this method is of limited value in view of the high cost.

The limitations of bacteriology are imposed;

(a) by the numbers of bacteria present in the sample of the material used for the examination. Repeated examinations may be necessary to demonstrate the bacilli, particularly in the so-called closed lesions, where not only the numbers small, but bacterial viability may be less than that of organisms obtained from open cavities, where the organisms are numerous;

(b) bacteria may be affected by the treatment the specimen is subjected to in preparation for examination; the use of sodium hydroxide and acid materials may destroy the germs; and,

(c) certain living human mycobacteria, notably those which are totally INH resistant, have a remarkably lessened virulence for guinea pigs, which may develop tuberculous

lesions which are not only not fatal, but may be spontaneously reversible. In these circumstances intravenous inoculation of the mouse gives rise to a rapidly fatal tuberculous disease.

Limitations to bacteriology may also be imposed by technical errors which can have serious implications in terms of the application of erroneous reports to individuals or communities. The utmost precaution must be taken to ensure that these personal errors are not committed.

Errors which may lead to confusion in examination include the use of non-sterile containers, failure to cleanse glassware thoroughly, the use of slides which may have been contaminated in previous examinations, failure to mark slides clearly, to choose suitable specimens of sputum, to carry out concentration or decontamination procedures accurately, to examine slides for long enough periods of time, the acceptance of acid-fast debris on the slide as mycobacteria, faults in staining techniques, and faults in microscopy, including failure to wipe the oil immersion objective between examinations, leading to the transfer of mycobacteria from one slide to another and, finally, to check colonies for acid-fastness.

The atypical mycobacteria include:

(a) the photo-chromogens (Yellow growth in light),
(b) the scoto-chromogens (colour in darkness),
(c) the non-photo-chromogens, and
(d) the rapidly growing bacilli, non-coloured (Runyon) which grow in two to four days at 37°C.

These are largely saprophytes and as their pathogenicity is not yet firmly established, they may well give rise to confusion in the laboratory.

The differentiation of the mycobacteria is done on a basis of:

(a) growth and colony characteristics,
(b) sensitivity to antibiotics,
(c) biochemical characteristics, particularly enzyme determinations, of the catalaze proxidase type,
(d) chemical tests, and
(e) animal pathogenicity.

In the discussion on the importance of bacteriological diagnosis in tuberculosis the aims of bacteriology were defined as:

(a) to make a firm diagnosis;
(b) to determine the dangers to contacts;
(c) to control therapy;
(d) to control admissions to hospital; and,
(e) to determine the epidemiological state of the bacteriological community, in other words, to act as a check on the presence or absence of drug-resistant organisms in the community.

From the public health point of view these aims have the order as outlined. The first two are undoubtedly the most important.

The importance of impeccable techniques in the conduct of bacteriological examinations and the dangers to operators inherent in such methods as laryngeal swabbing were stressed. The laboratory technician must be protected not only against infection with the mycobacteria of tuberculosis, but against his own human failings.

Reference was made to some more elaborate methods of obtaining sputum, such as bronchial lavage, bronchoscopic examination, and the use of heated aerosols, but it was recognized that these methods could only be applied on an individual basis.

Drug sensitivity tests are of very much less value in the management of the individual patient than they are in the determination of the epidemiological implications for the spread of drug-resistant organisms in the community. Indeed, their employment in the management of the individual patient may result in more harm being done to the patient than good, and the physician may be misled by these crude tests - which do not always run parallel with clinical observations - into the use of forms of therapy which are not necessary, and moreover, dangerous.

In free discussion it emerged quite clearly that there was an imperative need for simplified, but effective, bacteriological techniques for use in the developing countries, and some reference was made to simple methods of preparing specimens with 5% oxalic acid, the prepared material being inoculated directly onto highly buffered modified Lowenstein-Jensen media. This method has the advantage that in tropical environments there is a good margin of time available between plating and incubation (up to ten days), with a high expectation of growth.

The importance of a clear explanation and tact in obtaining useful specimens from patients cannot be over-estimated. The importance of supervised collection of material from the patient was also stressed - particularly if some benefit was to be derived, for example, from a positive smear, such as a pension or free treatment for tuberculosis. It must not be forgotten also that some benefits may accrue from negative sputum smears and this again may lead to the misuse of non-positive material.

In certain communities of the South Pacific, difficulties were experienced in the preparation of such simple bacteriological material as smears. These difficulties stemmed largely from lack of trained personnel and transport, and in some cases the disinclination of technicians to handle tuberculosis material.

Some discussion centered on the advisability of establishing a central laboratory which would supply material to the periphery and supervise the work at the periphery. For doubtful cases, the central laboratory may serve as a reference centre. A central laboratory need not be an elaborate affair and it is not costly to establish.

In conclusion, the following facts were noted:

(1) Bacteriology offers the most definitive method of diagnosis.

(2) It is an economical method of diagnosis, comparing favourably with tuberculin testing and much more than favourably with X-ray examination in this respect.

(3) It is not difficult to train technicians in simple bacteriological techniques; any intelligent non-professional can be trained to prepare and examine smears.

(4) If technicians are not available, the doctor himself must attend to the job, or train other workers to do the work.

(5) The most practical methods of examination of material in the field are sputum smear examination.

(6) The absence of culture facilities should not deter us from the simple methods of examination.

3.4 Radiological examination

The advantages of X-ray examination in tuberculosis control lie in the fact that radiology demonstrates tuberculosis at an early stage, and it is the quickest method of tuberculosis case-finding. Its main disadvantage lies in its cost, both initial and operating.

Radiology offers a wide variety of techniques for precise localization and demonstration of shadows in the lungs, namely:

(a) fluoroscopy or screening,
(b) photofluorography,
(c) radiography, and
(d) tomography.

In addition to postero-anterior and lateral films, other views including lordotic and oblique views might be utilized for more precise localization and diagnosis.

Fluoroscopy has the advantages that one can demonstrate the actual movement of the organs examined, the aeration of the lungs can be observed and the operator can limit the focus of attention to the site of interest. The disadvantage lies in the facts that no record can be kept following fluoroscopy and, above all, radiation hazards are greater than with other methods of X-ray examination - the operator must always be protected from direct and scattered radiation.

High quality miniature films (70 mm, 4 x 5 inches, 100 mm) approach the diagnostic accuracy of large films and may also be used to evaluate progress in patients under treatment. The use of photofluorography thus represents an economic advantage in its operation. The initial cost, however, remains a great hindrance to its wide use in most developing countries. The risk from exposure to radiation is greater than that involved in radiography but it is substantially less than that associated with fluoroscopy.

Radiography is an expensive method of X-ray examination. Clinicians must insist on the requirement of high quality films, free from artifacts. Waste cannot be afforded.

In the X-ray room:

(a) the patient should be properly positioned on the cassette; the position should be central, without rotation; the shoulders should be down, and the scapulae pulled well away from the lung field;

(b) artifacts due to hair, etc., should be guarded against;

(c) the film should be taken in full inspiration and voluntary movement must be eliminated; and,

(d) penetration and contrast should be good; grids should be used and penetration should be such that only the upper four or five thoracic vertebrae should be seen on the film with any clarity; the focus point should be at mid-thoracic level; factors should be carefully worked out for each patient, and recorded for future reference, if and when further X-ray studies are made.

In the darkroom, attention should be paid to cleanliness, to light-proofing and the state of the safety lights. The timing of each processing step should be precise, the temperatures of the solutions should be controlled, and facilities for washing of films should be adequate. Only in this way can waste of film be avoided and reduced to the irreducible minimum arising from lack of co-operation on the part of the patient. In this way the costs will be reduced.

The reading of the X-ray film falls into two parts:

(a) description, and
(b) interpretation.

Films should be read and described in a systematic way, so that nothing will be missed. Care should be taken not to mistake normal structures for pathological shadows.

One should always be aware of radiation hazards and individuals should not be exposed to unnecessary X-ray examinations. In case it is necesssry, the use of short exposure times, with high-speed films and screens, patient protection devices, proper coning of the beam, and of light-beam diaphragms is important.

The discussion on differential diagnosis in pulmonary tuberculosis was illustrated by still slides of a number of conditions commonly confused with the disease. Reference was made to the characteristics of certain X-ray shadows, namely:

(a) localized, segmental or lobar shadows, homogeneous in density and pneumonic in character;

(b) cavitation in lungs, or excavation;
(c) the discrete nodular shadow - the so-called "coin" lesion; and,
(d) diffusely nodular, inhomogeneous shadows.

It was recognized that the X-ray examination was the most sensitive of the three diagnostic measures available to the clinician, but it was not necessarily the most accurate. It was invaluable in initial diagnosis and essential in follow-up examinations. The use of bacteriological examination for this latter purpose carried risks of inaccuracy, due to the fact that if therapy is adequate, bacteriological sterility is achieved early in the management of the disease. Only X-ray examination can determine whether improvement or deterioration has occurred over a period of time, or whether no change has taken place.

In conducting an X-ray examination four questions were asked, namely:

(1) Where is the site of the lesion?

(2) What is the extent of the lesion?

(3) Is the lesion tuberculous?

(4) What is the character of the lesion? (acute, chronic, etc.)

The X-ray examination can answer accurately only the first two questions. It was clear from experience that the X-ray cannot usually declare precisely that a lesion is tuberculous. This limitation should be recognized and the X-ray appearances correlated with other diagnostic material by the clinician when making a diagnosis of tuberculosis. Similarly, the character of a lesion can only be inferred from X-ray appearances - with little certainty and only indirectly. The radiologist is rarely in a position to interpret films in terms of pathology - this is the function of the pathologist.

Discussion on the specificity of reading X-ray chest films was illustrated by reference to studies showing the degree of variation which existed even between experienced readers, both in the fields of diagnosis of tuberculosis and evaluation of progress in patients under treatment, or under review. Individual differences of opinion could be substantial. Intrapersonal difference in interpreting the same set of films was also shown to be considerable.

It was concluded from these studies that a single reader, no matter how experienced, was highly likely to under-read the true positive and over-read the false positive in a series of films.

The recommendation which emerged from the discussion was that improvement in the detection rate could be obtained by using a panel of at least two readers who, reading independently, could refer films in dispute to a third reader. Only in this way would positive diagnosis be achieved at a level close to the actual existing rate of positive films, and the number of false positive reports be reduced to a minimum.

In the evaluation of progress the clinician should always have some reservations in using X-ray to assess progress if films are taken at short intervals.

Finally, it was recognized that all diagnostic techniques have their limitations. To be aware of the "perilous material we are dealing in" is to take all precautions to guard against these limitations.

4. THE TREATMENT OF TUBERCULOSIS

4.1 General

In discussing the factors influencing the treatment of tuberculosis, the rules which govern proper treatment and the usual causes of failure of therapy, namely those due to the nature of the disease, of the patient's state of health at the onset of treatment, and to maladministration of therapy, the iatrogenic causes were emphasized. The striking importance of unresolved psychological conflicts in hindering recovery from tuberculosis was stressed, as was the imperative need for the attending physician to acquaint himself with the physical and cultural background of the patient in order to facilitate his management. Failure of therapy to achieve healing and to prevent the emergence of drug resistant organisms might well be expected in patients with chronic, fibrotic excavating disease. In other patients, healing could reasonably be expected provided therapy was adequate and the patients were co-operative. The special difficulties in the management of alcoholic, diabetic, mental, old, and debilitated patients, and those who suffer a sudden cultural change and who have difficulty in adjusting to new environments, were discussed. It was believed the iatrogenic causes of failure lay largely in the fact that the situation had not been clearly explained to the patient leading to a loss of control over him and the use of inadequate therapeutic regimens. They could be due also to gross interruptions of therapy routines and particularly the inability to realize that therapy should be prolonged and uninterrupted.

The importance of the control of patients at a community level and the need for notification of disease and the establishment of central registers to control the patients, were recognized. It was also recognized that voluntary co-operation was preferable to legislation in the control of the patient, but the need for legislation might arise in certain situations. The importance of the health education programme and the need to utilize established public health measures in order to prevent the disease spreading were stressed.

The importance of a firm diagnosis of proved tuberculosis before therapy was re-emphasized. Developing communities cannot afford to treat too many non-tuberculous patients.

The aims of treatment were considered to be:

(a) to render the patient non-infectious;
(b) to prevent the dissemination of organisms from the patient to his susceptible contacts; and
(c) to heal the patient's disease.

The general principles of treatment were outlined as follows:

(1) Treatment must be vigorous, prolonged, uninterrupted, and continued for a minimum period of twelve months. It should be planned and combined with surgical intervention if the need for this arises and the facilities are available.

(2) Treatment must be supervised and drug consumption must be checked in situations where self-administration is necessary.

(3) Treatment should be combined with progress checks, and reviewed regularly, so that deterioration, or the need for therapy change, or surgical intervention can be recognized early.

(4) Relapse must be prevented.

From the point of view of specific therapy, the drugs of choice are streptomycin, PAS and INH. Two guiding principles in their use should be adopted:

(a) resistance to streptomycin, PAS and INH develops most often and earliest in patients with chronic, fibrotic cavitating disease; and,

(b) it is slow to develop in patients who are given another drug in combination with INH from the beginning of the treatment.

4.2 Management of patients receiving initial treatment

Brief attention was given to the question of the justification of using a single drug regimen in the treatment of tuberculosis, the drug of choice being INH. It was recognized that a one drug regimen is less satisfactory than a combined regimen, on the grounds of clinical effectiveness and the development of INH resistant organisms, but when the government is faced with the choice between doing nothing at all or providing one drug, the provision of INH alone is fully justified. INH alone is definitely the drug of choice for preventive treatment and chemoprophylaxis of tuberculosis.

The limiting factors which apply to combined drug therapy are those of cost, acceptability to the patient, ease of administration and ease of supervision of treatment. A combination of PAS and INH is satisfactory treatment for tuberculosis but it is very expensive. Two other combined regimens are substantially cheaper than the PAS/INH combination. These are thiacetazone/INH regimen and intermittent streptomycin/INH regimen. The thiacetazone/INH combination (150 mg of thiacetazone with 300 mg of INH daily) compares favourably in terms of clinical response with PAS and INH. Thiacetazone must, however, be used carefully as acute yellow atrophy of the liver can occur and less severe injury to the liver is not uncommon. The dose, 150 mg of thiacetazone, is critical. Doses below this are not effective and larger doses enter the toxic range. The margin between therapeutic and toxic doses is small. More encouraging results have, however, recently been obtained with the

intermittent streptomycin/INH regimen. Here streptomycin (1 gram) is given with INH in single doses of 650 mg, twice a week. The results of the comparative trial of this regimen against the PAS/INH regimen are so encouraging that it seems that not only may costs be reduced in the management of tuberculosis on a mass basis, but it may be possible to change drug administration programmes from daily administration, usually self-administration with limited supervision, to twice weekly fully supervised administration, leading to full control of the patient. This would be a great step forward.

Therefore, at this time there are at least three valuable combination of drugs available for use in our out-patient programme, i.e., PAS and INH, thiacetazone and INH given daily, and streptomycin and INH given twice a week.

Checking drug consumption in situations of self-administration can be made by simple methods of urine testing.

The steroids were considered to have a limited application in the treatment of tuberculosis in view of the immediate and remote disadvantages displayed by the drugs. They should be used only in situations of severe 'toxic' tuberculous disease and perhaps topically in tuberculous meningitis. They have no place in the management of the average tuberculous patient.

The criteria which should be satisfied before the patient is discharged from treatment were considered to be:

(1) The patient must be feeling well and should have completed the minimum period of treatment.

(2) The patient should be non-infectious.

(3) There should be no evidence of excavation in the lungs, the X-ray shadows should be stable for at least six months.

(4) Follow-up arrangements should be made.

4.3 Management of patients receiving retreatment

In the management of patients whose disease has been unsuccessfully treated in the past and whose organisms are now resistant to streptomycin, PAS and/or INH, it must be recognized that the conditions which led to the therapeutic failure are still present, that they may well persist and reduce the effectiveness of alternative drug therapy. Unless these so-called second line drugs are quickly effective, or unless they can be combined with surgery to become quickly effective and convert the patient to a sputum negative state, the organisms will rapidly become resistant to the alternative therapy and one will be faced with the same therapeutic failure. It must be admitted that most of our patients who reach the stage of therapeutic failure with streptomycin, PAS and INH are in fact beyond the reach of surgical conversion to a sputum negative state, and those who can be rescued from the sputum positive state with alternative therapy are few indeed. The drugs which are available for use in this situation are pyrazinamide, cycloserine, alphaethylthioamide and its

derivatives, viomycin, kanamycin, etc. The first three of these are given orally, but viomycin and kanamycin have to be given parenterally. These drugs have many disadvantages. They are invariably highly toxic and the margins between therapeutic and toxic doses are small. As a result of this, they should not be given to out-patients. Finally, all these drugs are most expensive and they should, therefore, only be used if:

(a) there is evidence of persisting cavitation and surgical treatment is prepared, and

(b) the trend of the disease is unfavourable and the condition is desperate in the individual patient.

If the situation is not carefully evaluated, the patient may well be put to a greater risk from drug toxicity than if he had been allowed to continue isoniazid alone.

The salvage drugs should never be used solely on the basis of drug resistance tests. This is not to deny that the tests are useful or that the emergence of drug resistance presents a problem. It presents a problem in terms of a reduction of the therapeutic usefulness of drugs in the case of the individual patient, and has epidemiological implications on the spread of drug resistant organisms in the community. It is the second of these implications which is more important. Drug sensitivity tests are of less value in the management of the individual patient - indeed their employment may result in more harm being done to the patient than good, in that the physician may be misled by these crude tests, which do not always run parallel with clinical observations, into forms of therapy which are unnecessary and dangerous.

It is imperative to achieve quiescence of a disease quickly at the outset of treatment and to recognize early those patients whose control by medical means alone is likely to be impossible. In these cases, appropriate action must be taken, that is surgical intervention if possible.

Primary therapeutic failure is unfortunate. Complete therapeutic failure is a tragedy for the patient and a dangerous threat to the community. If possible, these patients should be put under INH alone for as long a period as possible. This recommendation is based on the reported finding of a lower pathogenicity in monkeys by induced massive infection with INH resistant organisms.

In the broad sense of tuberculosis control, surgical treatment is the least significant part of management. The individual patient may benefit and the procedure may reduce the infectiousness of a small number of patients, but the contribution which surgery makes to the total control of the disease is very small. It is an expensive trapping to a tuberculosis control programme. The indications for surgical intervention embrace solely a series of mechanical problems which exist in a patient's lungs, and which cannot be overcome medically. The clinical

indications include persisting cavities, main stem bronchial stenosis, the so-called tuberculomata, destroyed lungs or segments of lungs and pleural complications. Certain limiting factors must be considered before a decision to use surgical intervention is made. The patient's age and general conditions are important. In general terms, patients over the age of forty years are unsuitable for surgical intervention, as many of them have substantial non-tuberculous lung disease and respiratory reserves are, in general, low. Finally, medical treatment should have achieved its maximum benefit before surgical intervention. Operations should not be done on patients whose chest X-rays show a changing picture.

4.4 Hospital versus domiciliary therapy

The aim of any treatment programme is to reduce the amount of infection or the size of the infection pool in a community, in the shortest time and the most economical way, and so limit the spread of the disease from affected to susceptible individuals. Patients discovered to have tuberculosis, therefore, must have treatment and that treatment must be adequate and supervised. This truism underlines four things:

(a) treatment cannot be started without adequate provision being made for the supply of drugs;

(b) the drugs must be supplied free to the patients;

(c) patients should not be found unless adequate treatment facilities are provided for them; and,

(d) it has become obvious that the efficiency and success of a tuberculosis control programme is measured not by the number of patients detected, but by the number of detected patients who complete a satisfactory course of therapy; haphazard and inadequate treatment can only bring disaster to the patient and to the community.

The second important question is whether a patient is to have his treatment in a hospital or on an ambulatory basis. The development of out-patient services has been hampered by a number of factors. Firstly, physicians have all been trained in hospitals and, therefore, they all believe that the hospital plays the most important role in a control programme. Secondly, people are pre-occupied with the need to ensure rest for the patient and our thinking about management does not keep pace with new developments in therapy. Thirdly, it is not known whether an out-patient is at any disadvantage when compared with the patient who receives all of his treatment in hospital, in terms of the outcome of his illness, speed of recovery and the rates of relapse amongst patients apparently rendered quiescent. Lastly, it is not known whether the contacts of out-patients are at a greater risk of infection than those of the hospitalized patient.

As to the first two questions, there appears to be only the smallest justification for keeping a patient at rest if effective drugs are used. There can be no justification for forcing prolonged bed rest

on patients who do not need it. It can even do more harm than good, both physically and mentally. Patients receiving treatment can, and should be asked to, continue their work.

As to the two other questions it has been shown quite clearly by the Madras experiments that, provided therapy is adequate, the ambulant patient is at no real disadvantage when compared with the hospitalized one, whether considered in relation to reaching the goal of bacteriological quiescence, extent of recovery, or possibility of relapse after therapy, nor are his contacts at greater risk than those of hospital patients. Most new disease occurring in contacts declares itself within three months of the discovery of the patient. In most adequately treated cases reversal of infectiousness occurs within this period, and even in this transition period the risks to contacts decrease sharply, because before the bacilli are eradicated entirely from the sputum the bacillary population has already been reduced drastically. It proves that most of the damage done in a particular household has taken place before the patient seeks treatment.

For practical purposes, the categories of patients who need hospital treatment are:

(a) those seriously ill, who cannot fend for themselves, and

(b) patients with tuberculosis requiring surgical intervention.

Outside of these two categories the choice is more in favour of domiciliary care. Certain criteria must however be satisfied before such domiciliary service is acceptable. These are:

(1) There should be adequate supervision, this is so important that no ambulatory service should be started if supervision of a high order cannot be provided.

(2) There should be no great disturbance of the patient's usual life.

(3) All susceptible contacts of ambulant patients must be protected by BCG vaccination.

(4) It should be possible to offer patients some form of education in simple hygiene and sanitation, sputum disposal, etc.

Therapy should be designed in such a way that the patient is brought to our notice at short and frequent intervals. An injection of streptomycin incorporated into therapy will do this. Streptomycin merely anchors the patient to the control service.

In situations where patients can attend health centres or district dispensaries for treatment, the problems are smaller and the behaviour of the patients and their progress can be fairly easily supervised. It is when treatment has to be given in areas where such facilities are not available, and treatment has to be continued for long periods in this environment, that the difficulties become greater.

Here, the conditions of the homes, the presence of young children and adolescents in the house, the availability of transport and the possibility of arranging the necessary frequent visits by supervisors, or even the provision of such personnel, are of paramount importance.

In order to reconcile these difficulties into a satisfactory out-patient programme, we should:

(1) Try and make the people see that they themselves have a contribution to make to tuberculosis control in their area. We must try and convince them that control is a community affair and not solely the concern of the control services. We must find out who are the influential leaders in the community. If we can convince them, they will convince the people. It is important to remember that the apparent leader may not necessarily be the most influential man in the community.

(2) Make the utmost use of non-professional people, both to distribute drugs and to supervise administration. Such people include school teachers, service officers and non-commissioned officers, police officers, and in fact, anyone of reasonable intelligence who is in-charge of a special group of people, can be asked to supervise therapy on an out-patient basis.

(3) Make therapy acceptable to the patient; avoid bad reactions or toxic reactions as far as possible; do not use the exotic drugs, for instance, in out-patient practice; take care that over-dosage of the commonly-used drugs is not practised; be sure that therapy is uniform and that there is no confusion in anyone's mind as to what he should be doing with any particular patient.

(4) Provide simple tests to check the consumption of the drug prescribed, but do not use them indiscriminately; random sampling would suffice in most instances and above all, a patient should never be allowed to relate the testing of a sample of urine to drug consumption.

(5) Design therapy so that if self-administration of drugs is necessary the patients are brought to the supervisor's notice at frequent intervals. The importance of an injection of streptomycin in ensuring this has been mentioned.

Another factor of importance is the degree of experience that patients in communities have with out-patient treatment programmes. The longer an out-patient programme has been operating successfully in an area the more likely will it be accepted by the patients and the more likely the patient will be to take his medicine. Long association builds up a pattern of behaviour. There is an appreciation of the fact that this form of treatment does not disturb the individual unduly and therefore it is accepted. A long association provides opportunities for people to see that patients are discharged as cured and this proves the efficacy of treatment. The important thing is that this is happening right in their own community and the people can identify themselves with it.

5. PREVENTION OF TUBERCULOSIS

5.1 General principles on the prevention of a disease

It is axiomatic that the best way to protect the community against the risks of tuberculosis infection is to eliminate those persons who are spreading the disease in the community by the use of adequate and energetic case-finding and therapeutic programmes. Adequate therapy rapidly reduces the infectiousness of the majority of our patients. The prime aim of such therapy is to produce non-infectious states in patients suffering from tuberculosis. This is undoubtedly the best preventive measure in tuberculosis control. However, in most developing countries, existing resources for detecting and treating of tuberculous cases are often limited and so prevent the possible coverage within a short time. Control of tuberculosis by treatment alone would therefore be ineffective or would take a long time to achieve in these countries. Protection of susceptible is, therefore, required, even more urgently.

The selection of a specific prevention measure, that is, the selection of either a biological or chemical prophylaxis, is determined by considerations of such things as:

(a) the estimation of the degree of risk which exists to susceptible individuals in a community if the preventive measure is not applied;

(b) the estimation of the degree of protection which it is hoped can be achieved by the particular preventive measure employed;

(c) the degree of harm, if any, which may be done to healthy persons by the use of such a particular preventive measure;

(d) the acceptability of a particular preventive measure by the subjects under consideration; and,

(e) the administrative effort which must be provided to bring the operation to a successful conclusion and the availability of resources for this purpose.

In any programme of prophylaxis or prevention, as in tuberculosis control, the importance of the preliminary organization, which must be meticulous, and of a systematic approach to the problem, cannot be overestimated. The coverage of susceptible persons in the community should be as complete as one can maintain.

5.2 Biological prophylaxis, BCG vaccination

BCG vaccination has been utilized as a preventive measure against tuberculosis since 1921 and over the past twenty years vaccination has been practised on a mass scale involving hundreds of millions of people. Despite this, there is still doubt in the minds of some as

to whether or not the value of the procedure has been established. An unequivocal answer to this question is important, because in a number of developing communities in the tropics an immunization programme using BCG vaccine is the only kind of tuberculosis control which can be carried out effectively, largely for financial reasons. The answer will have importance for many years in those countries where resources for more extensive programmes cannot be made available in the foreseeable future. Answers are given to us from valid statistically controlled trials, from the indirect evidence of other studies, and from consideration of animal studies related to the question. The important trials which have done much to clarify the issue are:

(a) The British Medical Research Council Tuberculosis Vaccine Trials involving BCG vaccine and a vaccine produced from the vole bacillus on adolescents.

(b) Aronson's trial amongst the North American Indians.

(c) The United States Public Health Service Trials in Puerto Rico, Alabama and Georgia.

The British Medical Research Council trials began in 1950 and are still continuing; the latest report on the trials was published in 1963. The trial was limited to adolescent schoolchildren aged 14-1/2 to 15 years at the time of entry to the trial. None were suffering from tuberculosis at the time of entry nor were the children known to have been in recent contact with known cases of tuberculosis included. The study was so designed that low-grade reactors were excluded from the trial of vaccine, although they were retained in the trial as controls together with the positive reactors to low-dose tuberculin skin test.

Over the period of ten years some important observations were made. They can be summarized as follows:

(1) For the whole period, the annual incidence of tuberculosis occurring in tuberculin negative reactors who were not vaccinated was 1.9 per 1000. The annual incidence of tuberculosis amongst those who were vaccinated with BCG vaccine was 0.4 per 1000. This represents a reduction attributable to vaccination of roughly 80 per cent. on the expected incidence of tuberculosis, if all had remained unvaccinated.

(2) The protective effect of the vaccination was proved substantially in this group and was shown to last at least ten years.

(3) The lesions which did develop in vaccinated children were less extensive and less severe than those which developed in unvaccinated children.

(4) The dangers of developing disseminated forms of tuberculosis such as tuberculous meningitis, and miliary tuberculosis, are greatly diminished by vaccination.

(5) Children who show an initial strong reaction to the tuberculin test (low dose) run a substantially greater risk of developing tuberculosis over a period of observation, than those children who show the lower grades of reaction.

(6) It seems likely that children who display these low-grade reactions do possess some immunity to tuberculosis. This is not as great as those possessed by the vaccinated child.

Aronson's trial amongst North American Indians showed unequivocally that BCG vaccination would confer substantial and lasting protection against tuberculosis, even in the face of adverse circumstances and high risks of exposure to infection. Morbidity was reduced 75 per cent. over a period of eleven years and mortality was reduced 80 per cent. over a period of fifteen years.

The morbidity over eleven years amongst the vaccinated persons was 4.1 per cent. and among the controls 16.4 per cent. The study showed that during this period there was no significant waning of the protective effect of the vaccine used (liquid vaccine), and over a twenty-year period of observation the vaccine appeared to confer protection for at least fifteen years with a minor decline after ten years.

The two trials carried out by the United States Public Health Service (USPHS) were less satisfactory in point of view of results. In both trials there was a considerable proportion of low-grade reactors amongst the study groups, but no attempt was made to differentiate between these and the weak reactors (negative reactors) in respect of BCG vaccination.

In comparing the results of the USPHS trials with those of the British Medical Research Council and Aronson, it seems that vaccination was considerably less effective in the former (USPHS 30 per cent. reduction in incidence amongst non-reactors as against 80 per cent. reduction in the United Kingdom series).

There are three possible explanations for this:

(1) The vaccine used in the United States Public Health Service trials might not have been as potent as that used in the United Kingdom trials.

(2) Whereas, in the United Kingdom and North American Indian trials, persons with low-grade sensitivity reactions were excluded from the trial, except as controls, these were included in the USPHS trials. It has been shown that such low-grade sensitivity may be associated with a considerable resistance to tuberculosis. Therefore, the inclusion of these persons in a control group will decrease the case rate in the control group compared with that of the vaccinated group.

(3) In the USPHS study, the cases notified were recorded, while in the other two studies, active case-finding had been carried out so a greater number of early cases were found in both groups.

It is important that the protection acquired by means of BCG vaccination relates not only to the manifestations of primary tuberculosis, such as miliary tuberculosis and meningitis and other disseminated lesions, but also to the adult types of pulmonary tuberculosis.

The allergic response to tuberculin cannot be regarded as a protective device, but the response has been widely used as a guide in the examination of the effectiveness of BCG vaccination. The best experimental studies on this question have been made by the USPHS on guinea pigs in an attempt to determine whether there is a direct association between the degree of post-vaccination allergy and the degree of protection induced by the vaccine. The studies were done with the object of reproducing in animals what is being done in humans in vaccination programmes, in order to compare the responses to vaccination which are readily observed in man, namely, the lesion from vaccination and the post-vaccination tuberculin sensitivity. It was found that the degree of post-vaccination sensitivity of tuberculin in guinea pigs was closely associated with the degree of acquired resistance. The higher the level of tuberculin allergy induced, the stronger was the resistance to challenge infection. The studies also showed that in guinea pigs there is no direct correlation between the size of the vaccinal lesion and the degree of resistance acquired. The size of the vaccinal lesion is determined largely by the total mass of bacterial cells injected regardless of whether the bacilli are living or dead.

As far as it is possible to use laboratory results in animals as a guide to anti-tuberculosis work in humans, these results tend to indicate that vaccines producing the strongest sensitivities induce the greatest resistance to virulent infection and that the qualitative, as well as the quantitative, measure of the post-vaccination allergy can serve as a practical guide to successful vaccination in man. A scar, on the other hand, is merely an indication that the vaccination has been satisfactorily done in a technical sense.

The controlled BCG trials in man have also shown a direct correlation between the degree of allergy produced by the vaccine and the immunity induced by it. The trials in which the higher degrees of post-vaccination allergy were produced showed the higher degrees of protection. In the Aronson trial, two batches of vaccine which gave low conversion rates also showed a lower protective effect. All the available evidence seems to support the assumption that in a vaccination programme in which a high degree of post-vaccination allergy is produced, a degree of protection of the order of 80 per cent. is to be expected, whereas the degree of protection will be considerably lower if a low degree of post-vaccination allergy has been produced. The implications of this in post BCG vaccination assessment programmes are clear. It is worthwhile observing here that these conclusions are based on observations of the immediate conversion rates obtained two to three months after vaccination. Danish studies on the degree of post-vaccination allergy produced by liquid vaccine indicate that post-vaccination allergy persists practically unchanged for at least five years. (This was the vaccine which was so strikingly successful in the British Medical Research Council studies.) In the Danish studies the workers were convinced that

remote post-vaccination allergy was not influenced by super-infection in the groups that they studied, and they concluded that BCG-induced allergy is always stable.

The question arises whether persons who have lost their hypersensitivity following primary vaccination should be revaccinated. Some authors believe that immunity probably persists despite the loss of allergy. The Danish workers believe that inability to sustain long-term conversion is probably related to some deterioration in the potency of the vaccine used. Revaccination of persons who have lost their sensitivity to tuberculin can do no harm, to the contrary, some good can be done.

To the extent that BCG vaccination really prevents the development of 80 per cent. or more of tuberculosis amongst vaccinated persons, it would seem to be of as much potential importance in tuberculosis control as all other control measures taken together (case-finding, treatment, isolation), and, of course, it is very much cheaper than these other methods.

However, many questions about BCG vaccination relating to our own particular context of activity are still unanswered. There have not been published controlled studies of BCG vaccination in tropical countries which would indicate that the efficiency of BCG vaccination is of the same order as shown in the British Medical Research Council trials. There are many obvious reasons for the possible failure of BCG vaccine to offer the same degree of protection in the tropics as it does in temperate climates. These are related to the storage of vaccine and to the stability of the vaccine. Technical methods of vaccination vary also, and it may be that techniques are unsatisfactory in some of the countries in which disappointing results had been obtained.

5.2.1 Factors influencing the results of BCG vaccination

It is well established that a high degree of protection is obtained only when a potent and correctly treated vaccine is given in the correct manner to the right people. The variations in the results of the various controlled trials, and also in the mass vaccination programmes conducted today, might well be due to variations in one or more of the following three factors, namely:

(a) the vaccine used,
(b) the method of vaccination, and
(c) the criteria used for the selection of people for vaccination.

From studies of the degree of protection following BCG vaccination in man it is difficult to obtain evidence as to what influence each of these three factors has on the degree of protection induced. Their effect on vaccination in man has to be judged on indirect evidence which has been produced by studies of BCG vaccination in animals and by studies of post-vaccination allergy in man.

What influence the method of vaccination has is probably not important. The intradermal method of vaccination is practised almost

exclusively in the vast majority of countries. Oral vaccination and vaccination by multi-puncture percutaneous techniques are not used in the South Pacific territories.

5.2.1.1 The vaccine

BCG vaccine is a live vaccine. No standard procedures for its maintenance or preparation have yet been adopted so that it is not surprising that vaccines from different laboratories show marked differences in their allergy-producing and immunizing effects. The vaccine when injected is a suspension of bacilli containing usually 0.04 mgm. to 0.1 mgm of bacillary mass of suspension; 0.1 ml of the suspension is injected intradermally. The aim is to have the highest proportion of bacilli alive at the time of injection. Here lies the source of some of our greatest difficulties and also one of the greatest sources of variation between BCG vaccines. Liquid vaccines may at the time of manufacture contain close to 100 per cent. live bacteria but at the time of injection the percentage may be very much lower. This is chiefly because:

(a) bacilli in suspension are highly fragile, and
(b) they are effected by exposure to strong daylight and/or sunlight and are effected adversely by exposure to heat.

The vaccine should be protected from these deteriorating influences from the time of manufacture to the time of injection. One should not use a liquid vaccine longer than four weeks from the time of manufacture. This fact alone limits its use in tropical communities. The storage conditions and length of time between manufacture and use are the factors which cause the most important variations in potency between vaccines used in mass vaccination campaigns. Freeze-dried vaccines are more stable than liquid vaccines.

The heat stable vaccines, the first of which was developed by the Japanese, is at present the product of choice. The viability of the vaccine is claimed to be 60 per cent. of the bacillary mass, and there appears to be no limit to the life expentancy of the bacillus. This is important because experimentally there is not only a quantitative difference but also a qualitative difference between the host response to live and killed vaccines, and to vaccines containing different proportions of live bacilli.

It seems that the best vaccine for use in the South Pacific territories is the vaccine possessing a heat stability factor. It is, however, advisable to protect the vaccine by refrigeration as far as possible.

5.2.1.2 The criteria for selection of people for vaccination

In many tropical areas, a low-grade tuberculin sensitivity is widespread. This weaker sensitivity, often referred to as non-specific sensitivity, appears not to be due to tuberculous infection.

It is generally believed that BCG vaccination should be preceded by a tuberculin test and that tuberculin positive reactors should be excluded from vaccination, partly because it is supposed to be of no benefit to them, and partly because there is at least a theoretical possibility that it may do harm (this last is now ignored following many trials). The evidence which has been presented from the BCG trials shows that children with low-grade sensitivity (who were not vaccinated but followed up) had a much lower incidence of tuberculosis than children without allergy who were not vaccinated. If low-grade allergy is caused by some less virulent organism than the human mycobacterium tuberculosis, the possibility cannot be excluded that such non-specific infection might induce not only sensitivity to tuberculin but also immunity to tuberculosis as does BCG vaccine. In the large-scale BCG vaccination programmes going on in the tropics today, persons with low-grade sensitivity are also vaccinated. However, important implications emerge if it can be shown that persons with low-grade sensitivity would not derive any positive benefit from vaccination. Until it is known, we should vaccinate all those with low-grade sensitivity reactions.

As regards revaccination there is no evidence which justifies first vaccination of non-reactors to tuberculin, although from extensive experience it is known that revaccination, like vaccination of people with low-grade sensitivity, will result in an increase in the degree of tuberculin sensitivity.

5.2.2 Assessment of BCG programmes

The purpose of the BCG assessment programme is to check whether the operational and technical efficiency of the campaign is maintained at the highest possible level and to identify any failures in this respect. This involves continuous and current appraisals of such aspects of the programme, as:

(a) the allergic and local response to vaccination. This requires the construction of distribution curves of tuberculin reactions to determine that the technical performance has been satisfactory, and that the tuberculin responses are maintained at a high level indicating that a uniformly high level of protection is maintained;

(b) adequate storage and handling of the vaccine involving regular evaluations of the potency of the vaccine, before vaccination and during vaccination in the field; and,

(c) coverage of the population eligible for vaccination, 75 per cent coverage at least should be the aim.

If, and when, unsatisfactory results are revealed by the assessment, immediate steps can be taken to correct the underlying faults or defects and the campaign can then be brought up to standard.

The complications arising from BCG vaccination are due mainly to:

(a) faulty techniques - the injection may be made subcutaneously rather than intradermally;

(b) too large a dose of the vaccine being used, and this applies particularly to infants and very young children; and,

(c) secondary infection.

The common complications include excessive ulceration of the site of injection, the development of caseating gland masses in the axilla, keloid scars, occasionally lupoid reactions in the skin and erythema nodosum. It has been shown that these complications can be eliminated if the dose is reduced. At the same time, a high post-vaccination allergy can be obtained.

The exact place of BCG vaccination in a control programme will vary in different communities according to the epidemiological situations and the existing facilities for tuberculosis control. Where prevalence of tuberculous infection is high and the incidence of disease is also high, or the risks of the development of disease after infection has occurred are high, then BCG mass vaccination is mandatory. Where the prevalence of tuberculosis has decreased to a sufficiently low level mass programmes are no longer necessary and attention can then be given to a selected age group on an "at risk" basis.

5.3 Chemoprophylaxis

Chemoprophylaxis means the prevention of the development of disease in apparently healthy persons exposed to risk by the administration of drugs. In tuberculosis chemoprophylaxis the drug of choice is INH. Theoretically, INH chemoprophylaxis could be used in two ways: to prevent infection, and to prevent the development of overt disease in a person already infected. In infection prophylaxis the drug is given to the person before infection occurs, the aim being to prevent the implantation of tubercle bacilli in host tissues. For many reasons infection prophylaxis is not a practical procedure, as the use of INH does not eradicate an implanted organism, but simply freezes the situation for as long as the drug is administered. This might be valuable in infancy when a child is born to a highly infectious mother and segregation is impossible or in laboratory workers who accidentally are exposed to a mass dosage of infection.

In disease prophylaxis we are dealing with a person who has already been infected with tuberculosis. Apart from a positive tuberculin test, he is, to all intents and purposes, not suffering from tuberculous disease. The drug is administered to prevent the development of certain manifestations of the infection. The younger the individual the more likely the infection is to cause serious pathology. Prophylaxis can prevent the local extension of the primary focus, metastasis from a primary focus, if this has not already occurred, and if distance spread has already occurred, the full development of metastatic lesions.

The problems associated with immunity and hypersensitivity in tuberculosis are full of paradox. Immunity developed by a host following natural infection with tuberculosis is not absolute; it is not clearly defined, nor can it be measured. Hypersensitivity cannot be regarded as a protective device.

A natural infection with tuberculosis is dangerous because neither the dosage nor the virulence of the infecting organisms can be controlled. Immunity to the disease is increased as a result of the infection, but the price paid for this, paradoxically, is the liability to develop tuberculosis. The problems are difficult to unravel in a disease which at one time protects and at another is dangerous to the subject (opie). Primary tuberculosis cannot always be regarded as an innocuous condition. Fatality from the complications of untreated primary tuberculosis remains high in many countries.

A number of experimental trials have been carried out in the past ten years with regard to chemoprophylaxis of tuberculosis. Such trials have been conducted in the United States by the Public Health Service, in France and Italy and more recently, in Greenland. From these trials it seems clear that the majority of subjects receiving prophylaxis are in a favourable situation with respect to the unpleasant consequences of infection.

Disease chemoprophylaxis provides us with a powerful tool for use in the prevention of tuberculosis. Concentration on the infected prevents subsequent development of complications in a great number of them. It reduces the number of people who will excrete bacilli in the future and indirectly, it protects the rest of the community.

Epidemiological and other studies have shown that the risks of developing tuberculosis are highest in the first two years following infection. After this period the risk lessens considerably. Tuberculosis prophylaxis is therefore most effective if used mainly in the newly-infected persons. However, many operational difficulties are involved in selecting these persons. The older the person the more difficult it is to determine the precise time of infection. By inference, the younger the child the more likely is an infection to be a recent one. On this basis, the application of chemoprophylaxis has its highest priority among the tuberculin reactive children under the age of five years and among those children who can be shown to be recent converters. Infected children who show a high intensity reaction to tuberculin (15 mm of induration or over) often have a higher risk of developing tuberculosis than those who display the weaker grades of reaction. These children could well be subjects of chemoprophylaxis. A further group which could well benefit from chemoprophylaxis would be the infected intimate contacts of patients with infectious tuberculosis.

In fact, secondary prophylaxis might well be given wherever possible to all people in the Mantoux-positive but disease-free category, but administrative and operational difficulties may hamper the wide application of such prophylaxis. Efforts might, however, be made to introduce it into "captive" populations such as schools, hospital staff, service groups, labour lines, etc.

Supervision of continued and regular medication is essential for the success of such programmes. Many intelligent non-professional people can be trusted to distribute the drugs and keep simple records. However, too much responsibility must not be forced on these people and supervision should be done by professionals.

There are many questions relating to chemoprophylaxis not yet fully understood. What is the drug of choice? What is the most effective dose of the prophylactic drug? Should one use one or two drugs? Should medication be continuous or intermittent and for how long should it be given? With regard to the use of two drugs, the difficulty lies in the choice of the companion drug for INH. There are objections to both PAS and thiacetazone. PAS, because of its unpleasant gastro-intestinal accompaniments, and thiacetazone because the margin between toxic and therapeutic doses is so small.

There is in fact no conflict between the use of BCG and chemoprophylaxis in the prevention of tuberculosis. The objectives are quite different. BCG is given to tuberculin negative reactors and chemoprophylaxis to tuberculin reactors. The question is merely to decide which of the preventive measures should have priority in any particular community. If tuberculosis is highly prevalent and the incidence of the disease is high, that is, if the risks to susceptible persons are high, BCG vaccination should receive the top priority. Conversely, if the prevalence of infection and the incidence of disease are low, in other words, if communities are close to the target of eradication of tuberculosis, chemoprophylaxis would become the most useful preventive measure. In general terms, the administrative effort required for a mass BCG vaccination campaign is less than that required for a chemoprophylaxis programme. Chemoprophylaxis is difficult to supervise. This fact limits its mass application in communities. It is extremely hard to induce apparently healthy people to continue to take a drug for long periods when no obvious benefits accrue from this.

In sum, the efficiencies of these two preventive measures are about the same and the maximum efficiency of each is about 80 per cent. The complications are roughly the same in each and none is at all harmful. Operationally, BCG vaccination has an advantage over chemoprophylaxis but there is no conflict involved. When risks of infection are high, BCG vaccination is imperative. When risks are low, chemoprophylaxis is the method of choice. Infection chemoprophylaxis will not prove to be a practical tool in prevention. Disease chemoprophylaxis will, however, be a useful tool in a relatively younger age group among whom the risk of developing post-primary tuberculosis is greater.

6. THE FUNDAMENTALS OF THE CONTROL OF TUBERCULOSIS IN COMMUNITIES

The problems of community control of tuberculosis stem largely from the fact that the disease is a chronic and infectious one, and shows an unpredictable potential for relapse after apparent healing, often lying dormant for years. Patients may harbour tuberculosis, often extensively, without significant symptoms, therapy must be prolonged, and death from tuberculosis is commonly not an early one. The lack of pressing symptoms may lead to long delays in seeking treatment, with the result that the dissemination of the disease proceeds unchecked.

In certain developing communities 50 per cent. of the population may be infected with tuberculosis, and one per cent. may be spreading the infection. The combination of a large pool of infectiousness and limited

resources imposes problems in control which on the surface may appear to be insuperable. Problems are also amplified by administrative difficulties. In the South Pacific island territories, for example, the provision of transport is a major difficulty.

In these circumstances, compromise is essential not in the sense of compromise in principle, but in practice. This has been made easier by the significant advances of the past two decades, effective therapy is now available and the realization that the earlier conceptions about management, based on the individual and intimately concerned with the doctor/patient relationship, in which initiative in diagnosis and treatment lay with the patient, are now no longer wholly valid. Emphasis has now become centred on control in communities. Initiative has passed to the medical officer and the deficiencies of the old approach, which did much to perpetuate the disease in the community, can be overcome. Attention is shifting slowly from the fact that patients need treatment, to the fact that in the community a much larger number of healthy persons must be protected from infection if the disease is to be brought under control. The aim of the tuberculosis control programme is not therefore primarily to cure a few patients, but to diminish as fast as possible, and in as economical a way as possible, the number of healthy people who might contract the disease, by reducing the pool of infection in the community and thereby the risks of exposure to the disease. It is incidental to this aim that tuberculous patients will be cured.

The community attack is based on two opposed premises:

(a) tuberculosis is an infectious disease and it should be managed on a communicable disease basis irrespective of cost; and

(b) resources are commonly limited and if we are dealing with public funds maximum benefits must accrue from minimum expenditure. The community must benefit before the individual.

In therapy, is it better to provide expensive therapy 100 per cent. effective to a few patients, or to provide a less expensive regimen, perhaps less effective than the first, to 95 per cent. or more of those people needing it? In tuberculosis control programme in communities of limited resources the latter answer must be accepted.

Must one provide such a programme with highly trained technical staff? In the older days when the approach was based on an individual attack such professional attention was mandatory. Today, it is clear that non-professional assistance is not only forced on us but it is eminently acceptable and ethically justified. The contributions made by non-professionals are most valuable in the mass control of tuberculosis. Professional personnel should concern themselves with policy, planning, supervision and evaluation. They are too valuable to be utilized in any routine matters.

In appropriate circumstances the less expensive therapeutic regimens are highly justified. So justified indeed, that we are in a

position to depart even more radically from the old concepts of management, and to provide effective therapy on a mass basis to patients who, with a few exceptions, might never need hospital attention. The fundamental implication of the Madras experiments has been that the dissemination of tuberculosis and its perpetuation in the community proceeds from the cases which have not been diagnosed. The danger of spread of tuberculosis lies in the period before the infectious source is discovered.

In the selection of a therapeutic regimen the provision of drugs is commonly a matter of economics rather than of personal choice. It is agreed that in terms of speed of recovery, attainment of bacteriological quiescence and radiological regression, combined therapy is preferable to single drug therapy, but if the question of cost is important, the use of a single, daily, high-dose INH regimen is fully justified. The problem of drug resistance is not yet a great one in our communities. It is imperative to recognize that to leave patients untreated is far more dangerous to the community than to produce a few patients who harbour drug resistant organisms.

The selection of patients is, in the same way, subject to priority considerations. The patient with a positive sputum smear is undoubtedly the most dangerous member of the community and demands priority treatment. It is recognized that persons with X-ray shadows only and perhaps other categories of suspects, might well merit treatment. These latter bacteriologically negative groups cannot be considered to be as dangerous to the community as the first category and their management must await the expansion of resources available for their treatment. Even then, the use of a single drug regimen given as preventive treatment is fully justified. What is not justified in this context is concentration of efforts on these other two categories, if the majority of infectious cases in the community are not undergoing treatment, or if the management involves substantial interference with the patient's personal life. These persons must be allowed to continue their personal lives unhindered and must not be admitted to hospital.

When patients are to be managed on a domiciliary basis, the fundamental problem is to ensure that if drugs are self-administered they are in fact consumed regularly as directed. It is in this area that the use of non-professional workers assumes its greatest importance and the organization of a meticulous supervisory service is essential. Too much is at stake here in terms of community protection to deny this statement.

Although it is a natural corollary to this discussion, the best protection is offered a community by controlling the disease amongst infectious patients; specific protection implies biological and chemical prophylaxis. There is no doubt about the effectiveness of both of these measures when properly used and used to the fullest capacity. The emphasis placed on each measure will vary with local circumstances.

One final consideration. Effective therapy and efficient prophylaxis are the means of control but the problem cannot be solved merely by their availability. Control of tuberculosis is no easy matter for reasons which are clear. Much more has to be learned about the use of

these methods and their availability is no substitute for close and unremitting attention to the details of careful planning, efficient administration and periodical evaluation, without which no control programme will succeed. The ultimate responsibilities lie today with those who realize this. In consideration of the mechanics of control, it is recognized that there are substantial differences in the emphasis placed on the means at our disposal, depending amongst other things on whether we are dealing with a community whose resources are considerable or one with limited resources, or whether the prevalence of infection and the incidence of disease in the community is high or low.

Certain guiding principles are, however, common to both community control programmes:

(1) The most successful control programme is one which prevents the disease developing in healthy individuals. The primary objective is the interruption of transmission of tuberculosis from the infectious to susceptible individuals.

(2) This points to the need to discover those cases in the community who spread the disease. It is fundamental that the known tuberculous patients must all be under efficient therapy. Efforts must be unremitting to discover also the unknown infectious patients.

(3) Having discovered the patient, he must be rendered, first, non-infectious, then healed and the healing must be maintained.

(4) Infectiousness implies dissemination and dissemination implies contacts. The contacts of all known infectious patients must be investigated. The investigation of contacts and their management according to their infection state requires the provision of:

(a) a tuberculin testing service,
(b) bacteriological service,
(c) X-ray service, and
(d) treatment service.

(5) Susceptible persons will be found in every community. Protection by vaccination can be provided for these. The extent of the need will be determined by the prevalence of infection, the incidence of disease and the estimation of the risks run by susceptibles. In areas of high prevalence and incidence BCG vaccination is mandatory.

(6) Case-finding, treatment services, chemical and biological prophylaxis and patient reviews imply the organization of known cases into some order so that contacts with patients will not be lost. Organization demands the establishment of a case register. The uses to which the register is put will determine its scope, but for valid statistical purposes the prime need or the priority need is to register all patients bacteriologically proved to have infectious tuberculosis. Expansion of the register to include other categories of individuals can take place as facilities and resources or needs are increased.

(7) The organization and supervision of a control service require the appointment of a full-time organizer. Divided control is inefficient and may be dangerous. The organizer must be assured of the support of his director of health services and his subordinates.

Advice cannot be given in connection with the establishment of priorities in any general way in the South Pacific communities. These are the responsibilities of the director of health services, but certain things should be avoided in the establishment of a tuberculosis control service and others should be kept in mind. They are as follows:

(1) Do not wait for a supply of professional personnel before establishing a service. Any intelligent non-pfofessional can be trained in the essentially simple diagnostic methods used in tuberculosis control such as tuberculin testing, bacteriological and radiological techniques.

(2) Do not hinder the development of the service by too slavish adherence at the outset to ideals and techniques in performance. Few can afford the luxury of the ideal at the beginning of the service.

(3) Do not establish the service by building an elaborate chest clinic unit, centrally situated. These clinics have voracious appetites for men and materials and will deprive the periphery of attention.

(4) Try and incorporate the control service into the general framework of the health services and use existing facilities such as general hospitals, clinics, etc., in fact any place with some medical organization, for the purpose of clinic practice.

(5) Do not establish elaborate diagnostic facilities; but as resources permit, incorporate the simplest techniques compatible with efficiency into the service.

(6) No matter how limited the resources are, one can always do something to deal with the problem of tuberculosis control in any community.

(7) Establish priorities in the development of the service and keep to them. Make sure that all personnel are familiar with the policies of control.

(8) Establish uniformity in techniques so that no confusion will exist in the minds of subordinates.

(9) Remember that the overall aim of the programme is the prevention and treatment initially and later on the reduction of tuberculosis in the community. Tuberculosis will not be controlled if cases are not found. Cases cannot be found by static units or static people. They must be looked for energetically.

In planning a tuberculosis control programme, remember the following principles:

(1) Plan the programme realistically and practically, that is economically.

(2) Demonstrate facts rather than quote opinions.

(3) Exploit special or personal relationships fairly but ruthlessly.

(4) Consider the possibility of using outside help if this can be useful.

(5) Programme activities should be encouraged so that the work of the tuberculosis control service can be integrated into that of the other health services. In this way often saving in costs can be achieved, particularly in relation to such things as transport.

7. THE GENERAL PRINCIPLES OF COMMUNITY ORGANIZATION IN THE CONDUCT OF HEALTH PROGRAMMES

In conducting community health programme, it is always important to understand the dynamics of group behaviour. This can be summarized as follows:

(1) Communities, like individuals, exhibit wide differences in constitution and behaviour.

(2) Communities have a right to self-determination, but even in a democratic situation power is a necessary ingredient in social relationships. Rules must be obeyed after they have been accepted as beneficial to the community as a whole.

(3) A community group grows in stature by collaboration with the leader. It cannot grow if the group is subordinate to the leader.

(4) Representation within the group should be equitably distributed and barriers which prevent communication within the group must be eliminated if the community is to develop fruitfully. (Religious, political and personal differences are involved here.)

Certain principles must be observed in applying a health programme to a community:

(a) There must be an obvious need for a particular service.

(b) The service should be available equally to all members of the community.

(c) Health personnel should be regarded merely as consultants to the group.

(d) The welfare of the community as a whole should prevail over the personal prestige or interest of the doctor, or of certain cliques.

The aim of community organization in health matters is commonly to bring about a change in attitudes and behaviour. It must be recognized, however, that it might not always be desirable to bring about a radical change.

In tuberculosis control the objectives of the programme would be to eliminate contagion in the community. This involves obtaining the acceptance of modern principles of management and of certain forms of treatment. This may require the rationalization of superstitution into a form compatible with modern concepts of causation of disease. This is preferable to blind substitution of modern concepts which are rarely acceptable.

Acceptance must come from within the group. A decision which has its origin from outside of the group or community is not usually accepted. If it is apparently accepted, it will be rejected at the first opportunity.

Health education is a slow process. It takes time to create needs within a community or to stimulate a desire for change. It is important to realize community organization is a means of achievement of an end. It is not an end in itself. It is, above all, a continuous process which uses group organizations already existing in a community, which does not interfere materially with the traditional structure of the community, which seeks support for and co-operation with new ideas and avoids competition.

The methods of community organization create and maintain a continuously productive balance between needs and resources. Community organization is a process of continuous evolution and change.

In the particular field of tuberculosis the social anthropologist has many questions to ask. What is the traditional belief about the disease, its causation and management? Can these beliefs be reconciled with modern beliefs wholly or in part, to make the modern ideas acceptable? If there is even partial acceptance can this be utilized in the interests of tuberculosis control in a community? If patients refuse treatment, who are they, and why do they refuse? Do they refuse all treatment or is disinclination restricted to a particular drug?

Inclinations, established customs and traditional beliefs must be recognized, accepted, rationalized or modified to the fullest extent in the interests of the control of tuberculosis for the benefit of the community.

The preliminary approach to the problem is an estimation of the needs of the community and of the resources available to meet these needs. What is the number of patients involved? Can treatment be provided for them in an acceptable form? If therapy is provided, is the social development of the community of a sufficient order to guarantee that treatment will be taken regularly, particularly if circumstances are such that self-administration of drugs without continuous supervision is necessary? Is financial or other support needed? What groups can be usefully employed to assist in the programme of organization? Clubs, sporting groups, women's committees, private practitioners, social workers, are all important here in resolving non-medical difficulties.

All useful communication media should be considered. Posters, filmstrips, films, the flannelgraph, and radio broadcasting all have their uses, but it must also be mentioned that they may have their limitations.

It is essential to remember that such media should be in a form which is consistent with the community environment. Materials useful for communities in one environment may be, and often are, completely unacceptable and unsuccessful when applied to communities living in another environment. Information may be wrong, incompatible with experience, or unacceptable on the basis of personal feeling, expectations or hidden motivations.

The best technique is that of informal group discussions, democratic and free from preaching, paternalism or authoritarianism, which do not excite fear, antagonism or aggression on the part of the participants. The language used must be simple.

Finally, and most important, is that force and imposed ideas can have the most unfortunate results.

One should not exclude anyone from consideration in assessing the contributions others can make to the success of organization. This includes those whose reactions might on the surface be inimical, the bush doctor or sorcerer, for instance. He stands in the same relation to the native community as the priest to his congregation. He is "the poor man's psychiatrist" and as such his influence is extensive and pervading.

It is essential to be honest in one's dealings with communities. To be caught out in dishonesty is fatal to success. Therefore, one must be honest with one's self. One should not be too proud to allow another to take credit for something initiated by himself. The important thing to achieve is a change for the better and its maintenance. Who gets the credit is immaterial.

Finally, the best programmes are those which use skillfully the contributions that can be made by the people themselves. Lasting changes are initiated and maintained only in this way.