DETAILED REVIEW OF THE PROGRAMME AND BUDGET ESTIMATES FOR 1975

DEVELOPMENT OF THE ANTIMALARIA PROGRAMME

The Twenty-third World Health Assembly, in resolution WHA23.12, requested the Director-General "to continue to keep the World Health Assembly and the Executive Board informed of the development of the programme following the revised strategy of malaria eradication".

A review of the malaria problem, of the policy followed in the implementation of the revised strategy, of the status of antimalarial activities in 1973 in the various WHO regions, of the coordination, training and research aspects of the programme, is contained in Annex I.

In presenting this review, the Director-General wishes to call the Assembly's attention to his concern over the present malaria situation and to seek guidance as to what the future role of WHO should be in helping countries affected by malaria to combat the disease.

Following the spectacular results obtained initially, the programme met with a number of difficulties of a financial (administrative), operational and technical nature, resulting in setbacks and overall slow down of the progress. A thorough evaluation and assessment of the global programme imposed itself and this was undertaken in 1967 and 1968, indicating the need for revising the strategy of the malaria eradication programme and this revised strategy was ultimately adopted by the World Health Assembly in 1969.

The principal postulates of the revised strategy were: replanning of the programme based on available financial and manpower resources as well as mobilization of all forces to maintain the gains already achieved for areas where, due to complex ecological conditions, a time-limited programme was not likely to succeed. As a result, in some countries further progress was made but in others setbacks continued to occur. In general it must be admitted that the programme has lost the prestige and appeal of the former policy of intensive, time-limited eradication on a global scale. Some international and bilateral agencies which had been assisting the programmes greatly reduced and/or withdrew their support to antimalarial activities. Even a number of governments have reduced their allocation to their malaria eradication programmes. Under these circumstances, coupled with the increase in price of insecticides, transport, other equipment and wages, it is understandable that not much progress could even be expected.

Yet, malaria remains, among the parasitic diseases afflicting the health of the people in a large number of tropical or subtropical areas, a prominent cause of death and suffering and the most serious obstacle to production and economic development.

Integration of antimalarial activities within the general health services, however rational its principle may be, has failed in many cases to maintain the required level of protection of the population mainly because the health services had not reached the necessary degree of coverage and efficiency.

The situation of malaria in Africa warrants particular preoccupation; it is on that continent that sizeable populations living in endemic areas are still deprived of any protective measures and that morbidity and mortality rates are the highest.

Whatever assistance WHO can offer - and can engage other international multi- or bilateral agencies to provide - will be of little avail without unequivocal recognition by the governments concerned of the priority to be given to the protection of the population against malaria, to the formulation of programmes adapted to the country situations and to the allocation of the resources indispensable to their implementation.

The World Health Assembly on many occasions in the past has urged the Organization and the governments of malarious countries to mobilize available resources and to continue to consider malaria eradication as a priority programme. Being fully aware of all the pros and cons that could be put forward in favour of malaria eradication programmes, but bearing in mind the possible consequences of reduced antimalaria activities, the World Health Assembly and the Secretariat have to accept the challenge at this point. The Director-General would therefore appreciate if the Assembly would pronounce on the level of priority the Organization should continue to accord to the stimulation and coordination of international efforts against malaria.
Introduction

Malaria continues to be a major public health problem in many parts of the world, especially in the developing countries. Although four more countries have recently been entered in the register of areas in which malaria eradication has been achieved, namely, Cuba, Mauritius, European Portugal (excluding the islands), and Yugoslavia, progress of antimalaria programmes was generally rather slow for administrative and financial rather than for technical reasons. While a number of the malaria eradication programmes have developed satisfactorily, the implementation of a change of strategy was hampered in others. The least progress was made in countries where time-limited eradication is impracticable at present. In the majority of these areas malaria continues to be highly endemic and to take a heavy toll among infants, young children and pregnant women. It is equally disconcerting to note that large epidemics have occurred in areas in which malaria transmission has been allowed to re-establish itself after a period of successful antimalaria operations. While natural disasters may have played some role in these events, the major causes were disruptions or severe reductions of administrative and financial support.

In some areas the realization of a regional concept of malaria eradication has not received due attention by governments of a few individual countries. While, in general, intercountry coordination has been well established, further efforts are required in some geographical areas for simultaneous efficient action in reducing the level of transmission of malaria.

1. The problem

1.1 Geographical extent

Australia is so far the only continent from which malaria appears to have been eradicated. While the United States of America and the majority of the Caribbean islands have achieved eradication and in Europe only one country is still having some residual foci of malaria, the disease remains deeply entrenched in tropical Africa and parts of Asia. In most of the other tropical and subtropical areas where malaria is still present, morbidity and mortality from the disease have significantly been reduced as a result of massive antimalaria operations. This applies in particular to the majority of countries in North Africa and in Middle and South America.

1.2 Morbidity and mortality from malaria

Apart from areas in the consolidation and maintenance phases of a malaria eradication programme, i.e. those under regular surveillance or vigilance, morbidity and mortality from malaria are difficult to assess.

Estimates based on data provided by 30 countries of the African Region during the Inter-regional Malaria Conference, Brazzaville, 1972, indicate that out of a total population of 201 000 000 some 196 000 000 are under malaria risk of whom 19 000 000 live in hypoendemic areas, 58 000 000 in mesoendemic areas and 119 000 000 in hyper-holoendemic areas. At any given time during the year it is estimated that there must be about 800 000 cases in hypoendemic, 16 000 000 cases in mesoendemic and 79 000 000 cases in hyper-holoendemic areas. These conditions are borne out by a high infant mortality.

In those areas of Asia which are not covered by regular antimalaria activities the prevalence of malaria is generally of a lesser order, but often the incidence of clinical cases and the fatality rates among adolescents and adults are higher due to a lesser degree of endemicity and thus of the communities' immunity.
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In 718.6 million population living in consolidation and maintenance areas throughout the world of which data are available, the morbidity from malaria was 0.46 per 1000 in 1972. Excluding the data from India the morbidity was 0.21 per 1000.

In 13 countries of the American Region the number of deaths attributed to malaria fell from an annual average of 43 368 during the period 1950-1952 to 1876 in 1967-1969.

Europe has become a major recipient of malaria cases from abroad and the relevant case fatality rates are higher than in areas with high malaria endemicity, due to non-existent immunity in the majority of cases and due to missed or delayed diagnosis.

If morbidity and mortality from malaria are used as a yardstick for the success of antimalarial operations then it may seem that some areas with apparently unsuccessful malaria eradication programmes have derived more benefit from these operations than countries with spectacular progress. This is due to a higher basic endemicity which makes malaria eradication a more difficult goal.

While in many countries with regular antimalaria programmes the general health service establishments were relieved from attendance pressure due to malaria and thus able to give more attention to their other tasks, the health services in tropical Africa still record a high number of malaria cases. In 11 such countries for which relevant data are available, in average 12.6% of all patients were malaria cases (1971). In the same countries only 0.46% of the health manpower was engaged in the prevention of the disease.

1.3 Malaria and socioeconomic development

The interrelation between malaria and socioeconomic development presents itself in two ways: on one side socioeconomic progress may be responsible for the disappearance of malaria such as largely was the case in most of the European countries and parts of the Middle East and on the other hand the vicious circle of disease and stagnation of socioeconomic development does not produce resources sufficient to liberate the population from these bonds.

The interrelation of socioeconomic factors and malaria can be illustrated by the example of 24 Middle and South American countries and territories in which malaria eradication programmes have been or are being conducted. In six of these countries and territories where malaria has been eradicated, the average gross national income (GNI) was well over US$ 1000 per capita (1970) and the ratio between the growth of the GNI and the growth of population between 1960 and 1970 was of the order of 4.6. In five countries where the programmes have made good progress the average GNI (1970) was US$ 858 and the ratio between its growth and that of the population was 2.6 (1960-1970). In six more countries, where the programme has made some progress, though less satisfactorily than expected, the average GNI was US$ 480 per capita and the ratio between its growth and that of the population was 2.3 (1960-1970). Finally, in seven countries where the programme has made no progress or even suffered a deterioration, the average GNI was US$ 457 per capita and the ratio between its growth and that of the population was 1.25, indicating very little progress in the socioeconomic sector.

From these data it may be concluded that the successful implementation of a malaria eradication programme requires a certain minimum level and a dynamic progress of socioeconomic development. In areas which do not fulfil these conditions and where malaria, a serious public health problem, is an impediment to general development it is therefore indicated to concentrate on reducing malaria and other important diseases by suitable control measures to such an extent that socioeconomic development can gather momentum and ultimately reach the level that is required for attempting the complete elimination of malaria.
1.4 National resources, administration

The national resources in terms of finance and manpower made available for antimalaria programmes vary widely from country to country. Thus a recent study of the 22 active malaria eradication programmes of the American Region showed that per capita expenditures from direct government appropriations ranged from US$ 0.15 to US$ 1.35 per annum. Operations in areas with hyper- and holoendemic malaria and perennial transmission are generally more expensive than those in areas with a lesser degree of endemicity and unstable malaria. The former category is mostly made up of countries in the tropical belt, with a lesser degree of socio-economic development and thus a reduced ability to support the expenditure required for a malaria eradication programme.

In Africa the situation is more precarious still: eight of the 25 countries for which details are available have annual health budgets of less than US$ 1 per capita, and only in four countries the annual health allocations exceed US$ 5 per capita. The weighted average for all 25 countries is US$ 1.165 per capita. In seven of these countries the health budget was less than 5% of the total government budget. In the 13 countries which have provided a further analysis of allocations the appropriations for malaria control ranged from US$ 0 to US$ 0.80 and averaged US$ 0.036 per capita and year. For the countries in question this share constituted in average 3.5% of the health budget. These figures are explicit and indicate that the majority of countries in Africa south of the Sahara are not yet in a position to undertake extensive antimalaria programmes.

Administrative and financial stability and continuity proved to be among the most important factors determining the success of antimalaria programmes. All programmes with unsatisfactory progress have suffered from shortcomings in administration and logistics and from severe fluctuations and inadequacy of financial allocations.

1.5 International and bilateral assistance

WHO has continued to provide advisory services to antimalaria programmes of countries requiring such assistance. In addition, the Organization has assisted Member States in the training of nationals and in certain instances by providing some items of supply and equipment or local costs. For understandable reasons such assistance was possible only by reducing the advisory services being provided. This in turn was made possible by the fact that nationals previously trained have acquired the required expertise for the planning and conduct of malaria eradication programmes.

While UNDP still maintains important assistance to a limited number of antimalaria programmes, UNICEF had practically phased out such assistance by the end of 1973. This Fund though supports the development of basic health services in some countries and contributes to their supply with antimalarial drugs, thus rendering indirect assistance to antimalarial programmes.

USAID, which so far is the most important bilateral agency assisting antimalaria programmes, has continued to reduce assistance in 1973, regarding both the number of countries assisted and the amount of loans. Other bilateral assistance, though significant for the individual recipient programmes, remained very limited if considered on a global scale.

1.6 Major problems

The major among the many obstacles hindering the development of antimalaria activities in the African Region are: the nature of the disease under the prevailing conditions; the limitation of available resources; the limited population coverage by the available health
services; the lack of reliable vital and health statistics; the poor awareness of the rural population that malaria is one of the main causes of mortality and morbidity.

In all other regions administrative and operational problems are the most frequent causes of failure or setbacks which have affected many programmes to some extent. These difficulties range from inadequate government support and impeded logistics to a precarious manpower situation or premature integration of malaria eradication activities with general health services which are yet unable to cope with the added responsibilities.

Most regions suffer from a discrepancy between demand and availability of qualified national and international staff. The existing training procedures and facilities are not adequate to produce the required quantity and quality of personnel.

Apart from these general problems, there exist those of a technical nature:

(a) Resistance of 

(b) Resistance of anopheline vectors to insecticides, especially to chlorinated hydrocarbons, which involves all regions to some extent. The use of alternative insecticides increases operational cost. There is growing evidence that the widespread use of agricultural pesticides contributes to insecticide resistance of the malaria vectors.

(c) Exophily of anopheline vectors which is geographically more confined but an important obstacle to interrupting malaria transmission in some countries, particularly on formerly forested areas that are being reclaimed for agriculture.

(d) Population movements, man's habits, inaccessibility or insecurity of malarious areas have impeded malaria eradication in several areas, often being responsible for maintaining foci of transmission in spite of generally satisfactory progress in the major parts of the countries concerned.

(e) With the increased international travel and tourist trade in recent years a significant number of imported malaria cases were recorded in malaria-free countries, particularly in Europe and North America. Urban malaria has often been referred to as a technical problem but it has been realized that in most instances administrative and operational rigidity or factors outside the control of the malaria services have helped the almost uninhibited development of malaria in certain urban areas in Asia.

1.7 Danger of epidemics

The threat of malaria epidemics exists wherever antimalaria activities have succeeded in interrupting or drastically reducing transmission over several years and where the premature cessation of attack measures has permitted the re-establishment of a high potential of transmission. Maintenance of important foci of infection in the neighbourhood of such areas, e.g. urban foci in Asia, reduction or breakdown of surveillance and delay or failure of applying effective remedial measures, e.g. in Asian countries as a result of war and lack or disruption of administrative support, may lead to rapidly spreading epidemics. The danger of epidemics can only be contained by a continuous and consistent effort on the part of competent and adequate services, demanding also a certain degree of administrative flexibility.
2. **Policy**

The targets of antimalarial activities and the strategy to be used differ according to the epidemiological, ecological and operational background of the areas concerned which can be divided into five categories:

(a) **In areas where malaria has been eradicated**

Promotion of the integration of malaria vigilance systems in the general health services where possible, but using malaria eradication programmes as interim measure for continuation of this surveillance where necessary. Definition of vulnerable areas. Evaluation of the receptivity of formerly malarious areas.

(b) **Areas with good prospects for reaching malaria eradication**

To maintain or to establish the priority of malaria eradication and if required to intensify the application of the measures currently in use. Alternative insecticides are to be used in areas with endophilic vectors which are resistant to chlorinated hydrocarbons, while antilarval measures might be the solution in areas with exophilic vectors. Although population movements may seriously interfere with malaria eradication, the problem could be overcome by a more flexible operational approach and by intercountry cooperation. Maintained external assistance to these programmes is essential in many countries.

(c) **Areas where malaria eradication programmes are not making satisfactory progress**

Realistic assessment of these programmes resulting in rephasing or possibly a restructuration following the new strategy of malaria eradication. The governments must be convinced of the dangers of a premature withdrawal of attack measures and of an untimely integration of malaria services with basic health services which are yet unable to cope with full surveillance. In some programmes it may be indicated to modify the immediate target to malaria control.

(d) **Areas where progress depends on the solution of serious operational or technical problems**

To limit transmission until such time as new attack methods or additional resources are available, by developing a flexible approach adapted to each area and to the relevant national economic plans. Intensified research is to aim at better and less costly alternative or complementary methods.

(e) **Areas where time-limited eradication is not feasible at present**¹

To reduce mortality and suffering from malaria and to relieve the socioeconomic impact of the disease. The areas concerned comprise tropical Africa, the Arabian Peninsula and a number of tropical islands of Asia and Australasia.

Spraying operations are generally to be limited to the protection of towns and labour aggregations in areas with endophilic vectors, while there is wide scope for antilarval operations, which in many areas may be reinforced by simple mechanical methods of source reduction. While facilities for treatment of malaria cases are to be gradually extended,

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the use of mass drug administration for malaria control is generally not envisaged, except in particular conditions, e.g. the prevention of malaria epidemics. In the hyper- and holoendemic areas of Africa chemoprophylaxis, using chloroquine, could be given to infants, young children and expectant mothers. In all countries concerned, WHO is attempting to stimulate and to accelerate the development of the basic health infrastructure, and to support the training of local personnel and the establishment of diagnostic facilities.

3. Status of antimalaria activities, 1973

Malaria was endemic in 145 (69.4%) of the 209 countries or territories for which data are available. By 31 December 1973 malaria had been eradicated in 36 entire countries or territories in which live 10.3% of the total population of originally malarious areas.

In 47 countries (32.4%) which still have malarious areas, eradication programmes did continue.

In 45 countries or territories (31.0%) malaria control activities were carried out, but only in eight have they protected more than 50% of the population, while in 23 they covered less than 10% of the inhabitants. In 17 countries or territories (11.7%), no specific antimalaria measures were applied.

By 31 December 1973 the population of originally malarious areas was 1900.15 million of which 786.77 million (41.4%) were living in maintenance phase areas and 596.17 million (31.4%) in areas in other phases of the eradication programme. Of these, 285.75 million were residing in consolidation, 306.46 million in attack and 3.96 million in preparatory phase areas.

Among the 517.21 million population not yet covered by malaria eradication, 148.14 million (28.6%) were protected by antimosquito measures or regular drug prophylaxis. 93.27 million (18.0%) are not yet systematically protected but reside in areas where antimalarial treatment is available, while 275.80 million (53.3%) are still completely unprotected.

In relation to the status of 31 December 1972 the maintenance areas have slightly increased by 2.2%, an increase which was parallel to a relative decrease of areas under the other phases of malaria eradication as no new programmes have started in 1973. A slight increase is also observed of areas under intensive mosquito control or regular drug prophylaxis, while the areas not yet protected by any measures remained virtually unchanged.

In 1973 WHO assisted antimalaria activities in 70 countries, 38 of them having malaria eradication, the remainder control programmes. In four more countries the Organization rendered assistance in the planning of malaria control programmes which are expected to become operational in 1974.

3.1 African Region

The epidemiological situation regarding malaria has remained largely unaltered, characterized by a high level of endemicity and intense transmission in most of the Region.

Only two islands have in their entirety reached the maintenance phase: Mauritius has been entered in the register of areas from which malaria has been eradicated, in La Réunion a relevant assessment has been carried out in 1973.

In the rest of the Region, several countries have started to investigate ways of expanding, rationalizing and standardizing malaria control techniques. WHO has rendered
consultant services to 14 countries of this Region, mostly through the three intercountry malaria teams. Several of the basic health service development programmes have a malaria component.

WHO assistance concerns in particular the planning of malaria control, the better utilization of available means, training of polyvalent workers and integration of antimalaria activities at different levels of the health services. To some extent WHO also assisted in feasibility studies such as house spraying with residual insecticides in forest areas of Togo, where the vector Anopheles funestus was nearly eliminated by one round of spraying, or the larviciding trials with temephos in a pilot area of the Comoro Archipelago which have yielded promising results.

Although the malaria situation has not greatly changed, with only 3.5% of the population under risk protected in malaria eradication programmes and 89.1% not yet protected by control measures or in reach of antimalaria treatment, some improvements were brought about in 1973 which are expected to start producing expansion and amelioration of malaria control in the following years.

3.2 American Region

Of the 34 countries and political units with originally malarious areas in this Region, 12 had achieved eradication in their entire territories, Cuba being the country which has most recently been entered in the register. In 22 units active malaria eradication programmes have continued in 1973; the entire territories of Argentina, Guyana and the Panama Canal Zone are in the maintenance or consolidation phase while 19 units are partially in the attack phase. Particular progress was observed in Costa Rica and in Paraguay where in 1973 considerable areas shifted from attack to consolidation phase. Of the 540.9 million population of the Region in 1973, 198.3 million lived in originally malarious areas. Of these 89.0 million (44.9%) were in maintenance, 46.1 million (23.3%) in consolidation and 46.8 million (23.6%) in attack phase areas. Some 16.2 million population (8.2%) live in areas which do not yet qualify for transfer to the consolidation phase, but where attack measures were temporarily suspended; 0.1 million inhabitants live in areas which are inaccessible and therefore not included in the programme.

Two major technical problems exist in the Region: the resistance of A. albimanus to chlorinated hydrocarbons, concerning large parts of Middle America, and the resistance of P. falciparum to chloroquine, concerning mostly Brazil, Colombia and some of the neighbouring countries. In spite of these factors the programmes of Brazil, Costa Rica, Guyana, Honduras, Nicaragua and Panama continued to make progress in 1973. However, in the absence of similar technical problems some of the programmes failed to develop satisfactorily due to administrative and financial shortcomings.

3.3 South-East Asia Region

Five of the originally malarious countries of this Region have malaria eradication programmes while the remaining three apply malaria control with the ultimate objective of eradicating the disease.

As per 31 December 1973 the population in originally malarious areas numbered 834.6 million of which 370.6 million (44.4%) lived in maintenance, 164.5 million (19.7%) in consolidation and 165.7 million (19.9%) in attack phase areas. Of the remainder 78.5 million (9.4%) were protected by intensive mosquito control, 11.9 million (1.4%) had access to antimalaria treatment and 43.3 million (5.2%) were not yet protected by any measures.
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As compared to 1972 the areas in the maintenance phase have slightly increased and those in the other phases of the eradication programme have correspondingly decreased. Besides technical problems among which resistance of *A. culicifacies* and *A. stephensi* to chlorinated hydrocarbons, the exophily and exophagy of *A. philippinensis* and *A. balabacensis*, in certain areas and the resistance of *P. falciparum* to chloroquine in wide areas of Thailand and its westward spread are the most prominent, it is administrative and financial shortcomings as well as premature integration of operational activities which have contributed to difficulties experienced in the eradication programmes of India, Sri Lanka and Thailand. It is gratifying to note that the programme in Bangladesh continued to develop satisfactorily and that also the malaria control activities in Maldives Islands have made good progress.

3.4 European Region

Of the 19 countries with originally malarious areas, 14 have eradicated the disease in their entire territories. European Portugal (excluding the islands) and Yugoslavia have recently been included in the register of areas from which malaria has been eradicated.

As per 31 December 1973 the population in originally malarious areas numbered 357.9 million, of which 297.5 million (83.1%) lived in maintenance, 41.0 million (11.4%) in consolidation, 5.7 million (1.6%) in attack and 3.0 million (0.8%) in preparatory phase areas. Of the remainder 6.4 million (1.8%) are protected by mosquito control or drug prophylaxis, 0.1 million have access to antimalarial treatment and 4.2 million (1.2%) are not yet protected at all.

As compared to the status of 1972 some more areas were included in the eradication programme, especially due to the favourable development of malaria eradication in Algeria. In Greece and in the USSR malaria remained reduced to very limited foci in consolidation phase areas which are under focal remedial measures. In Turkey the development in the few remaining attack areas was favourable, but several grouped foci in the consolidation area required intensive operational measures. In Morocco the general malaria incidence has decreased in 1973 as compared to 1972.

3.5 Eastern Mediterranean Region

Out of the 24 countries and political units with originally malarious areas, four have achieved the eradication of malaria in their entire territories. Eight more have eradication programmes and nine have major malaria control programmes.

As per 31 December 1973 the population of originally malarious areas was 205.4 million, of which 5.8 million (2.8%) lived in maintenance, 28.4 million (13.8%) in consolidation and 77.0 million (37.5%) in attack phase areas. Of the remainder, 45.3 million (22.1%) were protected by intensive mosquito control or drug prophylaxis, while 34.8 million (16.9%) had access to antimalarial treatment, and 14.0 million (6.8%) were yet completely unprotected.

As compared to 1973 change was negligible as far as areas under malaria eradication are concerned, but larger areas were included under malaria control. Whereas the malaria eradication programmes in Iran, Iraq, Jordan, Syria and Tunisia have continued to make satisfactory progress, malaria transmission was largely uninhibited in wide areas of Afghanistan and Pakistan whose programmes remained to be beset by administrative, financial and technical difficulties. Malaria control activities have gathered momentum in Egypt, Saudi Arabia, Somalia and Sudan by supplementing larviciding with the propagation and use of larvivorous fish.

3.6 Western Pacific Region

Of the 18 originally malarious countries and political units in this Region, four have
achieved the eradication of malaria and six more have eradication programmes. Malaria control is being applied in six countries though mostly to a rather limited extent.

As per 31 December 1973 some 18.5 million (26.6%) of the 69.6 million population residing in originally malarious areas lived in maintenance phase areas; 3.5 million (5.1%) were in consolidation, 10.4 million (15.0%) in attack and 1.0 million (1.4%) in preparatory phase areas. Some 5.7 million (8.1%) population were protected by mosquito control, 25.2 million (36.2%) had access to antimalaria treatment and 5.3 million (7.7%) were not yet protected at all.

The eradication programmes in BSIP and Peninsular Malaysia have made good progress in 1973 and in the Philippines plans for pilot studies or vigilance operations have taken a more definite shape. On the Indo-Chinese Peninsula, however, progress was slow and due to the unsettled situation, malaria control activities did not materialize to the expected extent.

4. **Coordination**

In 1973 WHO continued to stimulate and to sponsor intercountry and interregional coordination of antimalaria activities in the form of coordination board meetings, border meetings and exchange of epidemiological and operational information. These efforts extended to all regions and have helped to resolve problems connected with malaria foci in border areas, and to achieve to some extent synchronization or adjustment of operational timetables.

5. **Training**

The International Malaria Eradication Training Centre at Manila, Philippines, was closed on 30 June 1973. In the 10 years of its existence 57 regular courses and other group training activities were held which were attended by 1326 participants. The Centre which was assisted by WHO, USAID and the Government of the Philippines provided facilities for the training of professional and higher scale technical personnel and has in this respect not yet been replaced.

National malaria training centres, most of these assisted by WHO, have continued to function in all regions, extending training facilities more and more to personnel of the general health services, especially in view of the integration of operational activities in malaria control or of vigilance in the maintenance phase of malaria eradication programmes. In several countries, e.g. Iran and Malaysia, public health institutes have started to provide malaria training of professional personnel, a development which is hoped to help in future to overcome the gap created by the closing of the Manila Malaria Eradication Training Centre.

Apart from the regular training activities, WHO has sponsored a seminar on in vitro testing of *P. falciparum* sensitivity to chloroquine which was held at Kuala Lumpur, Malaysia in November 1973 and attended by 12 staff members of national services and five WHO staff members.

6. **Malaria research**

In 1973 WHO has assisted 41 malaria research projects, conducted by institutes throughout the world, including international and regional malaria reference centres and collaborating laboratories. WHO has also continued the interregional field research programme on the epidemiology of malaria in the northern savanna area of Africa. This research has widened the knowledge of the immune response of the human host and of the biology and the biochemistry of plasmodia and advanced the technique of in vitro cultivation of malaria parasites. It has
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further developed the chemotherapy of malaria and the methods of malaria eradication and control, and advanced knowledge in the field of entomology.

In the field of the immune response of the human host the development was intensive, covering three major aspects: the serological measurement of this response, the mechanisms involved in the initiation of the immune response, particularly protective immunity, and the possibilities for immunization against malaria.

The methods of the indirect haemagglutination test (IHAT) and the indirect fluorescent antibody test (IFAT) were further improved and to some extent standardized. They have become more reliable and reproducible and their application has been extended, especially in sero-epidemiological studies providing longitudinal profiles. Steps were taken to extend the application of malaria serological tests to laboratories throughout the world.

Experiments in monkeys and other laboratory animals, particularly rodents, have provided an insight into the mechanisms of humoral immunity and into the role of T and B lymphocytes in the initiation of the immune response. Although we still do not have a technique suitable for the measurement of protective immunity these studies were of great importance for the understanding of the peculiarity of the immune response following malarial infection and for elaborating a rationale for developing immunizing agents.

In the extensive attempts of developing immunizing agents it has become apparent that those eventually prepared on the basis of blood forms while not providing total protection from infection would still alleviate the disease and possibly reduce to zero the mortality caused by malaria. On the other hand, immunizing agents prepared from sporozoites which were irradiated using well defined dosages and periods of radiation have proved to be very promising in as much as they provided total protection in a certain percentage of animals. Recent observations on human volunteers, not conducted under WHO grants, indicate that irradiated sporozoites may prove to be suitable for developing a malaria "vaccine", but further studies are required before attempting application on a larger scale. Although many technical problems need still to be solved it seems reasonable to express the hope that in the near future further progress will be made which ultimately permits the preparation of a successful immunizing agent against human malaria.

Research on the parasite has also made considerable progress and further insight was obtained into the metabolism of plasmodia, their ultrastructure and the mechanism they employ to invade the host cells. The studies on the metabolism of plasmodia have increased our knowledge as far as proteins, amino acids, purins, folates, lipids and carbohydrates, specific metabolic pathways and metabolic activity during the various developmental stages of the parasite are concerned. The results of these studies are closely related with efforts to advance, on a rational basis, the development of new chemotherapeutic agents. They should also be instrumental in improving the in vitro cultivation of plasmodia. Major progress was also made regarding the strain identification of plasmodia by means of the identification of specific enzymes. This technique opens the way for a wide range of important epidemiological and immunological observations.

Regarding the malaria vector the extensive research programme has further widened our knowledge of genetically distinguishable strain characteristics coded by specific chromosome inversion polymorphism patterns which may reflect differences in the bionomics within the same species of anophelines. Also the bionomics of many vector species were subject to special studies among which that of the susceptibility to plasmodial infection may yield important indications of practical value. As far as biological and genetic control of vectors are concerned, little progress has been made and neither one nor the other seem to be applicable on a large scale although the former appears to have better prospects.
When considering the development of new means and methods for control or eradication of malaria, chemical control of the vectors remained the method of choice. For financial and technical reasons DDT is still the most important residual insecticide. In view of insecticide resistance in certain anopheline species WHO has made considerable efforts in the testing of new insecticides, but not many candidate compounds are available. The evaluation of fenitrothion has continued and this insecticide has so far given promising results.

Chemotherapeutic research has led to the development of screening and testing models which permitted the processing of thousands of compounds, but at present only four groups of candidate compounds deserve attention for further clinical and field trials. Advance was also made in studying the mechanism of action of standard antimalaria drugs such as quinine, chloroquine and sulfonamides. These studies have also thrown light on the mechanism of drug resistance in plasmodia.

The efforts of WHO have been directed towards coordinating research on the various aspects of the parasite, its vector and the intermediate host under the general auspices of improving the existing means and of developing new ones for the control and eventually the eradication of malaria.

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