MALARIA ERADICATION

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MALARIA ERADICATION

1. INTRODUCTION

Several resolutions regarding malaria eradication were issued during the last three years, and a presentation of certain excerpts from these resolutions will serve as an introduction to this document.

1.1. The XIV Pan American Sanitary Conference (October 1954)

"1. Declares that it is of the utmost urgency to carry out the terms of Resolution XVIII of the XIII Pan American Sanitary Conference, which recommends that the Pan American Sanitary Bureau promote the intensification and coordination of anti-malaria work, with a view to achieving the eradication of this disease in the Western Hemisphere; and that the Member Governments should convert all control programmes into eradication campaigns within the shortest possible time, so as to achieve eradication before the appearance of anopheline resistance to insecticides.

2. Instructs the Pan American Sanitary Bureau to take steps to implement the aforesaid resolution and to study international measures to ensure the protection of those countries or territories that have achieved eradication of the disease.

3. Authorizes the Director of the Pan American Sanitary Bureau to secure the financial participation of public or private organizations, national or international, in order to further the aims set forth in this resolution."
1.2. Eighth World Health Assembly (May 1955) Resolution WHA8.30

"1. REQUESTS governments to intensify plans of nation-wide malaria control so that malaria eradication may be achieved and the regular insecticide-spraying campaigns safely terminated before the potential danger of a development of resistance to insecticides in anopheline vector species materializes;

2. AUTHORIZES the Director-General to request those governments in whose countries malaria still exists to give priority to malaria eradication projects in their requests for assistance under the United Nations Expanded Programme of Technical Assistance, and to provide the locally available resources which are required to achieve malaria eradication;

"II. DECIDES that the World Health Organization should take the initiative, provide technical advice, and encourage research and coordination of resources in the implementation of a programme having as its ultimate objective the world-wide eradication of malaria;

"III. AUTHORIZES the Director-General to obtain financial contributions for malaria eradication from government and private sources."

1.3. UNICEF-WHO Joint Committee on Health Policy (May 1955)

"The Committee believes that new anti-malaria projects should aim at eradication and that the requesting countries should be expected to have, or to establish, for such period as may be necessary, an adequate central anti-malaria organization for the implementation, coordination and guidance of the national programmes; should promote the necessary supporting legislation, and should pledge their financial support for the duration of the programme. UNICEF, on the other hand, should endeavour to continue its assistance till the termination of the programme.

"The Committee recommends that UNICEF give highest priority to the support of malaria eradication programmes.

"The Committee recommends that in special areas in which, for technical reasons, eradication programmes would be premature, support to control programmes could be considered."
"The Committee recommends that UNICEF and WHO use their full influence to convert presently supported malaria control programmes into eradication programmes as rapidly as possible."


"1. CALLS upon the Governments of States Members within the Region in which such programmes are feasible, to draw up long-term plans for eradication of malaria and to press their respective legislative bodies to commit adequate funds in advance for a five-year programme;

"2. REQUESTS the World Health Organization and the United Nations Children's Fund to provide the maximum possible aid to countries concerned."

1.5. The International Cooperation Administration

"The International Cooperation Administration (1955) in view of the development of resistance in anopholes vectors to DDT and the possibility that prolonged use of such insecticides may give rise to a serious situation in which much previous work could be nullified, has shifted the emphasis in its aid programme from control to eradication measures."

1.6. Ninth World Health Assembly (May 1956) Resolution WHA9.61 - Malaria Eradication

"1. REQUESTS the Director-General again to draw to the attention of governments the need to intensify their malaria control programmes so that malaria eradication may be achieved as early as possible, by stages under certain circumstances, with a view to ultimate economy in expenditure and to obviate the potential danger of development of resistance to insecticides in anopheline vector species;

"2. REQUESTS the Director-General again to invite contributions from governments, non-governmental organizations and private sources to the Malaria Eradication Special Account;

(Dr. Paul Russell's working paper No 13 in Inter-Reg. Conf.on Malaria for the Eastern Mediterranean & European Regions - 16 April 1956.).
3. **RECOMMENDS** that UNICEF continue its full support to the continuance and expansion of the existing control programmes as a step towards transformation to eradication campaigns;

4. **EXPRESSES** its satisfaction at the action of the Board in establishing its Committee on Malaria Eradication which will enable the Organization to take such steps as may be required.
2. FACTS AND FACTORS URGING IMPLEMENTATION OF MALARIA ERADICATION PROGRAMMES IN THE EASTERN MEDITERRANEAN REGION

The facts have been piling up in the field of malariology since the introduction of residual spraying with modern chlorinated hydrocarbon insecticides, and the factors that have urged international bodies to recommend governments to convert their control programmes into eradication programmes can be presented in the following:

2.1. Distribution of Malaria and its Ravages

2.1.1. It was estimated that out of the 170 million population inhabiting the countries of the Eastern Mediterranean Region, 40-50 millions are living in potentially malarious areas.

2.1.2. Malaria has been regarded as the major health problem in most of the countries of the Eastern Mediterranean Region, and a major factor in stunting the physical and mental development of the people, in the high infant mortality and death rates, as well as in stifling the socio-economic progress of these countries.

2.2. Effectiveness of Residual Spraying Campaigns

2.2.1. The introduction of residual spraying with modern organic insecticides offered a most economic and effective method of controlling malaria in all the countries east of the Mediterranean, as demonstrated by the WHO malaria teams that worked between 1949 and 1955 in Iran, Iraq, Lebanon, Pakistan, Saudi Arabia and Syria. The national malaria services of these countries, as well as those of Israel, Jordan and Egypt, have been developed, and have been conducting mass malaria control campaigns in recent years. During 1955, 14 million population inhabiting these countries were protected through residual spraying campaigns at an average total cost of $0.20 per capita per year.

2.2.2. In countries where mass residual spraying was systematically carried out over three or more years, it was noted that malaria was almost eradicated. For instance in the whole of Italy, after systematic spraying with DDT since 1946, there were only five cases of malaria reported in 1954. In Venezuela the spraying programme commenced in 1945, and by 1950 eradication had been
obtained in certain areas of the country, and now more than 60% of the nation's population is malaria free. In Ceylon, the nation-wide residual spraying project commenced in 1946 led to malaria eradication in large areas of the island. In all these instances, it was shown that systematic spraying over three or more years led to the death of the malaria parasites in human carriers by stopping the transmission via the mosquito vector to fresh human victims. Although residual spraying may lead to the eradication of certain malaria vector species, yet in most instances, malaria eradication has been attained without mosquito vector eradication. The latter objective, i.e. the complete extirpation of the malaria-carrying species of anopheles is neither economically feasible nor technically possible except under unusual conditions.

2.3. Economic Gains from Malaria Eradication

2.3.1. The economic advantages to be gained from effective malaria elimination are spectacular. In Ceylon, the elimination of malaria from large areas of the 8.5 million populated island has enabled it to increase its rice crop by 50%, and has resulted in the resettling of over a million people in fertile areas previously uninhabitable because of malaria.

The major irrigation projects under study or under construction in the countries of the Middle East that will transform millions of acres of arid land into productive soil, will be economically constructed and will prove a blessing in the economic development of these countries only when malaria has been effectively eliminated.

The recent elimination of malaria from the Jordan Valley has led to the settlement of a quarter of a million population, and the construction of roads, villages, schools, post offices and markets, etc., even before the implementation of the Jordan Irrigation Scheme.

2.3.2. Malaria eradication is now being regarded, both by public health administrators as well as by qualified economists, as a capital investment. The benefits to be gained by substituting malaria eradication programmes for routine malaria control, though the initial per capita cost is slightly higher, are derived from the fact that the former will be self-limiting,
whereas the latter must be continued indefinitely, constituting a drain on the health budget of any malarious country.

2.4. Development of Resistance by Malaria Vectors

The success of malaria eradication by residual spraying of houses with chlorinated hydrocarbon insecticides largely depends upon the degree of susceptibility of the malaria vector species, both physiological and behaviouristic, to the insecticides used. Various degree of resistance to DDT have already been noted in Greece and Lebanon in *A. sacharovi*, in Saudi Arabia in *A. stephensi*, and in Java in *A. sundaicus*. In Nigeria, resistance to dieldrin was noted in *A. gambiae*. Elsewhere, as in Venezuela, Italy, and Ceylon, malaria vectors remain fully susceptible to DDT, in some cases after ten years exposure to it.

Should this immunity to insecticides become intensified through their continued application year after year, and there is accumulating evidence that this will ultimately take place, an unfortunate situation will arise, when modern insecticides that have been raising our hopes in achieving malaria eradication will become useless, as the resistant strains will not be poisoned or else will avoid contact with treated surfaces.

Thus the public health strategists are confronted with a problem in which the time factor is becoming a vital issue, and it is hoped that, apart from the economic gains involved in implementing malaria eradication programmes, this resistance threat will encourage the authorities to speed up the eradication operation and eliminate all sources of malaria infection within five years.

2.5. International Help

2.5.1. A golden opportunity has presented itself to all public health administrations to implement eradication programmes. Various governments, through bilateral and multilateral programmes, have made large sums of money available for such malaria eradication. During 1956, the estimated expenditure throughout the world, in connexion with malaria eradication, by

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1 See Annex II.
international bodies is summarized as follows:

<table>
<thead>
<tr>
<th>Fund</th>
<th>Amount</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>WHO Regular Fund</td>
<td>$477,026</td>
<td>(including advisers, fellowships, research grants and coordination conferences, etc.)</td>
</tr>
<tr>
<td>Technical Assistance Fund (through WHO)</td>
<td>$513,872</td>
<td>(including advisers and fellowships)</td>
</tr>
<tr>
<td>UNICEF (malaria eradication)</td>
<td>$5,000,000</td>
<td>(for insecticides, sprayers, laboratory equipment and vehicles)</td>
</tr>
<tr>
<td>ICA (malaria programmes)</td>
<td>$8,000,000</td>
<td>(including advisors and supplies and equipment)</td>
</tr>
<tr>
<td>Malaria Special Fund (WHO)</td>
<td>$8 -</td>
<td>(will include advisers, research grants, supplies, equipment, fellowships, help to training centres, and contributions to conferences)</td>
</tr>
</tbody>
</table>

2.5.2. Apart from this financial aid, the technical help offered by WHO or ICA malaria experts, as well as WHO stimulus in coordinating the malaria eradication programmes on inter-country and inter-regional levels, its help in encouraging research, and in helping the training centres, have to be reckoned with when advertising to governments the golden opportunities presenting themselves for implementing malaria eradication programmes.
3. PHASES IN MALARIA ERADICATION PROGRAMMES

3.1. Preliminary Phase

This includes the development and expansion of operations or conversion of the control programmes into eradication programmes. The duration of this phase is usually one year, and its activities are devoted to:

(a) Recruitment and training of staff at all levels.
(b) Organization of the national malaria services - administrative and financial.
(c) Preparation of a detailed plan of operations, determining year by year activities, areas to be sprayed, number of hours, personnel needed, schedule of teams during spraying period, and timing of pre-eradication and post-operational evaluations, etc.
(d) Development of activity and progress reports.

3.2. Total Coverage Phase

This is either directed to a whole district or province bounded by natural barriers (or by areas where malaria transmission is non-existent) to all the malarious areas in a country. The duration of this phase, whether applied to a district or to a country, is usually three to four years, depending on the degree of efficiency of the pre-existing control programme as regards the competence of personnel, the spraying operations whether complete or limited, and the status of legislative and epidemiological services whether adequate or deficient.

The interruption of the residual spraying coverage is based on the evaluation activities that will commence along with the initial spraying, and which will ultimately be merged into the next surveillance phase. These activities will ensure, through blood surveys carried out during the malaria transmission period on infants, children, and other population groups, that no malaria transmission has occurred in the sprayed area for at least three consecutive years. The ideal is to make these surveys in each village in the area covered, but failing this, a number of representative villages, about 20% of the total number, should be continually
surveyed for any malaria transmission. One year prior to the date
scheduled for interrupting the residual spraying, the evaluation
techniques should reach a stage which will allow the reporting and
registering of all malaria cases, as well as the parasitological
confirmation of these cases.

3.3. Surveillance Phase

This phase begins at the moment the routine sprayings are discontinued.
It is a continuation of the evaluation activities further developed so
as to include systematic investigation of any persisting malaria trans-
mission as well as carrying out epidemiological investigation of every
malaria case. It is recommended, that at least for the first three years
after interrupting the spraying, the Malaria Eradication Service takes
charge of this activity, with a view to ultimately handing it over to
the local health bodies.

During this phase preventive measures, including drug administration
and/or residual spraying, will be put into effect against re-introduction
of malaria transmission by carriers.
There are now six countries in the Region that are implementing eradication programmes or that have completed the preliminary phase of eradication. These are Lebanon, Syria, Jordan, Israel, Iraq and Iran. Certain administrative and financial difficulties are holding up the implementation of eradication in West Pakistan, but the Government is willing to push its efforts towards this objective especially as neighbouring countries are considering malaria eradication.

In the meantime, during 1956, pilot projects have been established with WHO and UNICEF help, in Ethiopia, Sudan and Somalia, the objectives of which will be to study local problems relevant to mass eradication campaigns, to provide solutions and recommendations for surmounting technical difficulties, as well as to draw up detailed plans which will take into consideration, apart from the technical side, the economic feasibility of such eradication programmes.

In Annex I, the data on the anti-malaria activities of each country in the Eastern Mediterranean Region in 1956, are presented separately. These data were collected from available sources within EMRO, and their presentation in this document is intended to contribute to the consciousness of malaria as a regional public health problem.

One cannot fail to recognize that malaria eradication entails a reform in public health administration to ensure the enthusiasm of the malaria workers in performing their duties thoroughly, to gain the support of the tax-payers and legislative bodies, to implement the coordination of work with other governmental bodies, to utilize efficiently the help of the International Agencies, as well as to contribute to the coordination of malaria eradication work both at inter-country and inter-regional levels.
5. INTER-COUNTRY COORDINATION OF MALARIA ERADICATION ACTIVITIES

The World Health Organisation has recommended that eradication programmes should be planned so as to aim at eradication simultaneously in as large an area as possible, preferably bordered by areas where, naturally or, as a result of control, there is no malaria transmission. This new conception in planning necessitates coordinated effort between neighbouring countries implementing malaria eradication programmes.

Any country launching such an expensive programme would like to have assurances that its neighbours are doing the same so as to ensure that no re-introduction of malaria infection, either through a human carrier, or an infected mosquito, will be allowed into any of the malaria-free areas.

EMRO has taken over the responsibility for coordinating this eradication programme in neighbouring Eastern Mediterranean Region countries. In this function it is assisted by the Malaria Section at WHO Headquarters, by UNICEF, TAB and ICA representatives. The steps taken to fulfil such responsibility can be summarized in the following:-

5.1. Regional Staff for Coordinating Eradication Programme:

The Regional Malaria Adviser, who joined the EMRO staff in July 1955, will be assisted in performing his functions, including the inter-country coordination programme, with an additional staff consisting of one sanitary engineer, one sanitarian, as well as a technician, a draughtsman and adequate secretarial staff. The Malaria Adviser will be responsible to the Regional Director at EMRO for all anti-malaria activities in the region, and will have direct channel of communication with the Malaria Eradication Services of the countries concerned on technical matters concerning the operations and their evaluations.

5.2. Establishment of a Regional Malaria Eradication Centre:

It is intended to establish a regional training centre in Iraq in 1957 for the training of malarialogists, entomologists, sanitarians and technicians in the operational techniques of malaria eradication and surveillance. In this
way, candidates from Iraq and neighbouring Arab countries will be indoctrinated in WHO principles of eradication and technical standards.

The training centre in Teheran will contribute by giving a postgraduate training, and a course on the epidemiology of malaria and other insect-borne diseases as well as demonstrate certain operational procedures followed in Iran.

The Training Centre of the Insect Eradication Section of the Ministry of Public Health in Egypt is giving a formal training course in malariology and insect control and has been contributing to the training of candidates from neighbouring Arab countries.

EMRO will offer its help in revising the courses with the authorities so as to make them include new developments in the malaria eradication operational techniques, and will, as well, help these training centres by offering the services of visiting short-term experts.

5.3. The Role of Malaria Eradication Advisory Teams

These teams are recruited by WHO Headquarters and are assigned upon request to countries implementing the eradication programme. Their main activities will be directed towards the assessment of eradication programmes, and towards investigating any special technical problems that may retard the implementation of malaria eradication. The recommendations of these teams will be coordinated with EMRO and the results of their investigation on technical problems will be given a wide circulation.

5.4. Fellowships and Visits

WHO is offering a few fellowships during 1957, and an increasing number in the following years, to senior national malaria directors, experts and technicians to visit other countries in EMR and in other regions to study the malaria eradication operational and surveillance programmes and exchange technical views on problems shared or encountered in the implementation of their programmes.

It is expected that governments implementing malaria eradication programmes will send also at their own expense and following the exchange of letters, certain experts to neighbouring countries to get acquainted with the set-up of
of the malaria eradication services and also to discuss the problem of frontier malaria and the cooperative preventive measures that will be taken to deal with it.

5.5. Inter-Country Conferences

An inter-country malaria eradication conference will be convened by EMRO in 1957. One delegate from each country where malaria is a major health problem will be invited by EMRO at WHO expense, and it is expected that governments will contribute to the pooling of knowledge and to the technical resolutions taken at this conference by sending at their own expense other participants. A review of the programme of eradication work in the region will be presented at this conference, and the results of investigations on technical problems relevant to malaria eradication will be presented. EMRO will offer its coordinating and technical services to governments for speeding up the implementation of the resolutions taken at the conference.

5.6. Public Information Services

EMRO will offer its help in encouraging and coordinating the efforts of the health and social leaders of each country in raising the consciousness of malaria as a regional problem and will supply the interested governmental sections, international agencies, press and radio, with progress reports on the regional malaria eradication programme.
General Information

1. Malaria was declared to be eradicated from the island on 9 January 1950 after four years of intensive anti-malaria campaigns by the Government.

2. The objective was "Malaria Anopheles Eradication" mainly through a larviciding campaign using 2-5 % DDT in fuel oil applied to all breeding places. The main malaria vectors in the island were A. superpictus and A. sacharovi. In 1955 only six A. superpictus larvae were collected in seven positive units in all the area surveyed.

3. The eradication of malaria came as a result of the four years intensive vector eradication, as can be noted from the following data:

   - No. of malaria cases reported during the two years prior to eradication (1943-1945): 13,494
   - No. of malaria cases reported during the four years eradication operation (1946, 1947, 1948, 1949): 6,996
   - No. of blood films examined during 1950, 1951, 1952: 10,513
     - No. positive ...... (vivax):...... 225
   - No. of blood films examined during 1953, 1954: 5,228
     - No. positive ................. nil

   (Results of 3,911 blood examinations made during 1955 not yet available)

4. The total expenditure for carrying out the eradication operations during 1946 to 1949 inclusive was estimated at £817,800 i.e. £0.45 per head per year (N.B. The total population in 1946 was: 450,000).

5. The total expenditure for carrying out the maintenance work after the eradication (entomological surveys, larviciding of positive and suspected units, as well as in generally assisting the sanitary inspector in routine mosquito, fly, quarantine, etc. measures) including wages, supplies, transport, etc. for the years 1950 to 1955 inclusive amounted to
£639,675 i.e. £0.21 per head per year (N.B. The total population in 1954 was 513,700).
EGYPT

1. Programme and Duration:-
Malaria eradication is being considered.

2. Statistics:-

No. of total population: 22,200,000

No. of population living in potentially malarious areas: 14,675,202

No. of villages situated in potentially malarious areas: 

No. protected during 1955 campaign (directly): 3,750,000

(indirectly): 4,900,000

Target number to be protected in 1956 (directly): 4,250,000

(Area east of the Nile Delta suggested as a start in eradication scheme)

Average annual cost of control programme per capita
in 1955 - by residual spraying: $0.12
- by larviciding: $0.18

Estimated average annual cost of eradication programme per capita for five years (according to estimates given by Director of Malaria Section): $0.22

3. Technical Data:-

Main malaria vectors: pharoensis, sergenti, (gambie eradicated from Upper Egypt in 1943 and constant vigilance is taken to prevent reintroduction from south).

Development of resistance: not observed - studies are underway.

Malaria transmission season: July till November (possibly earlier in the northern part of the Delta).

Timing and frequency of spraying: April till June (earlier in northern part of Delta). One spraying is sufficient.
Technical Data (contd.):

Other methods of control: larviciding near urban centres.
Insecticides used: DDT and BHC wettable powders.
No. of blood films taken in 1955: 183,629
No. positive and species of parasites: 317

(218 vivax, 99 falciparum)

4. Administration and Finance:

Personnel: 20 medical officers, 45 malaria engineers, (agricultural background), 58 laboratory assistants, 150 foremen, 2,150 labourers.

Advisory Committee: the Insect Eradication Section is charged with the training programme. A Higher Malaria Council exists consisting of representatives from various ministries.

Malaria budget (1955): £1,722,000

5. International Help:

WHO - A short-term consultant envisaged in 1956 or 1957.
UNICEF - Contribution of £250,000 in 1951 for establishing a DDT plant.

6. Inter-Country Coordination:

Invitation by WHO to two malariologists to attend Ad Hoc Meeting on Malaria Eradication in Athens (June 1956).
Fellowship to Director of Malaria in 1955 to visit Iraq malaria campaign.
Coordination of work with Sudan Government regarding the eradication of *Ae. gambiense* from the northern frontiers of Sudan.
1. Programme and Duration:—

Malaria control is starting in the country by the establishment in 1956 of a malaria pilot project in a sector of the Bhwash Valley. Duration three years. Other activities expected to commence also in Kobho Chercher plain and Gondar areas. The pilot project will investigate problems relevant to future mass eradication campaigns.

2. Statistics:—

<table>
<thead>
<tr>
<th>Description</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of total population:</td>
<td>15,000,000</td>
</tr>
<tr>
<td>No. of population living in potentially malarious areas: nearly all</td>
<td>........................</td>
</tr>
<tr>
<td>No. of villages situated in potentially malarious areas:</td>
<td>........................</td>
</tr>
<tr>
<td>No. of population protected during 1956:</td>
<td>none</td>
</tr>
<tr>
<td>Target number to be directly protected in pilot project:</td>
<td>100,000</td>
</tr>
</tbody>
</table>

Kobho Chercher Plain: 40,000

3. Technical Data:—

Malaria vectors: *gambiae, funestus, pharoensis, (pretoriensis, kingi, nili: suspected).*

Malaria transmission season: period following the south-west monsoon rains i.e. from late September to mid-December. Slight transmission noted in June-July.

Timing of spraying and frequency: under investigation. One spraying is suggested in pilot project during June and July.

Insecticides to be used: DDT, dieldrin, and BHC will be tested.

Malaria status: Malaria is hyperendemic in certain valleys offering breeding places for vectors throughout most of the year, otherwise in Ethiopia it is predominantly an epidemic disease.
4. Administration and Finance:

Personnel: two senior sanitarians, four technicians, eight foremen and fifty labourers.

Malaria budget: $72,000 recommended for 1956/57.

5. International Help:

WHO - 1955:
- 1 short-term malaria consultant for 3 months.
- 2 fellowships of 6 months each for senior sanitarians.
- 1 malaria team consisting of 1 malarialogist and 1 sanitarian.

ICA - 1956:
- 1 entomologist.

UNICEF
- March 1956 Executive Board approved the allocation of $29,000 for purchase of DDT, dieldrin, sprayers, anti-malaria drugs, laboratory equipment and transport.
1. **Programme and Duration:**

Malaria Eradication: 1956-1962 (7 years) plan of operations under study.

2. **Statistics:**

- **No. of total population (1954):** 21,000,000
- **No. of population living in potentially malarious areas:** 12,000,000
- **No. of villages situated in potentially malarious areas:** 40,000
- **No. directly protected during 1955 campaign:**
  - Under surveillance: 1,000,000
  - Total: 3,885,800
- **Target number to be protected in 1956 - about:**
  - Under surveillance: 2,000,000
  - Total: 5,160,000
- **Average cost of control programme per capita per year (1955) about:** $0.35
- **Average cost of eradication programme per capita per year during five years (estimated):** $0.45

3. **Technical Data:**

- **Main malaria vectors:** *sacharovi, maculipennis, superpictus,*
  *
  *stephensi, sulicifacies*
- **Development of resistance:** not noted, under study.
- **Malaria transmission season:** June till October in most of the country - extends through November and possibly December near Persian Gulf.
- **Timing and frequency of spraying:** March till mid-June (105 days) once as a rule.
- **Other methods of control:** surveillance and drug administration.
- **Insecticides used:** mostly DDT.
- **No. of blood films taken in 1953:** .......... 
- **No. positive and species of parasites:** ..........
4. Administration and Finance:

Personnel: 28 maliologists, 16 entomologists, 16 sanitary engineers, 4 sanitarians, 30 blood technicians, 2 pharmacists, 46 supervisors, 63 senior foremen, 366 junior foremen, 1,574 labourers.

Advisory Committees: The Scientific Council, about 10 members under Chairmanship of Minister of Health. Also the Institute of Malariaology which is taking charge of the planning, surveys, continuation activities, training, as well as technically supervising the surveillance activities.

Malaria budget 1956 estimated at $1,700,000 (to be made available from 7-year plan).

5. International Help:

WHO
- Visit of special WHO malaria consultant and regional malaria adviser (September 1955).
- Advisory team consisting of 1 maliologist and 1 entomologist started in July 1956.
- WHO team leader of insect control project acted as malaria adviser until May 1956.

UNICEF
- March Executive Board (1956) approved allotment of $1,848,000 for the provision of insecticides, vehicles, spray-pumps and other equipment.

6. Inter-Country Coordination:

Invitation by WHO to Directors of Preventive Medicine Department,
Malaria Institute, and Malaria Eradication Services to attend Athens Conference, June 1956.

Visits of malariologists from Afghanistan.

Visit of Iranian authorities to Iraq to coordinate work along frontier - 1955.

Exchange of notes between Iran and USSR regarding frontier malaria.
1. **Programme and Duration:**

Malaria Eradication: 1957-1961 (5 years) plan of operations under study

2. **Statistics:**

- No. of total population: 5,000,000
- No. of population living in potentially malarious areas: 3,800,000
- No. of villages in potentially malarious areas in the four northern liwas: 5,500
- No. directly protected during 1955 campaign: 1,393,000
- No. indirectly protected during 1955 campaign: 1,400,000
- Target number to be protected in 1956 by WHO team
  - in the north: 1,086,832
  - in the south: 1,100,000
- Average cost of control programme/head/year (1955)
  - in the north: £0.23
  - Average cost of eradication programme/head/year (for five years) estimated: £0.44

3. **Technical Data:**

- Main malaria vectors: *stephensi*, *superpictus*, *sacharovi*, *maculipennis*.
- Development of resistance: not noted, under study.
- Malaria transmission season: June till end of November.
- Timing and frequency of spraying: March till end of May (summer sprayings for temporary structures).
- Other methods of control: larviciding near towns and in Shatt-el-Arab swamps in south.
- Insecticides used: DDT mostly, Gammaxane and dieldrin in limited areas.
No. of blood films taken in 1955: ........................
No. positive and species of parasites: ........................

4. Administration and Finance:

Personnel (technical) contemplated for 1957:

1 malariologist (director),
3 malaria medical officers,
4 entomologists or assistant entomologists,
4 sanitarians or assistant sanitarians,
48 laboratory assistants,
254 senior and junior field assistants,
1,355 senior and junior foremen,
5,048 labourers.

Malaria Eradication Board: existing with 7 members from various ministries convening twice yearly.

Malaria budget for 1957: total: $3,326,840
 capitalist expenses $2,170,560
 recurrent $1,156,280

5. International Help:

WHO

- visit by WHO special malaria consultant and regional malaria adviser.
- malaria team: 1 malariologist, 1 sanitarian and possibly 1 entomologist and 1 technician in 1957.
- consultant entomologist: June-August 1956.

UNICEF

- proposed for September Board: $261,000 mostly for vehicles and laboratory equipment for a five-year programme.

6. Inter-Country Coordination:

Invitation by WHO to Director of Endemic Diseases and malariologist to Athens Conference.

Establishment of Regional Training Centre in Baghdad with WHO help.

Assignment of two malaria coordinators (1 sanitary engineer and 1 sanitarian).
Visits of Iranian representatives to malaria project in North 1955.

Two WHO 2-months' fellowships for two sanitarians from Syria in 1956.
ISRAEL

1. Programme and Duration:-

Intensive anti-malaria campaign has been continuing and official
sources mention that malaria eradication
is expected in three years (1956-1958).

2. Statistics:-

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of total population</td>
<td>1,700,000</td>
</tr>
<tr>
<td>No. of population living in potentially malarious areas</td>
<td>1,573,761</td>
</tr>
<tr>
<td>No. of villages situated in potentially malarious areas</td>
<td>............</td>
</tr>
<tr>
<td>No. protected during 1955 campaign:</td>
<td>1,573,761</td>
</tr>
<tr>
<td>(by residual spraying 59,806 - rest by other methods)</td>
<td></td>
</tr>
<tr>
<td>Target number to be protected in 1956 (by various methods):</td>
<td>1,573,761</td>
</tr>
<tr>
<td>Average annual cost of larviciding per capita (1955)</td>
<td>₤0.12</td>
</tr>
<tr>
<td>Average cost of eradication programme per capita per year</td>
<td>₤0.65</td>
</tr>
</tbody>
</table>

3. Technical Data:-

Main malaria vectors: *sergenti, superpictus, sacharovi*.
Development of resistance: not noted - under study.
Malaria transmission season: June till end of November and possibly
in December.
Timing and frequency of spraying: March till end of May
(sometimes repeated in autumn).
Insecticides used: DDT mostly.
Other methods of control: larviciding near towns and villages,
and also by drug administration.
No. of blood films taken in 1955: ............
No. positive and species of parasites: ............
4. **Administration and Finance**:

   **Personnel**: the number of professional and other personnel assigned to the malaria eradication in the Health Service is 185.

   **Malaria Eradication Board**: No available data.

   **Malaria budget in 1956**: £222,222

5. **International Help**:

   - Malaria consultant envisaged in 1956.
   - Consideration for help in providing additional vehicles, compression sprayers, and laboratory equipment is being studied.

6. **Inter-Country Coordination**:

   Invitation by WHO to Director of Malaria Services to attend Inter-Regional Malaria Conference in Athens.

   The control of malaria up to the frontiers in Jordan, Syria and Lebanon will be carried out by the malaria teams of each country. Control of malaria or the vector in no-man's land is suggested, to be carried out by an international team under the auspices of the United Nations Armistice Commission.
1. **Programme and Duration:**

Malaria eradication during 1956-1960 (5 and possibly 6 years), plan of operations under study.

2. **Statistics:**

- No. of total population: 1,400,000
- No. of population living in potentially malarious areas: 1,190,000
- No. of villages situated in potentially malarious areas: ...........
- No. protected during 1955 campaign: 400,000
- Target number to be protected in 1956: 450,000

Average annual cost of control programme per capita (1955)

- Residual spraying: $0.14
- Larvicidal: $0.36

Average annual cost of eradication programme per capita (estimated for five years): $0.20

3. **Technical Data:**

- Main malaria vectors: *sorgenti*, *superpictus*, *sacharovi*, *(claviger?)*
- Development of resistance: not noted - under study.
- Malaria transmission season: June till end of November and possibly December in Jordan Valley.
- Timing and frequency of spraying: March till end of May (sometimes repeated in August).
- Other methods of control: larviciding is a major activity because of habits of *sorgenti*, residual larviciding is being tried.

- No. of blood films taken in 1955 (from Jordan Valley): 4,207
- No. positive and species of parasites: 104 (59 *falcip*, 36 *vivax* 7 mal 2 mixed) (Among the 622 infants living in the Jordan Valley where an intensive larviciding campaign has been going on for the last three years, none were found positive).
4. Administration and Finance: -

Personnel (during 1956 or 1957):

1. malariologist
2. malaria medical officers
3. senior malaria supervisors
10. blood technicians
3. entomology technicians
8. malaria supervisors
36. foremen
220. labourers

Malaria Eradication Board: mentioned in plan of operations and consists of six members from the ministries, ICA and UNRWA.

Malaria budget in 1956: $112,000 (half budget assumed by ICA) -
(UNRWA committed also to $70,000).

5. International Help: -

WHO
- Malariologist to coordinate the activities of UNRWA and Government.
- Malaria consultant; April 1956.
- Malaria consultant; (2 months) envisaged late in 1956.

UNICEF
- March 1956 Executive Board approved allocation of $72,000 for purchase of insecticides, drugs, sprayers, laboratory equipment and vehicles for the years 1956 and 1957.

6. Inter-Country Coordination: -

Invitation by WHO to Assistant Under-Secretary to attend Athens Conference in 1956.

The control of malaria near Jerusalem in 'no-man's land' is coordinated between Israel and Jordan through the United Nations Armistice Commission.

Good working relationships between Jordan and Syria along frontiers, and exchange of visits between malaria personnel of both countries.
LEBANON

1. Programme and Duration:-
Malaria eradication during 1956-1960 (5 years), plan of operations.

2. Statistics:-

No. of total population: 1,500,000
No. of population living in potentially malarious areas: 300,000
No. of villages situated in potentially malarious areas: 750
No. protected during 1955 campaign (residual and larviciding): 254,000

(number protected directly by residual spraying
in 1955 = 135,000)
Target number to be protected in 1956 (by residual and
larviciding): 300,000
Average annual cost of control programme/head/1953: $0.21
Average annual cost of eradication programme/head/for five years (estimated): $0.34

3. Technical Data:-
Main malaria vectors: sacharovi, superpictus, (claviger? sergenti?)
Development of resistance: reported in sacharovi
(m.l.c. % to DDT = 1.7).
Malaria transmission season: June (coastal area) continues
till November.
Timing and frequency of spraying: Mid-March till end of June
(one spraying).
Other methods of control: larviciding in mountainous areas and
main towns.
Insecticides used: mainly DDT - occasionally dieldrin and BHC.
No. of blood films taken in 1955: 9,000
No. positive and species of parasites: 30 (29 vivax, 1 falciparum)
4. Administration and Finance:

Personnel: 1 chief of bureau,
6 malaria medical officers (part time),
1 entomologist,
1 assistant entomologist,
4 nurses,
4 chief sanitary inspectors,
4 sanitarians,
6 blood technicians,
4 entomology technicians,
16 foremen,
200 labourers,

Advisory Committee: exists and consists of 7 members - convenes twice yearly.

Malaria budget 1956: **********

5. International Help:

WHO
- special WHO malaria consultant and regional malaria adviser (September 1955).
- WHO malaria consultant (20 March-5 April 1955)
- WHO malaria consultant - 2 months envisaged in 1956.

UNICEF
- March Executive Board of 1956 approved $20,000 for the provision of DDT, sprayers, laboratory equipment and transport.

6. Inter-Country Coordination:

Invitation by WHO to Chief of Bureau to attend Ad Hoc Meeting in Athens (June 1956).

Exchange of information and coordination of work with Syria along frontiers.
1. Programme and Duration:

Continuation and enlargement of control programmes by degrees. Through the Government is giving great consideration to eradication, yet their decision to continue control measures has been forced because of financial and administrative considerations.

2. Statistics:

<table>
<thead>
<tr>
<th>Description</th>
<th>W. Pakistan</th>
<th>E. Pakistan</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of total population (1954)</td>
<td>32,700,000</td>
<td>43,100,000</td>
<td>75,800,000</td>
</tr>
<tr>
<td>No. of population living in potentially malarious areas:</td>
<td>16,000,000</td>
<td>25,000,000</td>
<td>41,000,000</td>
</tr>
<tr>
<td>No. of villages situated in potentially malarious areas:</td>
<td>about 54,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No. directly protected during 1955 (target for 1955 was 12,775,000):</td>
<td>8,275,436</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Target number to be protected in 1956 (directly):</td>
<td>10,000,000</td>
<td>5,000,000</td>
<td></td>
</tr>
<tr>
<td>(DDT available is only sufficient to protect 6 millions in West, and 3½ millions in East)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average annual cost of control programme per capita (1953):</td>
<td>$0.07</td>
<td>$0.11</td>
<td></td>
</tr>
<tr>
<td>Average annual cost of eradication programme per capita: (for 5 years)</td>
<td>............</td>
<td>............</td>
<td></td>
</tr>
</tbody>
</table>
2. Technical Data:

Main malaria vectors:

W. Pakistan - *superpictus*, *sulicifacies*, *stephensi*.

E. Pakistan - *philippinensis*, *sundaicus* *minimus*.

Development of resistance: not observed - resistance tests will be undertaken.

Malaria transmission season:

W. Pakistan - North: July to October.

South: August to November.

E. Pakistan - July till December (occasionally from April) peak in September, October and November.

Timing and frequency of spraying (as suggested by Government):

W. Pakistan: mid-June to mid-October (once).

E. Pakistan: October to May (twice).

Other methods of control: larviciding near urban centres, sometimes combined with limited residual spraying.

Insecticides used: mostly DDT - dieldrin under trial.

No. of blood films taken in 1955: (not yet available).

No. positive and species of parasites: (not yet available).

4. Administration and Finance:

Personnel: A new post of national malaria coordinator attached to Central Government has been established.

The provincial governments have one or two malaria officers and also in some cases, one entomologist. They are assisted by malaria inspectors and laboratory technicians. Details of number of personnel and their categories are lacking.
Administration and Finance (contd.)

Advisory Committee: The Central Government maintains a Malaria Institute with headquarters at Dacca and a branch at Karachi. The Institute directs a training course, as well as conducts surveys and evaluates results of control measures. There is no Malaria Advisory Committee or Board.

Malaria budget: Government's obligations in 1956: $220,000
(In addition Government will expend $168,000 on DDT produced at Nowshera plant for use in this programme.)

5. International Help:-

WHO
- Offer to provide a short-term consultant during 1956 is open.
- Recruitment of a top-ranking research malariologist to head the Malaria Institute provided for in 1956 budget.

UNICEF
- Executive Board September 1955 approved apportionment of $280,000 for purchase of 500 tons of 75% DDT and 600 sprayers (for use in East Pakistan). A final decision concerning a balance of 250 tons of DDT allocated but not yet shipped depends on WHO and UNICEF views on the 1956 plan of operations.

ICA
- 500 tons of DDT 75% supplied by ICA in 1955.
- Government requested recruitment of one malariologist for the Dacca Malaria Institute and two entomologists (one for East, and one for West Pakistan).

6. Inter-Country Coordination:-

Invitation by WHO for two malariologists from Pakistan to attend Athens Inter-Regional Conference on Malaria Eradication (June 1956).
SAUDI ARABIA

1. Programme and Duration:-

Malaria control entering its expanded phase during 1956.

2. Statistics:-

No. of total population: 7,000,000

No. of inhabitants living in potentially malarious areas (approximate): 5,000,000

No. of villages situated in potentially malarious areas: .........

No. protected during 1955 campaign (directly): 530,000

(through larvicidal): 150,000

Target number to be protected in 1956 (directly): 559,000

(through larvicidal): 150,000

Average annual cost of control programme per capita (1955)

residual: $0.28 - 0.35

larviciding: $0.18

3. Technical data:-

Main malaria vectors: *sergenti*, * gambiense*, *stephensi*.

Development of resistance: reported in *A. stephensi* but needs further investigation.

Malaria transmission season: January to May (Western area)

October to May in east and south.

Timing and frequency of spraying: 1-2 months before transmission season once per year.

Other methods of control: larviciding near urban centres.

Insecticides used: DDT mostly and BHC occasionally.

No. of blood films taken in 1955: 2,888

No. positive and species of parasites: 96

(vivax 14, falciparum 77, malariae 5)
4. **Administration and Finance**

**Personnel:**
- 2 malaria medical officers,
- 1 entomologist,
- 2 malaria inspectors,
- 2 sanitarians,
- 3 laboratory assistants,
- 15 field inspectors,
- 8 junior inspectors,
- 7 foremen,
- 200 labourers.

**Advisory Committee:** A recommendation to establish a Higher Committee for Malaria and Insect Control consisting of six members from various ministries is pending approval.

**Malaria budget (1956):** $750,000

5. **International Help**

**WHO**
- A team consisting of 1 entomologist (team leader), 1 junior malariologist and 1 sanitarian (team working since 1952).
- Laboratory equipment: $5,000

6. **Inter-Country Coordination**

Invitation by WHO for national malariologist to attend **Ad Hoc Meeting on Malaria Eradication in Athens (June 1956)**.
1. **Programme and Duration:**

A pilot and mass anti-malaria campaign with eradication as the objective commenced in 1956 and will continue until 1960. This operation is carried out by the Italian Trusteeship Administration in Somalia.

2. **General Information:**

- **No. of total population (8/10 nomads):** 1,268,624
- **No. of population living in potentially malarious areas:** all
- **No. of population to be protected in 1956:**
  - by pilot project: 125,000
  - by mass campaign: 60,000

**Malaria vectors:** gambiae and possibly funestus.

**Spraying season:** to be determined - preliminary observations indicate February for first cycle. The second spraying to take place six months later.

**Insecticides used:** In pilot project - Zone A - DDT twice yearly
- Zone B - DDT once yearly
- Zone C - dieldrin once yearly
- Zone D - BHC (during 2nd half of year when inhabited by nomads)

**Zone E** - Check area.

In mass campaign: DDT

**Personnel:** 1 director of pilot project, 1 director of mass campaign, 1 field supervisor, 1 assistant field supervisor, 2 laboratory technicians, 2 entomology technicians, and 6 motorized squads. Each squad consists of 1 foreman, 1 assistant foreman, 1 recorder, 1 marker, 1 mixer and 8 operators.

**Budget:** for two years (1956 and 1957): £100,000
3. **International Help:-**

**WHO**
- 3 months short-term consultant 1955.
- 3 months short-term consultant during 1957.
- 2 fellowships for directors to visit WHO assisted malaria campaigns.

**UNICEF**
- March 1955 Executive Board approved allocation of $89,000 for the provision of vehicles, sprayers and DDT.

4. **Inter-Country Coordination:-**

Invitation by WHO for the two directors to attend the African Malaria Conference (Lagos, November 1955) and for one representative to attend the Inter-Regional Malaria Conference (Athens, June 1956).
1. **Programme and Duration:**

   Malaria control has been proceeding in the country without international help. A pilot project in Fung area will commence work in 1956 for three years to study problems connected with future mass eradication campaign.

2. **Statistics:**

   - No. of total population (1954): 9,754,000
   - No. of population living in potentially malarious areas: 9,754,000
   - No. of villages situated in potentially malarious areas: ...........
   - No. of population protected during 1955 (residual and larviciding): 2,337,000

   Target number to be protected:
   - by residual spraying alone in 1956 or 1957: 634,000
   - by larviciding (or combined): 2,000,000
   Total: 2,634,000

3. **Technical Data:**

   Main malaria vectors: *gambiae*, *pharoensis*, *rufipes*.

   Development of resistance: not observed - under study.

   Malaria transmission season: all the year round with a peak during the period August to November.

   Timing, frequency of spraying and insecticides used:
   - Government procedure:
     July and October using DDT or BHC twice yearly.
   - For pilot project:
     May to July using dieldrin once a year.

   No. of blood films in 1955: ...........

   No. positive and species of parasites: *falciparum* predominating over *vivax* and no report of *malariae*. 
4. Administration and Finance:

Personnel: For pilot project (1956): 1 malarialogist, 1 entomologist, 1 senior sanitarian, 6 blood and entomology technicians, 25 mosquito men, 8 sanitary overseers, 120 labourers.

In Gezira Irrigated Area, protecting 3 million inhabitants: 1 medical officer, 1 senior public health inspector, 9 public health inspectors, 9 sanitary overseers, 104 mosquito men, 95 labourers.

Advisory Committee: Anti-Malaria Board consisting of seven members from various ministries, and from the Public Health Services of the Gezira Irrigated Area, is to be established in 1956.

Malaria budget: for pilot project (1956): £32,144
(1957): £75,768
for whole country (approx.): £430,500

5. International Help:

WHO
- (1955) short-term malaria consultant (3 months).
- (1956) 1 malarialogist, 1 entomologist and 1 sanitarian.
- Supplies of technical equipment mainly for training purposes to a value of: £3,000
- Fellowships.

UNICEF
- Executive Board September 1955 approved allocation of £34,000 for the provision of insecticides, sprayers, laboratory equipment and transport.

6. Inter-Country Coordination:

Invitation by WHO for a representative to attend African Malaria Conference (Lagos) November 1956, and to attend Athens Inter-Regional Conference in June 1956.

Coordination of work with Egypt in the eradication of *A. gambiae* from northern areas.
1. Programme and Duration:-

Malaria eradication during 1956-1960 (5 years), plan of operations ratifed by Parliament in April 1956.

2. Statistics:-

No. of total population: 3,600,000
No. of population living in potentially malarious areas: 1,150,000
No. of villages situated in potentially malarious areas: 
No. protected during 1955 (residual spraying): 283,000
Target number to be protected in 1956: 700,000
Average annual cost of control programme/head/
   (1955 Government statistics): $0.38
Average annual cost of eradication programme/head
   estimated for five years: $0.31

3. Technical Data:-

Main malaria vectors: sacharovi, superpictus, sergenti, (claviger?).
Development of resistance: not noted - under study.
Malaria transmission season: July till end of November.
Timing and frequency of spraying: March till end of June (one spraying)
Other methods of control: larviciding in south for rice cultivation and
   sergenti breeding places.
Insecticides used: DDT - occasionally BHE provided by Government.
No. of blood films taken in 1955: not available.
No. positive and species of parasites: not available.

4. Administration and Finance:-

Personnel: 1 director (malarialogist), 9 medical officers,
   1 entomologist, 6 assistant entomologists,
   28 blood technicians, 25 sanitarians,
   120 foremen and 700 labourers.
Advisory Committee: existing but needs strengthening from other Ministries.
Malaria budget for 1956: $210,285
5. International Help:

- WHO
  - Visit by Special Malaria Consultant and Regional Malaria Adviser (September-October 1955).
  - WHO malaria team composed of 1 maliariologist (team leader), 1 entomologist and 2 sanitarians.
  - WHO consultant (April-May 1956).

- UNICEF
  - March Executive Board approved $154,000 for the provision of insecticides, drugs, sprayers, laboratory equipment and vehicles.

- UNRWA
  - Spraying 60 villages in the south.

6. Inter-Country Coordination:

- Invitation by WHO to Director of Malaria Eradication Services to Ad Hoc Meeting in Athens (June 1956).

- Exchange of views with authorities in Jordan and Lebanon on anti-malaria measures taken along frontiers.

- Visit of WHO team leader in Saudi Arabia to Malaria Eradication Department (June 1956).
RESISTANCE OF INSECTS TO INSECTICIDES

1. Definition

The "resistance" of an insect to an insecticide is the word now used to describe strains or races, within the species of the insect, which are abnormal in being less susceptible to insecticides than the original or natural population of the species. Such resistance usually follows the extensive use of chlorinated hydrocarbon insecticides and the natural selection of those strains that are less susceptible to these insecticides.

Resistance manifests itself in two forms:

(i) Physiological resistance: which is described as an enhanced capacity to survive a poison.

(ii) Behaviouristic resistance: which implies the avoidance of lethal contamination with a poison.

2. The Significance of Insect Resistance in Public Health

Since the last World War, chlorinated hydrocarbon insecticides have been used extensively in the fight against insect-borne diseases such as typhus, relapsing fever, plague, malaria, yellow fever, dengue fever, filariasis and fly-borne diseases. These insecticides, the names of which are becoming very familiar, include DDT, Chlordane, BHC, and Dieldrin, are related chemically to each other, and in their various formulations (dusts, emulsions, wettable powders), and in appropriate dosages and techniques of application, proved to be very effective in killing the vectors of the above-mentioned diseases: Pediculus humanus, ticks, fleas, Anopheles mosquitoes, Aedes aegypti, Culex mosquitoes, and flies.

No public health administration, impressed with the uses of these insecticides which have provided the most effective and cheapest weapon to combat insect-borne diseases, could ignore their role in the various public health activities. The very big decline noted for the last ten years in the incidence of these diseases, especially malaria, typhus, and yellow fever in the previously infested territories of this globe, is mostly attributed to the use of these modern insecticides.
For the above reasons, any development of "resistance" by insects of medical importance to these chlorinated hydrocarbon insecticides will have serious repercussions, and will crush the hopes of public health strategists in their planning for a global-wide eradication of these insect-borne diseases.

3. Present Situation of Resistance to Insecticides in Insects

The first observations on the development of DDT-resistance were noted in the house fly. Such resistance is now widespread in many countries of the Eastern Mediterranean Region as well as in many parts of the world. The flies have developed a strong resistance not only to DDT, but also to the related BHC, Chlordane, and Dieldrin. The consensus of opinion nowadays is that the house fly can no longer be controlled with the halogenated insecticides.

The first report on the development of resistance by body lice came from Korea. There DDT could no longer control lice infestation. Signs of resistance have been observed since then in a few other countries including Egypt (Gaza).

Observations made in Gaza, Lebanon and Jordan where anti-flea campaigns using modern insecticides have been operating in Palestinian refugee camps since 1950, showed that the human flea (*Pulex irritans*) has developed resistance to DDT, BHC, and Chlordane. An allegation of resistance in the oriental rat flea (*Xenopsylla cheopis*) has been announced lately.

The German cockroach (*Blatella germanica*) has developed resistance to Chlordane in many localities, where the roach-pesticide, consisting mainly of Chlordane, has been used extensively over a few years. It has been reported from many areas that bed bugs are no longer affected by DDT residues.

A strain of the yellow fever vector (*A. aegypti*) from Trinidad has shown itself to be extremely resistant to DDT. This mosquito has been regarded as the one most susceptible to DDT, and has practically been eliminated from many areas in the Eastern Mediterranean countries, as a side effect to anti-malaria DDT residual spraying campaigns. The long absence of dengue fever (which is transmitted by the same mosquito) from the Balkans and from the neighbouring Middle East countries is attributed to the disappearance of *A. aegypti* from these areas. One can notice the concern of public health workers when a strain of this mosquito, as in Trinidad, shows such a high resistance, almost 500 times more than a normal susceptible strain.
The Eighth World Health Assembly drew attention to the potential dangers of resistance to insecticides in anopheline vector species, and requested governments to intensify plans of nation-wide malaria control, so that malaria eradication may be achieved and the regular insecticidal spraying campaigns safely terminated before serious resistance develops. In 1951 resistance of *Ae. saccharovi* to DDT was noted in Greece after six years of exposure to it. This resistance has steadily become more marked so that in numerous areas of Greece today, malaria control is not possible by DDT residual spraying. Incipient resistance has been noted in *Ae. saccharovi* in Lebanon (1955), and *Ae. stephensi* in Al-Hassa area in Saudi Arabia (1955).

Further investigations are needed to confirm the development of resistance in the latter two countries. Resistance to DDT developed by certain strains of malaria vectors outside the Eastern Mediterranean Region was noted in *Ae. quadrimaculatus* (Tennessee, USA - 1952), in *Ae. sundaicus* (Java 1954) and in five other anopheline species in Africa, Europe, and South America. Elsewhere malaria vectors remain fully susceptible to DDT, in some cases after ten years of exposure to it, as in Italy, India and Ceylon.

4. Present Knowledge Regarding the Mechanism of Resistance

It is regrettable that in spite of large-scale programmes of insect-borne disease control, in which modern insecticides are being used, our knowledge is quite meagre as to what causes death when insects are exposed to insecticides, and as to the biochemical and physiological bases of resistance. This is mostly due to the lack of interest in research on the part of health strategists of both governments and international bodies, as reflected by the insignificant funds set aside for research on resistance, when compared with the huge funds allocated for operations of insect-borne disease control by modern insecticides.

WHO commenced a survey of leading laboratories throughout the world where research on resistance is being carried out. The preliminary report concerning the work of twenty-seven of these centres in the European, Eastern Mediterranean and South-East Asia Regions indicates that their major activities are concerned with (a) efforts to develop resistant strains of vectors in the laboratory, and (b) surveys to determine the status of resistant vectors in certain countries.
Although these investigations are necessary as a guide for the large-scale programmes of insect-borne diseases control in which insecticides are being used, yet they do not provide any information on the mechanism of resistance or the means to combat it.

5. The Role of WHO in Stimulating and Coordinating Research on Resistance.

WHO has assumed responsibility for strengthening and expanding activities in effective research on resistance and has submitted a programme of coordination and stimulation of research on this problem. The WHO Executive Board at its Seventeenth Session (January 1956) approved the programme and asked that steps should be taken to provide Member Governments with advice on measures to be taken to control vectors which have developed resistance to insecticides.

The World Health Organization will make available to the Expert Committee on Insecticides in 1956 the data collected during its survey of the research on resistance carried out by major laboratories, and will ask it to submit a report on the scope and significance of resistance as a world problem, and to recommend a long-term cooperation programme of surveillance and research. A meeting of the directors of the laboratories collaborating in research programmes is planned for 1957, and this will be followed in the same year by the Expert Committee on Insecticides. The 1957 Committee will collate all available data and a series of recommendations made for the guidance of Member Governments on the future use of insecticides, and on the development of essential research on insect resistance.

WHO considers that the success of the whole scheme depends largely on the free and speedy exchange of information between field workers in charge of field programmes in various parts of the world, and laboratories, as well as between the individual laboratories participating in the scheme. WHO will collect and disseminate data on the scope and significance of resistance throughout the world and on measures to be taken to deal with individual situations. In the same manner it will provide scientific documentation for laboratories, as well as the services of leading scientists in the field of resistance, who will be recruited as consultants.
MALARIA ERADICATION

Inter-Regional Conference on Malaria for Eastern Mediterranean and European Regions

An Inter-Regional Conference on Malaria for the Eastern Mediterranean and European Regions was held in Athens from 11 - 19 June 1956. The conclusions reached at this Conference are as follows:

(1) The Conference believes that, with some reservations as regards certain areas where malaria is transmitted by Anopheles calviger, A. gambiae and A. sergenti, and where insecticide resistance of a high degree has developed as in Greece, residual insecticide spraying methods are effective in interrupting transmission all over the two regions. It confirms the statement of the Fifth Report of the Expert Committee on Malaria that wherever transmission has been interrupted for several years, discontinuation of the insecticide spraying is advisable, notwithstanding the continued presence of vectors.

(2) The Conference is of the opinion that malaria eradication is technically feasible in the two Regions, although it recognizes that administrative and financial difficulties prevailing in some of the countries may seriously handicap the pursuit of eradication and that international assistance may be required.

(3) As the eradication of malaria is technically feasible in the two Regions, the malaria programme should be re-orientated and the administrative pattern of the malaria organization should be revised with this aim in view. It is essential that each country should have a central organization appropriately staffed with adequately trained and paid personnel, with a director endowed with...
the full authority necessary to reach the target; he should be granted free access to the policy making levels of his Government.

4. An adequate and comprehensive budget for the operations should be made available to the director and the administrative handling of finances should be simplified as much as possible. Funds for malaria eradication from all sources should be pooled and administered under a single set of financial regulations so that administrative delays may be avoided.

5. The Conference is of the opinion that a Malaria Eradication Organization should have separate branches for operations, for inspection, for epidemiological surveys and surveillance and for administration, all responsible to the director of the central organization, advised by a scientific institution or organization.

6. The Conference gave special emphasis to the need of adequate remuneration and security of tenure of malaria eradication workers, so that suitable personnel may be recruited and retained in the service.

7. The Conference devoted much attention to the matter of training of personnel for malaria eradication programmes. Instruction of administrators in the objects and methods of the campaign and training in administration for the leading officers of the organization is highly advisable, for the administrative difficulties of the programme are often greater than the technical ones.

8. The Conference considers that a surveillance system, capable of tracing both new cases and residual foci of the transmission is a necessary factor in every malaria eradication organization and it requests the Expert Committee on Malaria to lay down the criteria on which a surveillance system should be based.

9. Mass chemotherapy - combined with residual spraying of insecticides - does not seem to be recommendable in the two regions, except in rare areas, where insecticides have failed to interrupt transmission. On the other hand, the radical treatment of all cases, in areas where spraying has been stopped is of fundamental importance in every eradication programme.
(10) The Conference studied the danger presented by the movements of population, including the pilgrimage to Mecca, and the existence of nomadic or semi-nomadic life involving millions of population in some countries of the Eastern Mediterranean Region. The Conference recognizes that this is an important and difficult problem for malaria eradication and expresses the wish that the epidemiology of malaria for these areas and the possible methods of control be studied.

(11) Although education of the public will go a long way to making eradication measures possible, the Conference felt that adequate laws or regulations are necessary and it gave a series of subjects with which such laws or regulations should deal.

(12) Knowledge of the distribution and degree of development of resistance in anophelines is still fragmentary, and the Conference is of the opinion that it would be advisable to strive to interrupt transmission as soon as possible so that spraying operations may be discontinued while the insecticide is still fully active against the local vectors.

(13) The Conference recognizes that although in some areas, resistance has appeared following air spraying with insecticides, there are still instances where it has occurred without any previous history of larviciding, either from the air or from the ground. The Conference is of the opinion that this question deserves further study.

(14) The Conference emphasizes the advisability of repeated testing of susceptibility of vector populations before and during any malaria eradication programme.

(15) The problem of the development of resistance would justify requesting WHO to consider the formation of special survey teams to study the situation of local anopheline fauna in countries where resistance is present or suspected.

(16) The Conference discussed special difficulties that are sometimes found in the course of eradication programmes - such as rice field malaria - which can
generally be controlled by residual insecticide, but which in particular cases may require anti-larval work or even legislation to control rice cultivation until malaria has been eradicated.

(17) Particular attention was paid to the remaining foci of transmission which are in most cases a consequence of inadequate spraying operations, though in some cases may be related to the ecology of the vector or of the human population. It is imperative for a malaria eradication organization to be able to detect these foci and to deal with them effectively.

(18) The Conference discussed at length the general public health policy in relation to eradication programmes and was of the opinion that the relevant organization often represents a great asset for a country so that even when malaria is eradicated, it should not be disbanded, but utilized in other public health fields - such as the control of other arthropod-borne diseases or in environmental sanitation. This will entail adequate training of the personnel, to be given possibly before the last phases of the eradication programme.

(19) Finally the Conference expressed the hope that the countries of the regions pursue their efforts towards eradication and that WHO intensifies its assistance, so that the malaria conditions of neighbouring countries do not jeopardize the results achieved.

(20) The Conference passed a vote of thanks to the Government of Greece for the generous hospitality extended to it, to Her Excellency the Minister of Social Welfare, Madame Tsaldaris, to the Under-Secretary, Dr. Psarreas, to the Mayor of Athens, Mr. P. Katsotas, and finally to its Honorary President, Professor Alivizatos, and to the Organizing Committee of which he was the Chairman, for the efficient organization of the Conference and the cordial reception and assistance extended to all the participants."
An Advisory Meeting on Malaria Eradication in Egypt, Iran, Iraq, Lebanon, Saudi Arabia and Syria was held in Athens from 27 - 29 June 1956. At this Meeting the following resolution was passed:

"The Advisory Meeting on Malaria Eradication

1. EXPRESSES its belief in the benefit of holding meetings at inter-country and inter-regional levels;

2. THANKS WHO for the leadership in coordinating the activities of neighbouring countries in the field of malaria eradication;

3. REQUESTS WHO to explore the possibilities of coordinating the assistance of International Agencies;

4. ENDorses the conclusions of the Inter-Regional Conference on Malaria for the Eastern Mediterranean and European Regions, and

5. WISHES to emphasize that surveillance programmes should be considered as an integral part of malaria eradication operations."
The resolution of the Eighth World Health Assembly on Malaria Eradication included the establishment of a Malaria Eradication Special Account based on financial contributions for malaria eradication from governments and private sources. It was resolved that the resources of this Special Account would be used to meet the costs of:

(a) research;

(b) such supplies and equipment, apart from minimal requirements to be provided from Regular and Technical Assistance funds, as are necessary for the effective implementation of the programme in individual countries, and

(c) such services as may be required in individual countries and as cannot be made available by the governments of such countries.

The following list shows the tentative proposals for the services and supplies suggested for each country during 1957 and 1958, and which may be covered by this Special Account.

\(^1\text{WHA8.30} \)
<table>
<thead>
<tr>
<th>Country</th>
<th>Requirements in 1957</th>
<th>Requirements in 1958</th>
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<tbody>
<tr>
<td><strong>ADEN</strong></td>
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<td></td>
</tr>
<tr>
<td>Fellowships:</td>
<td>3 sanitarians (6 months)</td>
<td></td>
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<tr>
<td>Consultant:</td>
<td>1 malariologist (3 months)</td>
<td></td>
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<tr>
<td>Supplies:</td>
<td>$1,000</td>
<td></td>
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<tr>
<td><strong>EGYPT</strong></td>
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<tr>
<td>Fellowships:</td>
<td>1 scientific graduate (chemistry of insecticides, 2 years)</td>
<td>Continuation</td>
</tr>
<tr>
<td></td>
<td>1 agricultural engineer (spraying equipment, 6 months)</td>
<td>1 epidemiologist in statistical analysis (1 year)</td>
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<tr>
<td></td>
<td>1 senior malariologist (eradication techniques, 3 months)</td>
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<tr>
<td>Consultant:</td>
<td>1 malariologist (3 months)</td>
<td>1 entomologist (3 months)</td>
</tr>
<tr>
<td>Research and Supplies:</td>
<td>On mass drug administration $3,000</td>
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<tr>
<td><strong>ETHIOPIA</strong></td>
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<td>3 sanitarians (Regional, 3 months)</td>
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<td></td>
<td>1 entomologist</td>
<td>1 entomologist (1 year)</td>
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<tr>
<td></td>
<td>2 technicians</td>
<td>Laboratory equipment $1,000</td>
</tr>
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<td>1 entomologist (1 year)</td>
<td>Laboratory equipment $1,000</td>
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<tr>
<td><strong>IRAN</strong></td>
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<td>1 science graduate for chemistry of insecticides (2 years)</td>
<td>Continuation</td>
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<tr>
<td></td>
<td>1 agricultural engineer for spraying equipment (6 months)</td>
<td>1 sanitary engineer for malaria control in development schemes (1 year)</td>
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<tr>
<td></td>
<td>For studying malaria eradication among nomads $3,000</td>
<td>1 epidemiologist for statistical analysis (1 year)</td>
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<tr>
<td>Country</td>
<td>Requirements in 1957</td>
<td>Requirements in 1958</td>
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<td></td>
<td>Fellowships:</td>
<td>Fellowships:</td>
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<tr>
<td>IRAQ</td>
<td>1 agricultural engineer for spraying equipment (6 months)</td>
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<td></td>
<td>1 science graduate for studying entomology (1 year)</td>
<td>1 epidemiologist for surveillance (3 months)</td>
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<td></td>
<td>Consultant:</td>
<td>1 entomologist (1 year)</td>
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<td></td>
<td>Research and Supplies:</td>
<td>Research and Supplies:</td>
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<td>For studying malaria eradication among nomads $3,000</td>
<td>For studying malaria eradication among nomads $3,000</td>
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<tr>
<td>ISRAEL</td>
<td>Fellowships:</td>
<td>1 entomologist for studying resistance of insects (6 months)</td>
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<td>1 senior malariologist for surveillance (3 months)</td>
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<td>Consultant:</td>
<td>1 malariologist (3 months)</td>
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<td></td>
<td>Research:</td>
<td>On biology and resistance of A. sergenti to insecticides $2,000</td>
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<td></td>
<td>For laboratory $1,000</td>
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<tr>
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<td>Fellows:</td>
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<td></td>
<td>3 sanitarians (Regional 3 months)</td>
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<td></td>
<td>3 technicians (Regional 3 months)</td>
<td>3 technicians (Regional 3 months)</td>
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<tr>
<td></td>
<td>1 science graduate as entomologist (1 year)</td>
<td>1 senior malaria officer for surveillance (3 months)</td>
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<td></td>
<td>Consultant:</td>
<td>1 entomologist (1 year)</td>
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<tr>
<td></td>
<td>2 sanitarians (Regional 3 months)</td>
<td>$2,000</td>
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<tr>
<td>LEBANON</td>
<td>Fellowships:</td>
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<tr>
<td></td>
<td>3 sanitarians (Regional 3 months)</td>
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<tr>
<td></td>
<td>1 senior officer for surveillance (3 months in Ceylon and Iran)</td>
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<td>Advisory Team:</td>
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<td></td>
<td>1 malariologist</td>
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<td></td>
<td>1 entomologist (3 months)</td>
<td></td>
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<tr>
<td></td>
<td>2 technicians</td>
<td></td>
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<tr>
<td></td>
<td>With transport and supplies</td>
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</tbody>
</table>
LEBANON (contd)

Research and Supplies: The role of A. claviger in malaria transmission $3,000

LIBYA

Fellowships: 1 medical officer or senior sanitarian (Regional 6 months)
Consultant: 1 malarialogist (3 months) 2 sanitarians (3 months)
Supplies: $1,000 $500

PAKISTAN

Fellowships: 1 chemist for studying chemistry of insecticides (1 year) 1 epidemiologist for statistical analysis (1 year)
1 epidemiologist for surveillance (3 months) 1 science graduate for entomology (1 year)
1 engineer for spraying equipment (6 months) 1 epidemiologist for surveillance (3 months)
Consultant: 1 research director (1 year) Continuation

Supplies: Supplies and equipment for research on insect resistance and for training purposes $5,000

SAUDI ARABIA

Fellowships: 1 medical officer (post-graduate course in tropical medicine, 1 year) 1 medical officer to specialize in tropical medicine and hygiene (1 year)
1 science graduate in entomology (1 year) 1 agricultural engineer to specialize in spraying equipment (6 months)
3 sanitarians (Regional 3 months) 3 sanitarians (Regional 3 months)

Advisory Team: 1 malarialogist 1 entomologist 4 months 2 technicians
With transport and supplies
<table>
<thead>
<tr>
<th>Requirements in 1957</th>
<th>Requirements in 1958</th>
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</thead>
<tbody>
<tr>
<td><strong>SOMALIA</strong></td>
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<tr>
<td>Fellowships:</td>
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<tr>
<td>- 3 sanitarians (3 months)</td>
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<tr>
<td>2 technicians (6 months)</td>
<td>2 technicians (6 months)</td>
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<tr>
<td>Consultant:</td>
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<tr>
<td>1 short-term consultant entomologist (3 months)</td>
<td>1 short-term consultant entomologist (3 months)</td>
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<td>Supplies:</td>
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<td>£500</td>
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<tr>
<td><strong>SYRIA</strong></td>
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<tr>
<td>Fellowships:</td>
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<tr>
<td>1 medical officer for tropical medicine and hygiene (1 year)</td>
<td>1 medical officer for vital statistics (1 year)</td>
</tr>
<tr>
<td>1 agricultural engineer for studying spraying equipment (3 months)</td>
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<tr>
<td>1 senior malaria officer for surveillance (3 months)</td>
<td>1 science graduate to study entomology (1 year)</td>
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<td>Consultant:</td>
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<tr>
<td>1 entomologist (4 months)</td>
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<tr>
<td>Supplies and Equipment:</td>
<td>Mostly microscopes and some laboratory equipment £2,000</td>
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<tr>
<td><strong>SUDAN</strong></td>
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<tr>
<td>Fellowships:</td>
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<tr>
<td>1 senior public health officer (Regional 3 months)</td>
<td>1 medical officer for tropical medicine and hygiene (1 year)</td>
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<tr>
<td>3 sanitarians (Regional 3 months)</td>
<td>1 science graduate for entomology (1 year)</td>
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<tr>
<td>Consultant:</td>
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<tr>
<td>1 entomologist (3 months)</td>
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<td>Advisory Team:</td>
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<td>1 malariologist)</td>
<td>1 entomologist 3 months</td>
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<tr>
<td>1 entomologist</td>
<td>2 technicians</td>
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<tr>
<td>With transport and supplies</td>
<td></td>
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<tr>
<td>Supplies and Equipment:</td>
<td>Laboratory equipment £1,500</td>
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<td></td>
<td>Laboratory equipment £1,000</td>
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<tr>
<td><strong>TUNISIA</strong></td>
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<tr>
<td>Fellowships:</td>
<td></td>
</tr>
<tr>
<td>1 medical officer to specialize in tropical medicine and hygiene (1 year)</td>
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</tr>
</tbody>
</table>
Requirements in 1957  Requirements in 1958

TUNISIA (contd)

Fellowships: 1 science graduate for entomology (1 year)
       (Contd)
       3 sanitarians (Regional 3 months)
Consultant: 1 malarialogist (3 months)
Supplies: $1,000

YEMEN

Fellowships: 2 sanitarians (Regional 3 months)
       2 technicians (Regional 3 months)
Advisory Team: 1 malarialogist
       1 entomologist ) 3 months
       2 technicians )
With transport and supplies

INTER-COUNTRY PROGRAMME

1. Regional Training Centres

Egypt: 1 malarialogist (3 months) 1 entomologist (3 months)
       Supplies for training $2,000 $1,000
Iraq: 1 entomologist (3 months) 1 statistician (3 months)
       1 senior technician (3 months) 1 malaria sanitary engineer (3 months)
       Supplies for training $2,000 $1,000
Iran: 1 statistician (3 months) 1 sanitary engineer (3 months)
       (specialist in spraying equipment) $1,000
       Supplies for training $2,000 $1,000

2. Regional Office

1 entomologist (F2) Continuation
1 senior technicians (F1) Continuation
Supplies $1,000 $1,000