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## Part I

### RECENT DEVELOPMENTS IN MOSQUITO-BORNE DISEASES: MALARIA

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This year, just 75 years after the great discovery in India by Sir Ronald Ross of malaria transmission by mosquitoes, we have both good news and bad news to report on the status of malaria. Indeed we can find much to tell that is of an optimistic nature—especially in the United States where the number of malaria cases, mostly imported from Vietnam, has declined dramatically during the past year and the prognosis is excellent for a continued decrease during 1973.

On the other hand, we have cause also for pessimism—because as we leave the United States, the picture often is discouraging. There is a recrudescence of malaria in certain parts of the world—in countries that have suffered most from this debilitating disease over the centuries—countries that often do not have the resources to do the job of malaria eradication that they so enthusiastically tackled a decade or two ago.

Let us first briefly mention malaria in the U.S. In the years immediately prior

to the Vietnam war, less than 100 cases of malaria were being diagnosed annually in this country as shown in Table I. By 1966 this figure rose to more than 700, and in 1970 reached a peak of 4,239 reported cases, mostly in returning veterans of the Vietnam war. In 1971 the figure went down to 3,047 and in 1972 the preliminary figure (CDC, 1973) dropped further to 810 cases—a dramatic but easily explained and welcomed reduction in

TABLE I.—Military and civilian cases of malaria, United States, 1959-1972.<sup>1</sup>

Year	Military	Civilian	Total
1959	12	38	50
1960	21	41	62
1961	45	37	82
1962	75	40	115
1963	58	90	148
1964	52	119	171
1965	51	105	156
1966	621	143	764
1967	2699	158	2857
1968	2567	131	2698
1969	3914	145	4059
1970	4088	151	4239
1971	2856	191	3047
1972	....	...	810 <sup>2</sup>

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<sup>1</sup> Onset of illness in the United States and Puerto Rico. Figures from CDC, 1972.

<sup>2</sup> Preliminary figure from CDC, 1973.

malaria morbidity resulting from the lessening U.S. involvement in the Vietnam war. Civilian cases have not fluctuated as have the military, ranging from a low of 37 cases in 1961 to a high of 191 in 1971, including needle-induced and transfusion-induced cases. Figure 1 shows graphically the relationship between civilian and military cases, with the dramatic rise and fall caused by the Vietnam war. Since 1959, the number of indigenous mosquito-transmitted (or "introduced") cases in the U.S. has remained at a low level of 0 to 5 per year.

On a worldwide basis, we have an entirely different situation. During recent years, the malaria picture has changed each year, but the changes are not great. Table 2 is taken from figures provided

by the World Health Organization (WHO) with most recent figures shown for 1971 and 1972 (WHO 1972, 1973). Of the total 1.821 billion persons estimated to live in malarious areas, 721 million were in maintenance phase, 303 million in consolidation and 324 million in attack phase based principally on house spraying for control of the vector. Only 4 million are in preparatory phase but 202 million are receiving control measures and 267 million are still without a program. Figure 2 illustrates the percentage of the population in each program phase, from 1961 through 1972. The percentage in maintenance phase has changed very little since 1966. Consolidation phase has been reduced during the 1970-1972 period, principally because of the reversions

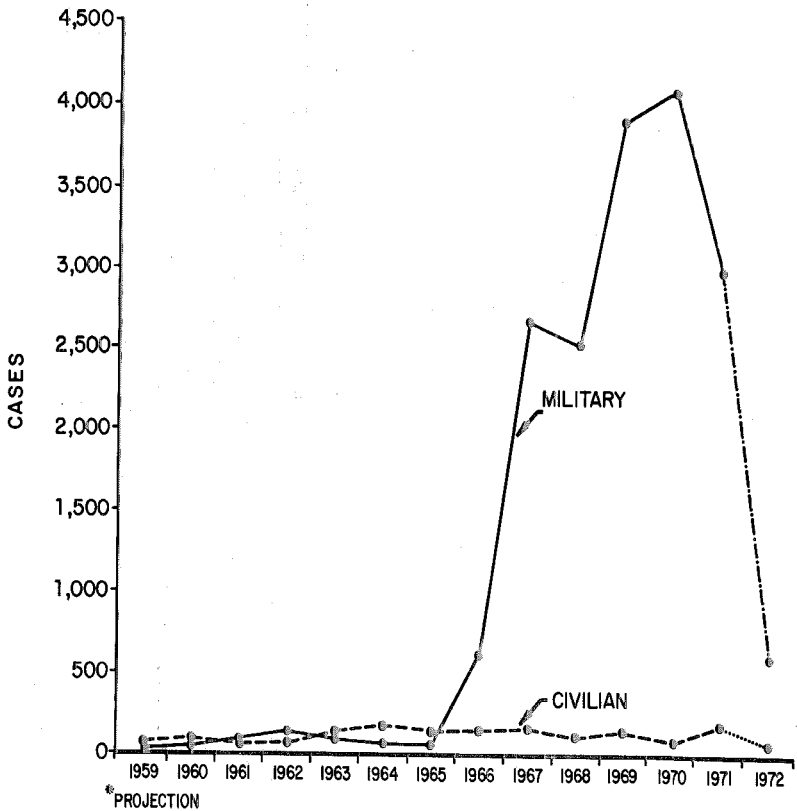


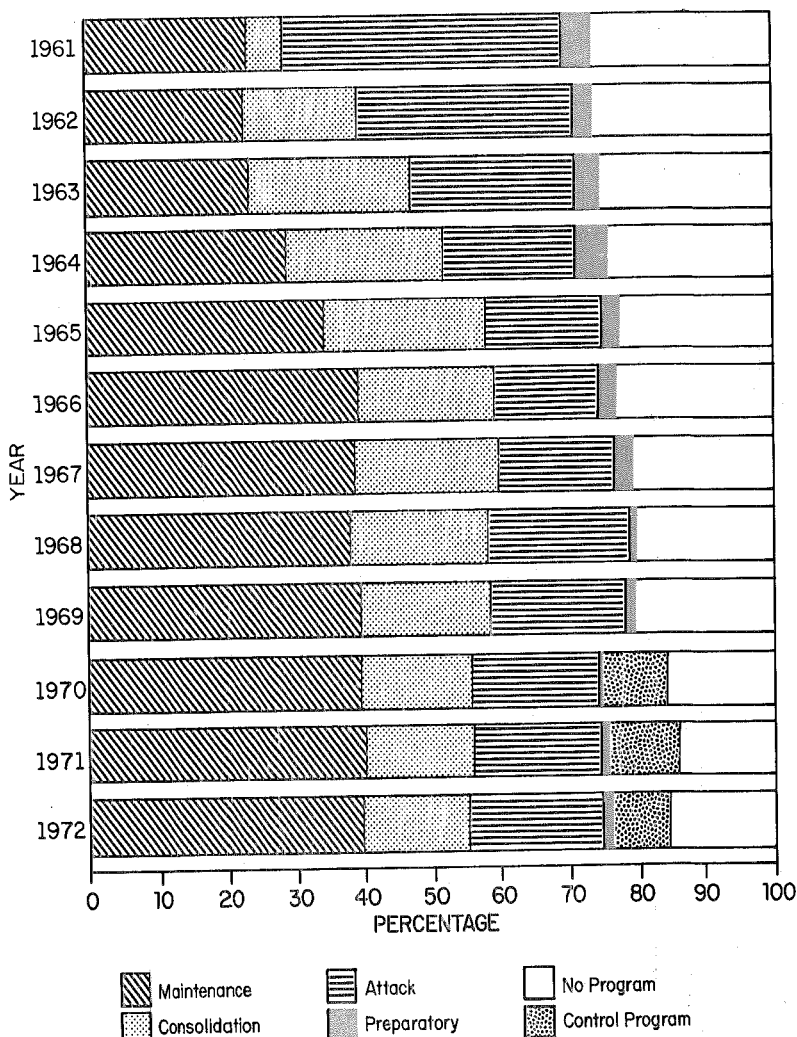
FIG. 1.—Military and civilian cases of malaria, United States 1959-1972.\*

to attack, brought about by recrudescences of malaria. Figure 3, taken from WHO (1973a) shows the status of malaria epidemiological assessment in mid-1972.

When we further examine Table 2 we will note that the changes which have occurred during the last few years are not dramatic. Total population of the

malarious areas has risen steadily and the number of areas with "no program" has dropped. A new category, "control," was added (WHO 1971), following the decision at the 23rd World Health Assembly (WHO 1970) to include "malaria control" as a logical step toward malaria eradication. Anti-malaria meas-

1972 Population of Malarious Areas: 1,821,000,000



Data from World Health Organization/Malaria Eradication, Geneva  
 FIG. 2.—Percentage of population of worldwide malarious areas by phase 1961-1972.

TABLE 2.—Worldwide anti-malaria program population phasing<sup>1</sup> (in millions) 1961–1972.

	Total malarious	Maintenance	Consolidation	Attack	Preparatory	Control	No programs
1961	1420	317	75	575	59	...	393
1962	1472	329	243	461	33	...	406
1963	1502	343	354	359	49	...	397
1964	1560	444	355	302	67	...	393
1965	1576	535	370	265	43	...	362
1966	1635	633	330	246	42	...	384
1967	1692	654	355	277	42	...	364
1968	1716	648	342	357	12	...	357
1969	1767	697	337	347	15	...	371
1970	1802	710	296	329	5	175	287
1971	1826	728	299	315	4	210	270
1972	1821	721	303	324	4	202	267

<sup>1</sup> From WHO sources. Figures do not include Mainland China, North Korea or North Vietnam.

ures, including standard mosquito control procedures applied to anopheline vectors of malaria, were recognized to have a legitimate place in programs to control this disease. WHO (1972) has issued a new "Manual for Planning for Malaria Eradication and Malaria Control Programmes" which provides guidelines for anti-malaria programs not previously available in comprehensive form from WHO.

Table 3 gives the regional program fig-

ures for 1972. It may be noted that the programs in Africa are lagging behind the other regions, with more than 200 million persons still living in areas with no program. In the Americas, progress has been impressive. As an example of this progress, Paraguay reinitiated malaria eradication efforts with full-scale DDT spraying in 1968 after an epidemic peak of over 50,000 cases in 1967. The epidemic was centered in a colonization area

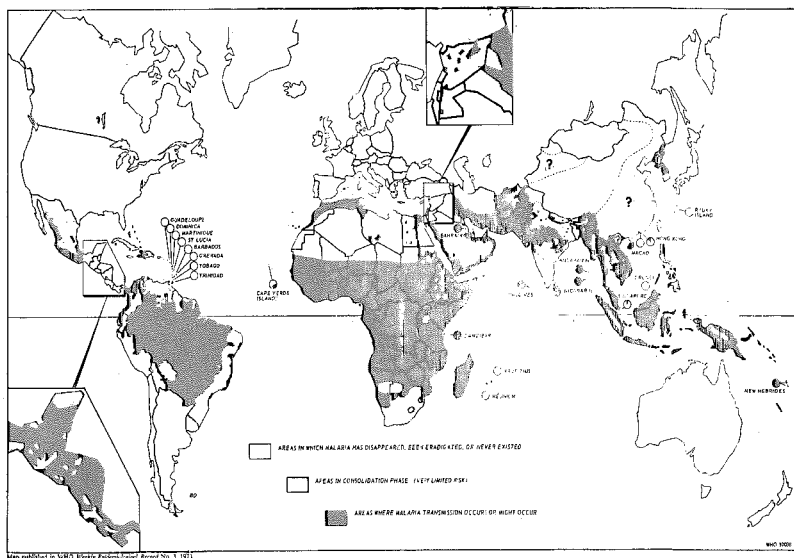


FIG. 3.—Epidemiological assessment of status of malaria, June 30 1972.

TABLE 3.—Worldwide anti-malaria program population phasing by region-1972<sup>1</sup> (in millions).

Region	Total Population	Total Malarious	Maintenance	Consolidation	Attack	Pre-paratory	Control	No Program
Africa	251	231	5	3	0	0	19	204
Americas	527	191	86	42	56	..	6	0
South East Asia	835	801	321	187	168	..	88	37
Europe	788	355	294	37	4	2	12	5
Eastern Mediterranean	236	176	6	24	87	..	43	17
Western Pacific	248	68	10	10	8	2	33	5
Total	2884	1821	721	303	324	3	202	267

<sup>1</sup> Figures from WHO sources, as of Sept. 30, 1972. Totals may not tally due to rounding off of figures. Mainland China, North Korea and North Vietnam not included in totals.

with high *Anopheles darlingi* densities. The number of cases has decreased rapidly to only 94 detected during 1972. Of these, 64 were imported from outside the country. A review team has just endorsed a program with 1.6 million population (83 percent of the malarious areas) to be protected only by surveillance activities, leaving routine DDT spraying only in colonization areas and in areas where danger of reestablishment of transmission exists because of arrival of imported cases from outside the country. Despite this and other good examples, 62 million persons remain in the attack or control phases in the Western Hemisphere, thereby indicating the existence of problems still requiring the attention of nations and international organizations. The Central America Research Station of CDC is attempting to solve some of the technical difficulties that exist in El Salvador and other countries in that area.

During the 1960s, U.S. assistance to malaria eradication programs around the world reached a peak and since then has declined. One item which illustrates the trend is the amount of the recently much-maligned DDT purchased for shipment to country programs. This is because the basis for anti-malaria work principally has been and continues to be the application of residual deposits of DDT to the inside of houses for control of the anopheline vectors of malaria. As DDT shipments to countries assisted by the U.S. Government decline, either other sources of DDT must be located, or work cur-

tailed. The U.S. has been the largest exporter of DDT to the various malaria eradication programs, and any decline therefore is bound to affect the programs adversely.

From Fiscal Years 1961 through 1973 the following amounts of 100 percent DDT (including both technical DDT and 75 percent DDT water dispersible powder converted to technical DDT equivalent) were purchased and shipped to countries receiving U.S. assistance (in millions of pounds):

Fiscal Year	Pounds DDT (millions)
1961	51.695
1962	53.281
1963	61.060
1964	37.348
1965	44.868
1966	46.678
1967	32.587
1968	44.142
1969	52.421
1970	30.153
1971	22.041
1972	5.181
1973	11.309

The peak year was 1963 when more than 61 million pounds of DDT technical equivalent were shipped. From 1964 through 1969 the figures were somewhat constant, but starting in 1970 the drop has been sharp. The 1973 figure principally represents a 9 million pound order to Brazil.

During the same period of time, the number of U.S. malaria advisors assigned to the countries receiving U.S. assistance reached a high of approximately 80 tech-

nicians in the early 1960s dropping to an estimate of less than 5 as of June 30, 1973. Since the beginning of the malaria eradication program assistance by the U.S. Government in 1958, 30 countries<sup>2</sup> have received direct assistance (Johnson, 1969). By June 30, 1973, approximately 10 will still be receiving aid—and those at a greatly reduced level.

At the same time as there has been a decrease in U.S. participation, there has been a regression of anti-malaria program activities in many countries. In India, for example, with the inadequacy of available resources there has been a recrudescence of malaria in certain areas. Table 4 shows this by indicating the number of blood slides examined each year in India from 1961–1971. Malaria cases have risen from a low of 1.2 per 10,000 in 1961, to 24.7 per 10,000 in 1971. Nepal, on the other hand, just north of India, has continued to make good progress,

although malaria is far from being eradicated there.

The figures for Pakistan are discouraging. The monthly confirmed cases for what formerly was West Pakistan were as follows for the past two years:

	1971	1972
January	1,983	3,953
February	1,440	4,929
March	1,854	7,161
April	3,998	13,262
May	9,690	25,569
June	10,666	37,186
July	10,863	25,974
August	30,971	77,382
September	48,614	189,103
October	52,005	172,859
November	22,671	55,420
December	6,492	19,819
Total	201,247	632,617

In 1970 there were some 201,000 confirmed cases in a total population of 60 million. In 1972, the cases rose to more than 630,000 in the same geographic area, an increase of over 300 percent. The problems there are not only financial but technical as well. Cyclical epidemics have occurred in the past in the Punjab and this may be what is occurring again. Resistance of the vectors to DDT is one problem receiving a great deal of attention in Pakistan. A shift to malathion would cost several times as much as DDT, but the program already is in financial difficulty and additional funds are almost impossible to obtain.

The above examples are indicative of the dilemma facing many programs today. There are some gains, but many setbacks. Technical problems are not easy to solve, and the solutions often are expensive. The programs unfortunately are faced with the cold facts of less financial assistance from the U.S. Agency for International Development (AID), less from the United Nations Childrens Fund, and less from the World Health Organization. Economy measures are forcing a cutback in personnel not only in the United States but in the international organizations as well. The Malaria Eradication Training Center located for the

TABLE 4.—India malaria surveillance data<sup>1</sup> 1961–1971.

Year	Number slides	Number positive	Cases per 10,000 pop.
1961	13,100,000	49,151	1.2
1962	26,123,000	59,575	1.4
1963	38,697,000	87,306	2.0
1964	44,458,000	112,942	2.5
1965	40,667,000	100,185	2.1
1966	39,828,550	148,156	3.1
1967	40,424,764	278,621	5.7
1968	41,991,322	274,881	5.5
1969	41,841,885	348,647	6.8
1970	40,960,000	694,647	13.8
1971	40,453,164	1,323,118	24.7

<sup>1</sup> From R. G. Scholtens, R. L. Kaiser and A. D. Langmuir, 1972, supplemented by CDC Malaria Program data. Total population of India in malarious areas: 1961—400 million, 1971—535 million.

<sup>2</sup> Far East: Cambodia, China (Taiwan), Indonesia, Laos, Philippines, Thailand, Vietnam.

Near East and South Asia: Ceylon, India, Iran, Jordan, Nepal, Pakistan.

Africa: Ethiopia, Liberia, Libya.

Latin America: Bolivia, Brazil, Colombia, Costa Rica, Ecuador, El Salvador, Guatemala, Haiti, Honduras, Jamaica, Nicaragua, Panama, Paraguay, Peru.

past decade in Manila, and prior to that in Kingston, Jamaica, is closing on June 30, 1973—because neither the WHO nor AID has funds available for continuation of this training center. Financing and staffing of programs is becoming more and more the full responsibility of the individual governments, but these nations often are unable to bear the burden alone.

We do know that tremendous accomplishments have been achieved by the programs for elimination of malaria (Johnson, 1967, 1969). What the future holds for the worldwide program is impossible to predict, but at this moment in time it appears that malaria resurgences are inevitable in many areas of the world and the prognosis is not pleasant to contemplate.

We also know, however, that many countries now are much more realistic about their malaria programs and better understand how to cope with them than they did in the 1940s and 1950s. Although it is not feasible to eradicate this disease at present in all areas because of the inadequacy of resources—technical, financial, and administrative—great attention is and will continue to be paid toward the elimination of malaria, especially as the nations realize what a tremendously adverse socioeconomic impact malaria has in endemic and epidemic areas. The importance of both eradication and control now is widely and belatedly recognized by all agencies concerned with the programs. The countries themselves have a long, tedious job ahead and they must build their programs on a solid

foundation of integrated control of both the vector and the parasite, if they are to succeed. I feel that malaria can and will be eliminated as a public health problem throughout much of the world during the remainder of this century—but only if nations work together, assisting each other to complete this arduous task that is a problem common to most of the developing countries.

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