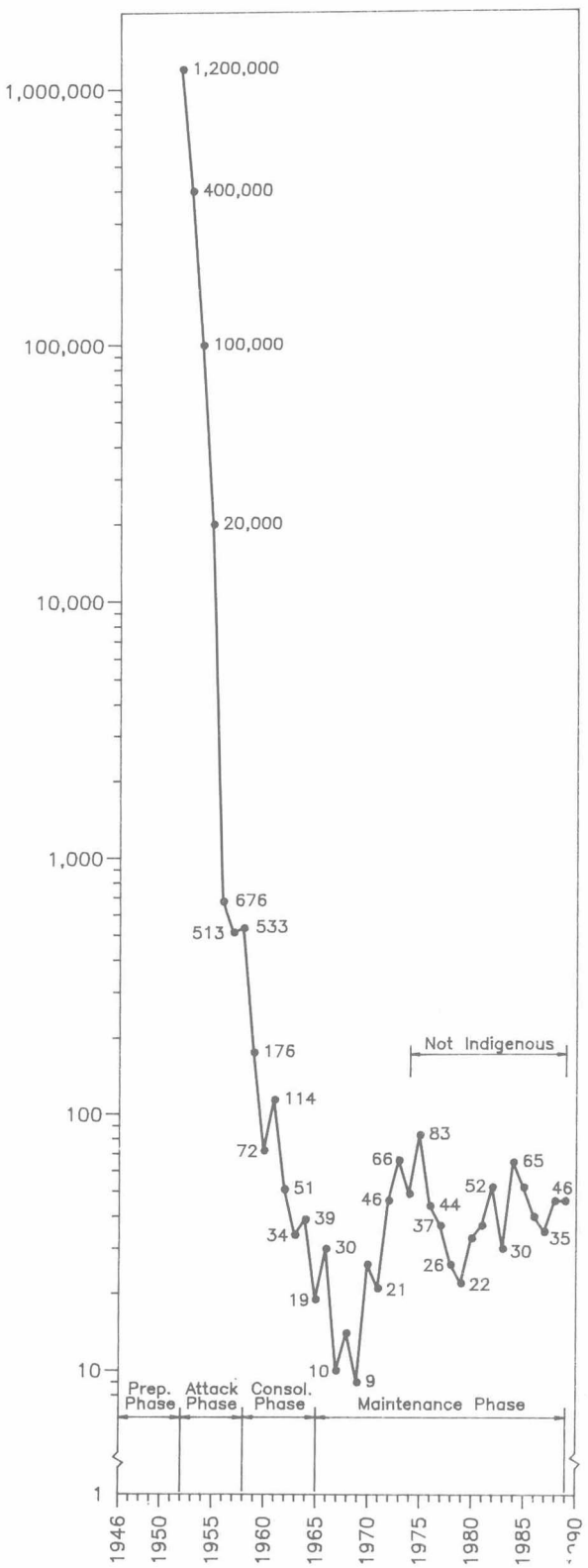
Malaria Eradication in Taiwan

May 1991

Department of Health
The Executive Yuan
Republic of China



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Decline and Fall of Malaria

Number of Annual Malaria Cases between 1952 - 1989
(in semi-logarithmic scale)

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FOREWORD

Malaria -- the most debilitating endemic disease of the rural community -- was finally eradicated from Taiwan in the early 1960s. Although there is no record to indicate when the disease came into existence in Taiwan, it is reasonable to assume that malaria had existed among the indigenous population for many centuries, perhaps since the arrival of the first settlers from other western Pacific islands. The tropical climate of the island, with its abundant seasonal precipitation, and the undulating terrain along the foothills of the Central Mountain Range provide ideal breeding conditions for *Anopheles minimus*, the principal malaria vector in Taiwan. Malaria transmission used to occur throughout the year; the disease was highly endemic almost everywhere on the island, particularly in the foothill regions. Before its eradication, malaria was a threat to the lives of many people, especially in rural communities, and was also a major factor deterring the economic development of the island.

A continuing struggle against this disease was initiated soon after the beginning of this century. The Japanese government, which ruled Taiwan during the period from 1895 until 1945, launched a large scale malaria control program in 1911 using Koch's method, *i.e.*, extensive, periodic blood examinations of the residents in the malarious areas, followed by radical cure treatment of the malaria cases detected. This method was applied to practically all the hyperendemic areas in Taiwan and proved to be very effective in maintaining a low parasite rate of 2%-3% among the inhabitants for the period from 1911 to 1944. However, malaria transmission was not interrupted and small outbreaks occurred whenever there were significant ecological or meteorological changes, such as severe typhoons which swept the island from time to time, earthquakes (*e.g.*, malaria outbreaks in Shinchu county following an earthquake in 1935), and the last but the most severe malaria outbreak, during and after World War II.

In addition to chemotherapy, other malaria control measures were also applied or tested before 1946. Larvivorous fish, *Gambusia affinis*, were brought in from Honolulu in 1911 and were widely distributed throughout the island in 1913. This fish, together with another species, *Poecilia reticulata*, are still present in goodly numbers in Taiwan proper as well as in Penghu and Lanyu. Anti-larval measures against the vector (such as removal of algae and weeds along irrigation canals, proper

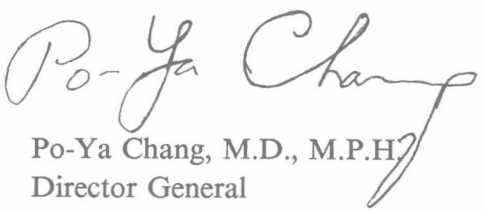
drainage of rice paddy fields to avoid overflow, filling-in of unnecessary depressions, and drainage of swamps and unwanted water collections) were tried here and there on a limited scale. Clearing of scrub, dead leaves of bananas, bushes and lower branches of trees around dwellings were a part of the semi-annual cleaning practices in the community. All these measures had their merits, but their effectiveness against malaria transmission was insignificant.

In November 1946 the Rockefeller Foundation, in collaboration with the Government, established a Malaria Research Center in Chaochou, southern Taiwan. Through this research center, new malaria control technology was introduced and technical personnel were trained. This research center became the Taiwan Provincial Malaria Research Institute (TAMRI) in 1948 and served as the headquarters for the malaria eradication program, launched in 1952 with the technical assistance of the World Health Organization (WHO) and the financial assistance of the Joint Commission for Rural Reconstruction (JCRR), the Mutual Security Agency (US/MSA), and the Council for United States Aid (CUSA).

To develop a network of health services, which were non-existent during the Japanese regime, counties and townships began to organize health centers and health stations during 1949 - 1952 with the financial assistance of JCRR. The establishment of the health services was very timely for the malaria eradication program, allowing for expansion of field operations through health centers and health stations. The malaria eradication program, on the other hand, provided a dramatic challenge and opportunity for the newly-created health units to acquire field experience in disease control. The system of centralized planning at TAMRI and decentralized execution of the program by local health units worked very well through the attack, consolidation and maintenance phases of the program. The number of malaria cases, conservatively estimated in 1952 as 1.2 million, was down to zero in indigenous transmission by the early 1960s.

On December 4, 1965 Taiwan was officially registered by WHO on its list of countries where malaria eradication has been achieved. In commemoration of the 25th anniversary of the WHO certification, The Department of Health of The Executive Yuan, with the collaboration of the Kaohsiung Medical College, held a ceremony and an International Symposium on Malaria on December 4-5, 1990. As part of the commemoration, our Department also invited several former TAMRI directors and technical staff and a former WHO adviser to prepare a document which would reflect the history and achievement of the malaria control and eradication

program in Taiwan up to this date, and which would serve to remind us of our grave responsibility to keep Taiwan malaria-free until global eradication of this debilitating disease has been achieved.



Po-Ya Chang, M.D., M.P.H.
Director General
May 1991

ACKNOWLEDGMENTS

Malaria eradication was achieved in Taiwan in the early 1960s; since then, many attempts have been made to assemble existing information on this accomplishment into a single document reflecting the long history of the struggle which culminated in its eradication. It was Dr. Chun-Jen Shih, the former Director General of The Department of Health of The Executive Yuan, who took the initiative to authorize the groundwork for consolidating available published and unpublished information pertinent to the existence and conquest of this problem in Taiwan. Without Dr. Shih's enthusiasm, encouragement and support, publication would have been extremely difficult, if not impossible.

Special acknowledgments are hereby given to those who have collaborated with The Department of Health to undertake the essential drafting of this document. They are Drs. Kuang-Chi Liang, Wan-I Chen and Cheng-Hua Chuang, former Directors of TAMRI; Dr. Donald J. Pletsch, former WHO Malaria Team Leader; and Dr. Jih-Ching Lien, former TAMRI Entomologist. All of them were, in fact, malariologists and key staff members of TAMRI who contributed greatly to the success of the malaria program from start to finish. Without their persistence in searching for and assembling basic information over more than two decades, and their devotion during more than a year in drafting and re-drafting the manuscript, this saga concerning a significant health triumph might still be lying dormant.

Acknowledgments are hereby extended to the former TAMRI technical staff, now with the National Institute of Preventive Medicine, for their valuable assistance in preparing material for this publication. They are Messrs. Shen-Yu Lin, Shih-Chang Chow, Hsi-Ming Huang, Sung-Yu Li, Teng-Chao Chang and Ms. Li-Jung Liu. The valuable collaboration of Dr. Kun-Kang Chang, Researcher of the Council for Agricultural Planning and Development (former JCRR), in providing information on JCRR's assistance to malaria and general health services is very much appreciated.

Last but not least, the valuable assistance given by Mr. Shih-Yan Yang of our Department in arranging publication, and by Ms. Ma-Li Liang in preparing and editing the document as well as designing the format for presentation, is gratefully recognized.

LIST OF ABBREVIATIONS

ABER	-	Annual blood examination rate
ACD	-	Active case detection
AES	-	Average enlarged spleen
An.	-	*Anopheles*
B.	-	*Brugia*
BHC	-	*benzene hexachloride*
CUSA	-	Council for United States Aid
Cx.	-	*Culex*
CY	-	Calendar year (January - December)
DDT	-	*dichloro-diphenyl-trichloroethane*
DEP	-	Department of Environmental Protection
DOH	-	Department of Health (Executive Yuan)
FOA/USA	-	Foreign Operation Administration
FSMS	-	Full-Scale Stratified Malaria Surveillance
FY	-	Fiscal year (July - June)
ICA	-	International Cooperation Administration
JCRR	-	Joint Commission for Rural Reconstruction
JE	-	Japanese Encephalitis
L.	-	*Leptotrombidium*
MAAG	-	Military Assistance Advisory Group
MEP	-	Malaria Eradication Program
MESA	-	Malaria Eradication Special Account
MMSS	-	Military Malaria Surveillance Section
MSA	-	Mutual Security Agency
NAMRU-2	-	U.S. Navy Medical Research Unit #2
NDMC	-	National Defense Medical College
NHA	-	National Health Administration
NIH	-	National Institute of Health
NIPM	-	National Institute of Preventive Medicine
NT$	-	New Taiwan dollar
P.	-	*Plasmodium*
PAHO	-	Pan American Health Organization
PCD	-	Passive case detection
PHA	-	Provincial Health Administration

POC	-	Post-operational children
RMVG	-	Rural malaria vigilance group
SGO	-	Surgeon General's Office
TACW	-	Taiwan Agricultural Chemical Works
TAMRI	-	Taiwan Provincial Malaria Research Institute
TIID	-	Provincial Institute of Infectious Diseases
TMVU	-	Township malaria vigilance units
ULV	-	Ultra low volume
UMVU	-	Urban malaria vigilance units
UNRRA	-	United Nations Relief and Reconstruction Administration
USAID	-	United States Agency for International Development
W.	-	*Wuchereria*
wdp	-	water-dispersible powder
WHO	-	World Health Organization

INTRODUCTION

After World War II, many countries in the Mediterranean and American regions applied DDT residual house spraying in malaria control with remarkable results, which had never been experienced before. Following the excellent performances, the *Third Report* of the World Health Organization (WHO) Expert Committee on Malaria (1949) stressed that ". . . by virtue of insecticides developed since 1940, it is now possible to obtain a degree of malaria control, amounting in some cases to actual eradication, formerly unattainable." Subsequently, the XIV Pan American Sanitary Conference (1954) and the Eighth World Health Assembly (1955) resolved to undertake a global campaign against malaria, with the ultimate goal of eradication. Practically all countries where malaria was a problem, with the exception of those in Africa south of the Sahara Desert, initiated their malaria eradication programs along the lines of the concept and technical criteria developed by the Expert Committee in its sixth to ninth reports (published 1957 - 1962). Generally speaking, in their initial stages these programs were carried out by specialized malaria eradication services -- ad hoc organizations distinct from the general health systems.

Although some progress has been made during the last three decades, only a few countries have achieved malaria eradication. As of today, the global malaria problem is still far from being solved. According to the WHO *World Health* magazine, December 1989, the total number of cases reported annually is estimated at 103 million, and outbreaks of malaria have been increasing over the past two years in parts of Asia, Latin America, and Africa south of the Sahara.

In light of the global evolution of the malaria control or eradication programs, Taiwan has been fortunate to have eradicated malaria in the 1950s through early 1960s, and to have maintained the malaria-free status since 1965, following official certification and registration by WHO on its list of countries where malaria eradication has been achieved (Wernsdorfer, McGregor, 1988). For the residents of Taiwan, it has been a noteworthy achievement in public health. Taiwan has eradicated one of the most devastating diseases, having saved thousands of lives, avoided economic losses of individuals and their communities, and eliminated the risk of many hundreds of thousands of people suffering each year from this disease. The laborious task of the last four decades, from preparatory, attack, and consolidation through maintenance phases of the program, resulted in a model of malaria eradication, as stated by Brown, Haworth and Zahar (1976):

> "An outstanding eradication program, however, is that on the island of Taiwan, where spraying had commenced in 1954 [1953, to be exact] . . . By 1960 there were only 44 cases of malaria in the island's 10 million population . . . Taiwan was registered as malaria-free in 1965."

There are many elements which may have contributed to the success of the malaria eradication program in Taiwan. Among them the most outstanding features can be described as follows:

* Malaria was such a serious public health problem that the Japanese Government, during its presence in Taiwan (1895 - 1945), made great efforts in carrying out malaria research and control activities. The basic epidemiological and entomological knowledge acquired, and the establishment of the malaria stations over the entire hyperendemic region, were valuable assets for planning subsequent antimalaria activities.

* In 1946, after World War II, the Rockefeller Foundation, in collaboration with the Government, established a Malaria Research Center in Chaochou, southern Taiwan. This Center was later incorporated with the Provincial Health Administration (PHA) to become the Taiwan Provincial Malaria Research Institute (TAMRI). The Rockefeller Foundation provided valuable technical and financial assistance through the end of 1949, introducing new technology, training key malaria personnel for TAMRI, and testing diverse malaria control methods. It would not be an overstatement to say that the Rockefeller Foundation sowed the seeds for the subsequent malaria eradication program.

* An island-wide, four-year malaria control program planned by TAMRI in 1951 received the technical cooperation of WHO and the financial assistance of the Joint Commission for Rural Reconstruction (JCRR), the Mutual Security Agency (US/MSA) and the Council for United States Aid (CUSA). The assistance provided by these external agencies was very essential at that time for acquiring the insecticides and equipment critically needed to undertake an island-wide program.

* Malaria endemicity and the major transmission season in each epidemiological area had been studied and the malarious area stratified before the initiation of the malaria control program. DDT spraying was applied only once a year in a short period of two months just before the major transmission season. The spraying coverage was gradually increased from the pilot project area (156,000

inhabitants) in 1952 to the hyperendemic area (1.5 million inhabitants) in 1953 and finally to include meso- and a part of hypoendemic areas in 1954 and 1955 (5.5 million inhabitants). In view of the good results obtained from the control program, the spraying operations were expanded in 1956 to cover the entire malarious area (6.8 million inhabitants), toward the objective of malaria eradication. The year 1957 marked the last year of the regular spraying program, covering the same area as in 1953, *i.e.*, the hyperendemic area. The strategy adopted to regulate spraying coverage in accordance with the stratified areas and transmission season proved to be very effective at a minimum cost. The same stratification strategy, based on degree of transmission potentiality, was followed in the surveillance program initiated in 1954.

* TAMRI, with 11 professionals and 52 technical and administrative staff, served as the Headquarters in the malaria program during the attack and consolidation periods. It was responsible for planning work; training local health personnel at county and township levels; providing technical direction to local health services; and coordinating administrative activities among government agencies at all levels, international and bilateral organizations, the Chinese Armed Forces and the communities concerned. As a research institution, TAMRI was directly involved in field research activities and in the evaluation of the malaria control program. In addition, it encouraged local industries in the production of the needed insecticide and field equipment. However, as far as field operations were concerned, they were decentralized at the county and township levels. From the beginning, the malaria program has been an integral part of the general health activities; therefore, field operations were executed by the same health services in all phases of the program, *i.e.*, attack and consolidation and maintenance. This system of centralized planning and decentralized execution of the program was considered one of the crucial factors in achieving the most efficient and the least expensive field operations possible in Taiwan.

* The communities concerned were motivated by the local health personnel to take part in every phase of the program, providing needed facilities and sharing local costs of operation. The participation of the communities and the cooperation of the armed forces were also decisive factors leading to the success of malaria eradication in Taiwan.

* The last, but not least, important feature of the malaria program was the fact that the field supervisors at all levels, *i.e.*, provincial (TAMRI), county and township, worked closely in harmony and with dedication to their respective areas of responsibility. The untiring endeavors of these field supervisors to fulfill their

assigned duties were truly admirable. Today, nearly 40 years later, the camaraderie and friendship forged among the supervisors during that period remain surprisingly strong, as evidenced by the frequent social reunions held in their respective geographical regions.

The objective of this document is to compile all published and unpublished information on malaria in Taiwan, from the time the disease was first recorded, through the period of the Japanese efforts to control this disease, up to the achievement of malaria eradication.

It is hoped that this document will be a valuable record in the history of public health in Taiwan, and that it would also be of interest to other countries in the world where their malaria problems still long for a practical solution.

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