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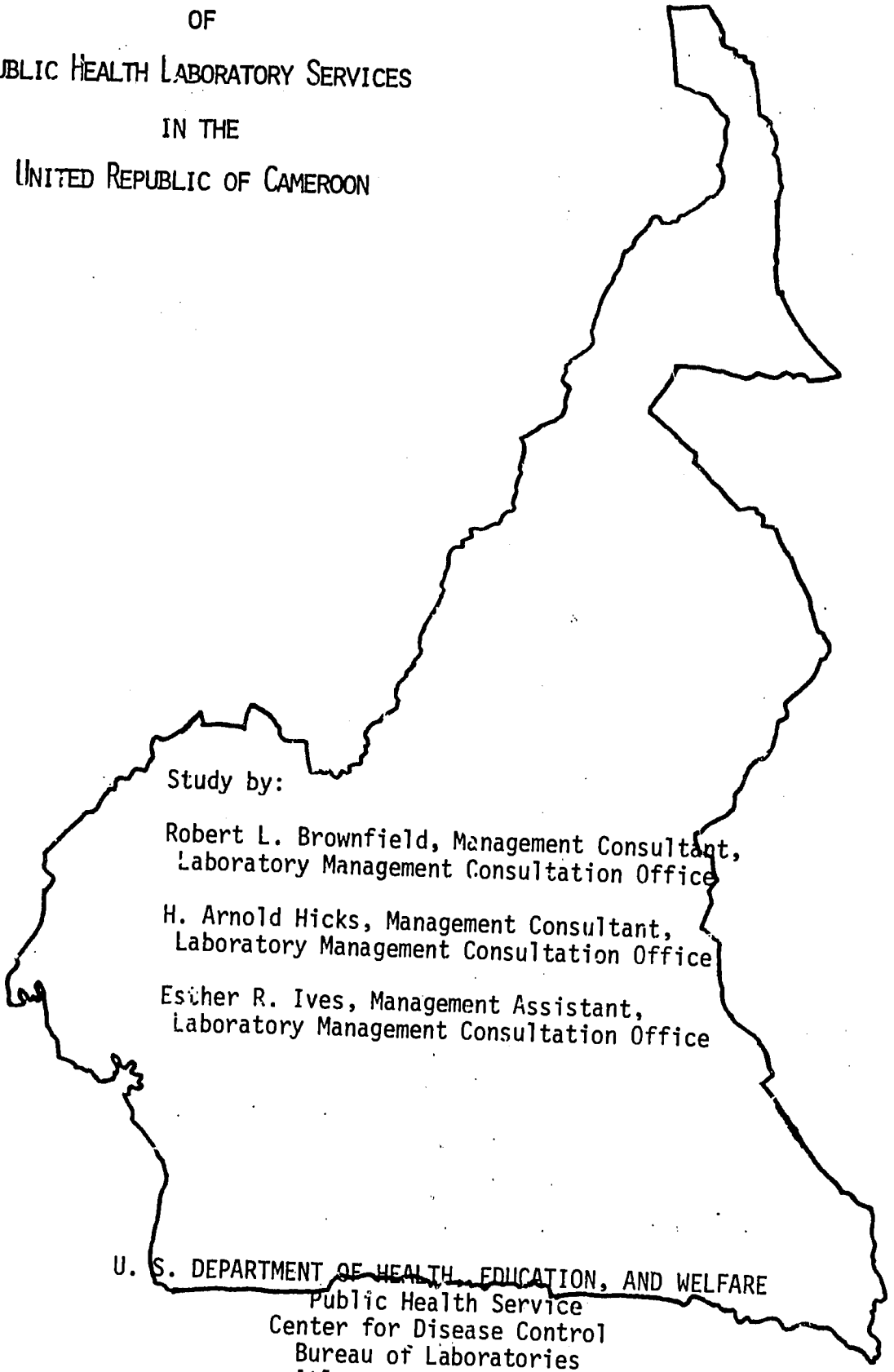
ORGANIZATION AND DELIVERY OF PUBLIC HEALTH LABORATORY SERVICES IN THE UNITED REPUBLIC OF CAMEROON



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I. INTRODUCTION

A. Purpose and Scope of Study

This report presents findings and recommendations resulting from a study to determine the feasibility of a Cameroonian proposal for the development of a National Public Health Laboratory System. The request for the study was made to the United States Government's Agency for International Development (AID) by the Cameroonian Ministry of Health. The AID and the Center for Disease Control (CDC) then made a contractual agreement by which the CDC furnished a team of three consultants to conduct the study.

The onsite portion of the study was made during the period October 20 to November 9, 1976 by the consultants from the CDC's Laboratory Management Consultation Office. We received substantial assistance from officials of the Cameroonian Ministry of Health, personnel of AID, and a CDC epidemiologist stationed in the United Republic of Cameroon. We have not attempted to name the many individuals who provided much needed assistance for fear of omitting the names of persons who were major contributors of information and ideas. Since the two senior members of the CDC team do not speak or understand French, most interviews were conducted through an interpreter, which greatly prolonged the interview sessions. We hereby express our appreciation to the many individuals who patiently and graciously supplied the information requested.

B. Study Methodology

The CDC team of consultants collected and studied the limited amount of data that was available in advance of the team's arrival in the United Republic of Cameroon. However, most of the findings and recommendations presented in this report are based on information and observations obtained through interviews with officials of the Ministry of Health and on visits to laboratories providing services at various levels in the Nation's capitol, Yaoundé, and other cities and villages. We visited what we believe to be representative examples of laboratories located at all levels in the health care system. The consultants relied heavily on information found in reports of two previous studies of the Nation's medical laboratory system. One of these studies was made in March and April 1973 by Dr. J. A. Le Viguelloux, World Health Organization (WHO) consultant. The second was made in February and March 1974 by Dr. Simon Atangana, Director of Preventive Medicine in the Cameroonian Ministry of Health, and Dr. Lazare Kaptué, Professor, University Center for Health Sciences (CUSS). In our opinion, these are excellent studies. Both studies appraised the status of the national medical laboratory system at the time they were made and identified the major inadequacies of the system. The second study contains a number of recommendations for correcting these inadequacies and outlines a plan for a National Public Health Laboratory Service. We did not obtain the full benefits from the findings and recommendations presented in these reports while we were in the United Republic of Cameroon, because translation to English was not completed until several weeks after our return to the United

States. We did obtain enough information from the reports to realize that they had identified many of the same problems we were finding on our visits to laboratories.

Therefore, the recommendations in this report are based on the work done in the two previous studies and on additional information supplied by the officials of the Ministry of Health who were interviewed or who participated in this study. We recognize that this report may contain some unintentional inaccuracies and omissions in the data and other information presented. However, we expect and intend that those who use this report will correct any inaccuracies found and supplement the information as opportunities to do so arise. We have tried to present findings and recommendations in an objective manner. In doing this, we have not intended to be critical of any aspects of the existing public health laboratory system. Rather, we have tried to take a factual approach and present realistically those actions that should lead to future improvement and to describe how these actions may be taken.

Our recommendations for improving the national laboratory system in the most feasible and logical manner are presented in Parts V and VI of this report. Obviously, most of these findings confirm findings presented in reports of the two studies mentioned above. Generally, the recommendations reinforce and supplement recommendations presented in the second report with regard to a proposed National Public Health Laboratory Service, although we recommend a somewhat different approach. Reasons for the differences in approach are presented in Part VI, Proposed National Public Health Laboratory Service.

As an aid to readers of this report, and in particular those who will be immediately responsible for giving direction and control to efforts to improve the national medical laboratory system, a substantial amount of pertinent background information is provided in Sections II, III, and IV. Section II deals briefly with the geography and population of the United Republic of Cameroon as a means of focusing attention on certain constraints on the delivery of medical care services to large segments of the population.

The disease problems of the nation are identified and discussed in Section III. In Section IV, the national health care system is described, findings of two previous studies of the various levels of medical laboratory services are summarized, and changes to the laboratory system recommended as a result of these studies are presented. The present medical laboratory system is then described.

A summary of laboratory problems and proposed solutions are presented in Section V. Finally, recommendations for developing the proposed national medical laboratory system are presented in Section VI. Additional material illustrating certain recommendations is in Appendices A, B, and C.

II. BACKGROUND

A. Geography

The United Republic of Cameroon, which became an independent nation on January 1, 1960, is in the western part of Africa on the Gulf of Guinea about midway between Senegal and the Republic of South Africa. It has an area of 183,381 square miles with, an estimated population of between 6 and 7 million, and an annual growth rate of 2%.

Cameroon is roughly triangular in shape (see Figure 1). It has a wide base in the south where it borders the Rio Muni province of Equatorial Guinea, Gabon, and Congo Brazzaville, and reaches an apex at Lake Chad in the north. The Gulf of Guinea and Nigeria to the west and the Central African Republic and Chad to the east complete the two sides.

The nation is divided into four distinct topographical regions:

South: 125 miles of low coastal plains with equatorial rain forests extending up to the Sanaga River.

Center: the Adamoua plateau (over 4,000 feet), a transitional region bordered by the Benoué Valley on the north.

West: a mountainous forest area with some 8,000 foot peaks, and including Mt. Cameroon at 13,000 feet.

North: Savannahs sloping down to the marshland of Lake Chad.

The climate of Cameroon is also varied, with rainy seasons and dry seasons. The coast is characterized by high humidity and temperature, with little variation; this area contains some of the wettest spots on earth. In Yaoundé and to the north, temperatures become more varied and humidity declines; in the extreme north, the land is arid and the temperature hot.

B. Population

About four-fifths of the Cameroonians live in the French-speaking eastern part of the country; West Cameroon is English-speaking. Cameroon has a complex ethnic makeup of about 200 tribes speaking 24 major African languages, but French and English are the official languages.

Cameroon is chiefly an agricultural society; most of the people live in small villages, and 82% of the labor force is engaged in agriculture. Only about 20% of the people live in towns with populations above 1,000. Forty-seven percent of the population is under the age of 15. The birth rate for 1965-70, the latest figures available, was estimated at 43/1,000 and the mortality rate at 23/1,000. The life expectancy at birth was 41 years. (Life expectancy is now estimated at 43 years.) Cameroon's population density averages about 35 per square mile, but may vary widely by area.

The largest city and principal seaport is Douala, population 435,000, located on an estuary formed by the ocean and the Wouri River. The capital, located about 200 miles east of Douala, is Yaoundé, with a population of 274,000. These cities are 4° north of the equator. On the coast in the

former British section of Cameroon is the tricity area of Victoria, Buéa, and Tiko, with a combined population of about 50,000. Victoria and Tiko are seaports; Buéa is the former colonial capital of West Cameroon. The three most densely populated areas of Cameroon are: (1) the western highlands of East Cameroon in the areas surrounding Yaoundé and up to Bafia; (2) the grasslands of West Cameroon around Bafoussam; and (3) the towns of Garoua and Maroua in the north and surrounding areas. Garoua, located in the most isolated area of Cameroon, on the Benoué River, is an important river port.

C. Political Subdivisions

Cameroon is divided into seven provinces headed by governors. These provinces, and some of their cities are:

(1) Center-South (Yaoundé, Bafia, Kribi, Ebolowa)

(2) East (Bertoua, Batouri)

(3) Littoral (Douala, Edéa, Nkongsamba)

(4) North (Garoua, Maroua, Ngaoundéré)

(5) North-West (Bamenda, Wum)

(6) West (Victoria, Buéa, Tiko, Kumba)

(7) South-West (Bafoussam, Bafang, Fontem)

The provinces are subdivided into a total of 40 departments, which are further subdivided into arrondissements or districts. The cities and towns are subdivided into quartiers (quarters).

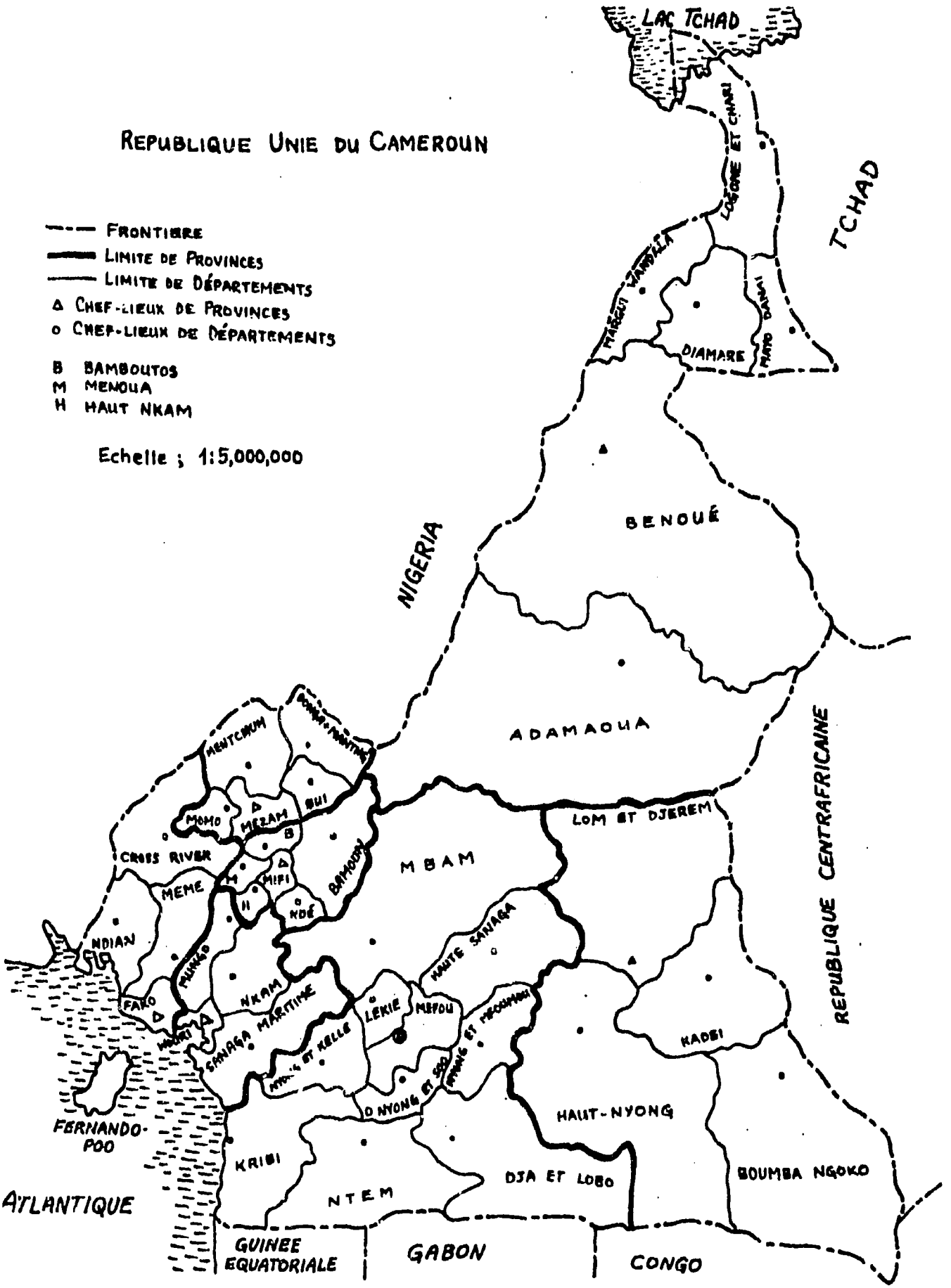

REPUBLIQUE UNIE DU CAMEROUN
FRONTIERE
LIMITE DE PROVINCES
LIMITE DE DÉPARTEMENTS
CHEF-LIEUX DE PROVINCES
CHEF-LIEUX DE DÉPARTEMENTS
B BAMBOUTOS
M MENOUA
H HAUT NKAM
Echelle ; 1:5,000,000
LAC TCHAD
TCHAD
LOGONE ET CHARI
MAYO DANAI
DIAMARE
BENOUÉ
NIGERIA
ADAMAOUA
REPUBLIQUE CENTRAFRICAINE
LOM ET DJEREM
MBAM
MENCHUM
MOMO
MEZAM
BUI
CROSS RIVER
MEME
MIFI
NDÉ
BAMOUN
NDIAN
FAKO
NKAM
SANAGA MARITIME
LEKIE
MEFOU
HAUTE SANAGA
KADEI
HAUT-NYONG
KRIBI
NTEM
DJA ET LOBO
BOUMBA NGOKO
FERNANDO-POO
ATLANTIQUE
GUINEE EQUATORIALE
GABON
CONGO

Figure 1

III. DISEASE PROBLEMS

A. Health Conditions in Cameroon

Cameroon has a wide range of diseases with health conditions similar to those of other central West African countries. Health problems include many transmissible diseases, parasitic diseases, vector-borne diseases, diseases due to unsanitary water supply, and nutritional diseases. Birth is very hazardous and the first year of life is extremely critical. Most deaths occur in early childhood. If a child reaches his fifth birthday, he has a good chance of living to be an adult.

The population in general suffers from a host of chronic diseases which are very important to the welfare and the economy of the nation. Officials of the Ministry of Health consider the following diseases to be the priorities among the transmissible diseases: malaria, filariasis, schistosomiasis, trypanosomiasis, measles, polio and other viral diseases, intestinal parasites, venereal diseases, tuberculosis, and leprosy. Priority non-transmissible diseases include: malnutrition and other problems in the infant population, diabetes, hypotension, and sickle cell anemia. Other common problems include tetanus, goiter and nutritional diseases, gastroenteritis and dysentery, respiratory infections, skin diseases, and trauma.

The maternal mortality rate varies according to the availability of health services. This is evident in the following figures:

Yaoundé	-	81.4 per 100,000 deliveries
Dschang	-	356.8 per 100,000 deliveries
Margui Wandala	-	382.4 per 100,000 deliveries

The mean stillbirth rate is 2,222.0 per 100,000 deliveries. Figures for 1974 revealed that of 255,950 births, 19% did not survive. There are no good figures on perinatal deaths because most babies who are born in hospitals leave the hospital 24 to 48 hours after birth, and there is little reporting of infant deaths. One analysis of birthweights of babies who died in the first week of life in the intensive care unit showed that 83% weighed below 2,500 grams. WHO studies have shown that birthweight conforms to the mother's nutritional state, particularly to the amount of protein ingested between the fourth and ninth months of pregnancy. Newborns in Cameroon, excluding multiple and premature births, were found to average 3,099 grams, which is 8.9% below WHO standards, implying a 20% deficit in the mother's protein comsumption.

Among children, the greatest mortality is from measles, dysenteries and gastroenteritis, bronchitis and pneumonias, malaria, anemia, malnutrition (kwashiorkor, marasmas), and tetanus. Other major diseases in the morbidity and mortality of children are intestinal worms, whooping cough, chickenpox, meningococcal meningitis, sickle cell disease, German measles, and polio. A study of infants' and children's deaths (ages 0-9) in the Pediatric Service of eight hospitals in 1973 revealed that 45% died from measles. At Central Hospital in Yaoundé, the figure was 74% (total of 131 deaths), and at Bertoua Hospital it was 80% (total of 161 deaths).

The latest Maternal and Child Health Annual Report printed in June 1975 points out that "the majority of deaths of young children could be avoided if pregnancies and deliveries were supervised better, if the vaccinal coverage were better, and if health and nutritional education were more developed."

Complete and reliable statistics on the nationwide incidence and prevalence of diseases and other health conditions in Cameroon do not exist. However, investigations, studies, and some research has been done on certain diseases to define foyers or determine incidence in a small area. These studies, for the most part, concern the "great endemics"--the "grands endémies"--which are the priorities with OCEAC (Organisation de Coordination pour la Lutte Contre les Endémies en Afrique Centrale). This organization holds an annual technical conference during which a great many presentations are made on the disease problems of the member-states and the results of surveys, investigations, and research are shared. The endemics of greatest concern are: trypanosomiasis, leprosy, and filariasis (especially onchocerciasis). Surveillance is maintained on the international quarantinable diseases: smallpox, yellow fever, cholera, and plague. Studies are also done on such transmissible diseases as tuberculosis, cerebrospinal meningitis, tetanus, poliomyelitis, and measles and on such problems as nutrition and vaccination campaigns. We studied some of this material in an effort to determine the disease problems of Cameroon, particularly as these problems relate to the requirements for laboratory services.

A discussion of the major diseases affecting the Cameroonians follows. Although statistics are fragmentary at best, they are

used, where available, to give some indication of the health problems in Cameroon.

B. Discussion of Disease Problems

Cholera

Douala has been a natural foyer of cholera since 1971. Outbreaks have also occurred at Kribi, Tiko, Cape Cameroon, Kumba and other places in the coastal area. The number of cases has varied from a high of 1,967 (17% fatality rate) in 1971 to a low of 3 (no deaths) in 1975. In the first few months of 1976, 53 cases with 13 deaths occurred. This disease is related to the water supply, but there are no facilities for dealing with it and no laboratory support services available. Specimens must be taken at the hospital in Douala and sent by plane to Yaoundé to be tested by OCEAC. The former Pasteur Institute had a cholera laboratory which examined and typed cholera specimens.

Cerebrospinal meningitis

This disease is particularly prevalent in the North Province where enormous epidemics of Type A Menigococcal meningitis occur in some years. Although vaccination has reduced the incidence, the death rate keeps going up. No reliable figures are available on the incidence, although thousands of cases are said to occur.

Diarrheas

This problem also affects the people in the North Province more than those in other areas, but is a cause for concern throughout the nation.

In 1974, 1,200 cases of bacillary dysentery were reported. In 1975, weekly notification by telegram to the Epidemiology Service showed an annual total of 36,450 cases.

Intestinal Parasites

This health condition exists at an extremely high level all over the country. Tens of thousands of subjects have been treated in the health centers and on survey tours by mobile teams. Parasitic diseases create a reduced capacity in adults to work and also affect school children.

A study made on the inhabitants of three villages in the Sanaga Valley showed the following prevalence of certain helminths:

Necator americanus (new world hookworm, which is also prevalent in Central Africa), 64%

Ascaris lumbricoides (round worm), 56%

Trichuris trichiura (whip worm), 79%.

A mission dispensary with good statistics, including graphs and charts, over a period of time found that helminths of the genus Ascaris and the genus Trichuris are the most prevalent among their patients. Ancylostoma (old world hookworm) is the most common cause of anemia.

Measles

This disease, a big problem in children, has a homogeneous distribution throughout the country. It is becoming an endemic disease with epidemics occurring during the dry season. Cases reported in 1972 numbered 22,202 (451 deaths) and increased to 34,750 (700 deaths) in 1974. In 1975, cases numbered 16,311 (495 deaths) through July. The

large increase in number of cases reported may be partially due to improved reporting. However, another aspect is the general failure of the mass vaccination campaigns due to inability to maintain the "cold chain" when transporting the vaccine. The damaged vaccine in most cases gives enough protection to prevent death but not enough to prevent the disease, hence, the progressive increase in incidence. In Cameroon, about 75% of the measles cases are in children under 24 months of age. One study showed that 40% of the cases were contracted at a Maternal and Child Health Center (PMI) or other health center.

German measles was thought to be unknown in Cameroon until 1973 when a small epidemic occurred in Bafoussam. The following year an outbreak occurred in Yaoundé. Although no case of congenital malformation was reported as a result of pregnant women's exposure to this disease, health officials believe the disease merits close surveillance.

Trypanosomiasis (Sleeping Sickness)

The overall incidence of sleeping sickness in Cameroon has varied from 9.7 per 100,000 in 1966, down to 2.3 per 100,000 in 1971, and then up to 6.3 (372 reported cases) in 1974, and 6.9 in 1975 (415 cases). However, most of these cases occurred in the ancient foyer of Fontem, but cases also occurred at Bafia, Douala, Campo, and Kribi. This mountainous area has a long rainy season which inhibits spraying, the climate is perfect for the disease, and control is very expensive. Much of the area is inaccessible, and supplies must be carried to the villages by bearers, which makes surveillance, case-finding, and treatment of patients by mobile teams extremely difficult. Diagnosis and treatment

must be done on the spot. To combat this disease, which affects the entire foyer population and reduces the ability to work, more rapid and reliable diagnostic methods for on-the-spot testing are needed, as well as an increased fight against the vectors, research on the possibility of animal reservoirs and on new methods of treatment, and resumption of case-finding which was stopped early in 1973. The number of cases keeps growing at Fontem because health officials have been unable to carry out a plan of attack because of the difficulty of access to the region. On the other hand, the situation at Bafia is stable, although the number of cases diagnosed increased from 25 in 1974 to 103 in 1975. Diagnosis has improved there due to development of the laboratory network, training of the microscopists in the health center, and a well-trained mobile team with better means of diagnosis.

Filariasis

The most prevalent of the filarial diseases is onchocerciasis or river blindness, found throughout the country, but with a varying prevalence. It has led to depopulation of fertile areas where people could be working. The Helminth Research Center at Kumba has done considerable research on onchocerciasis. A large foyer exists in West Province around Bafoussam. In December 1974, a joint investigation of 12 villages in 4 departments (Mifi, Bamboutos, Bamoun, Ndé) in the basin of the Noun and Ndé rivers was carried out by the Under Direction of Preventive Medicine and Public Hygiene, the Pasteur Institute, ORSTOM (Entomology Research) and OCEAC. The purpose was to determine what filarial diseases were present in this area and their clinical importance. Clinical and parasitological examinations were made of the inhabitants,

and insects were captured and studied for microfilariae. A total of 2,395 persons participated. Onchocera volvulus was the only filaria that was numerous in all the villages, which were divided into three groups. In the four villages of group 1, 50.8% of the adults had onchocerciasis; in the three villages of group 2, 81.6% had the disease; and in the five villages of group 3, 93.6% of the adults had onchocerciasis. (The overall rate for children was 33.8%.) In one village Loa loa was observed in 26.7% of the adults and Dipetalonema perstans in 61.3%. Thirty-two cases of elephantiasis, mostly in the lower limbs were also found. In most of the villages the parasitological incidence was much higher than the clinical incidence. Blindness was found only in the oldest adults from groups 2 and 3, but some damage to vision had occurred in all. Research with the insects captured identified the vectors of human onchocerciasis (Simulium damnosum), viral diseases, especially yellow fever (Aedes, particularly A. africanus), animal filariasis (Mansonia africana), Bancroft filariasis and malaria (Anopheles gambiae, A. funestus), and trypanosomiasis (Glossina fuscipes fuscipes).

Schistosomiasis (Bilharziasis)

There is a foyer of Schistosoma mansoni around Melen, and the disease is also endemic in North Cameroon in the Touboro region (department of Benoué). Schistosoma apparently exists to some extent throughout the country.

Tuberculosis

An Anti-tuberculosis Section was established in the Epidemiology Service to coordinate tuberculosis activities at all levels, and to

collect data on the disease. There are anti-tuberculosis dispensaries for treatment. Examination of sputum is supposed to be carried out in all health formations which have a microscope. Positives are to be sent to the departmental laboratories for confirmation. Treatment is to be on an ambulatory basis as much as possible. Complete records on each patient are to be kept and periodic reports made to the Anti-tuberculosis Section. The central office will assure that the centers receive the medicines and supplies they need to combat tuberculosis. This program has not been fully implemented, and only fragmentary statistics have been received from the peripheral areas. It appears that to a large extent the capability to detect tuberculosis does not exist in the peripheral areas. Mobile teams have carried out mass vaccination campaigns with BCG, particularly in the 0- to 20-year-old group. The disease predominates in adults aged 20-50 with the average age, according to a study of cases in Yaoundé, being 38.8 years. This study also showed 68% of the patients to be males and 32% females. Tuberculosis is known to be an important problem, but no reliable statistics are available on incidence or on locations of foyers, although respiratory and pulmonary diseases are common in the mountainous areas.

Venereal Diseases

Gonorrhea is a serious health problem that is just beginning to be realized. Anti-venereal disease dispensaries provide treatment for gonorrhea and syphilis.

Infectious Hepatitis

The incidence is dangerously high in certain zones of the country, particularly around Ebolowa.

Malaria

This disease is prevalent in the Benoué Valley, the basin of Lake Chad, the coastal region, and the forests of southern Cameroon. It is insignificant in the mountainous areas. Malaria is one of the important causes of child mortality and of miscarriages. Statistics show that a child has a 95% chance of getting malaria by the time he is 1 year old.

Leprosy

This affliction is a major cause of handicap in adults and is a major endemic problem of Cameroon. An Anti-leprosy Section in the Epidemiology Service, created in October 1974, is responsible for coordinating the leprosy activities throughout the country and for proposing an epidemiological strategy. The prevalence varies from 1.14% in East Province to 0.38% in North-West Province, with the greatest prevalence occurring in the provinces with the lowest population density: East, North, and Center-South. These provinces accounted for 66% of the 41,469 lepers on the rolls on January 1, 1975. This total has gone down each year since 1968, when the total was 57,128 cases. The number of new cases decreased from 2,766 in 1971 to 2,338 in 1974, so the endemic situation seems to be lessening. Cameroon has 15 leprosy hospitals, with 524 beds, which care for over 2,000 lepers. There are also 24 leper villages where nearly 1,000 lepers live. The remainder are handled by the various health formations, both public and private, throughout the country. Patients requiring surgery are handled at the Jamot Center in Yaoundé. Much of the leprosy work is funded by organizations from abroad.

Whooping Cough

This disease progressively reappears and is a problem of concern in infants and children. In 1975, 2,770 cases, with 62 deaths, were reported. Vaccine against whooping cough has been added to the infant vaccination campaign.

Tetanus

Tetanus plays an important part in infant deaths, and infants and children are being vaccinated against it now.

Poliomyelitis

Polio has been a problem around Yaoundé and the rest of Center-South Province and in North Province, particularly Maroua. In 1972, there was a nationwide epidemic. Canada offered to supply Sabin vaccine to Cameroon for 3 to 5 years. The Maternal and Child Health Service, in collaboration with the Epidemiology Service, launched an immunization program late in 1973.

Influenza

In 1974, 6,738 cases were reported to health authorities.

Typhoid Fever

In 1974, 42 cases were reported. No other information is available on this disease.

Leishmaniasis and Anthrax

These two diseases have appeared and have been contained in the extreme North, near the Chad border (department of Margui Wandala). The

prevalence is not known, but in 1974, 71 cases of leishmaniasis and 9 cases of anthrax were reported.

Rabies

Rabies is very prevalent in Cameroon, but no statistical data are available.

Yellow Fever

This is not a problem now, but since the disease is in monkeys, there is the possibility of future problems, and surveillance continues.

Smallpox

This is no longer a problem because the last case was in 1969. However, surveillance continues, and suspected cases are studied.

Malnutrition

The problem of malnutrition is greatest among children, although in some parts of the country protein intake is inadequate for all ages. This is partly an educational problem, and partly due to the transportation system which does not allow easy transfer of foodstuffs from one area to another. WHO has a regional nutrition expert in Yaoundé for Cameroon, Chad, Gabon, and the Central African Republic. The Ministry of Health has a Nutrition Service which maintains nutrition data and coordinates nutrition education of health professionals and the public.

Anemia

Iron deficiency especially is a big problem, as well as sickle cell and other anemias.

Goiter

This is an endemic problem in certain areas, particularly in East Cameroon. In one area, 95% of the people have goiters. Lack of iodine is the principal cause.

Cancers

Skin cancer is the most prevalent form of cancer in the country.

Vaccination Programs

Vaccination coverage did not reach the goal set for it in 1975 because of lack of money, deterioration of logistic means and late arrival of vaccination supplies at the national level. The latest figures for January 1 through October 31, 1975, on vaccinations are:

Smallpox	726,152
Yellow Fever	199,772
Measles	180,073
BCG (TB)	211,593
Polio	30,357
Cholera	55,844

C. Laboratory Workload Statistics

All laboratories in the national network of public health laboratories are supposed to send in monthly workload reports to the Epidemiology Service. In actual practice, they do not, and, consequently, there is no way to even estimate how many laboratory examinations are performed in Cameroon in a year. However, those reports that are sent in are compiled in an annual report. Table 1 reflects the information that is available for 1975.

Although fragmentary, the information in Table 1 does give an indication of workload distribution and of disease incidence. It can be noted that malaria, filariasis, and stool specimens represent 82% of the examinations performed and 95% of the positives found. Reviewing the "Percent Slides Positive" for each of these shows that only 12% of the filariasis slides are positive, so perhaps more of these examinations are done on a national basis than are warranted. But, the 35% positives for malaria and 78% for the stool parasites indicate that these are major problems that warrant a large share of the workload throughout the country. Trypanosomiasis specimens made up about 7% of the workload, but less than 1% of the positives. Such a disease should probably be studied intensely only in the known foyers. Tuberculosis specimens showed a 41% positive rate, but relatively few such specimens are examined. This indicates that it would probably be worthwhile to increase the tuberculosis workload. Sickle cell is in the same category as tuberculosis; 48% of the slides are positive, but few are examined, so an increased workload is justified. We realize that these deductions are only valid if the basic statistics are reliable; however, they give an indication of how good workload statistics could be used in the future to define disease problems, locate foyers, and use scarce resources to the best advantage.

TABLE 1

Laboratory Workload Reported - 1975

Type of Examination	Total Slides Examined	Total Positive Slides	% Slides Positive	% of Total Slides Examined (110,880)	% of Total Positive Slides (37,994)
Malaria	33,227	11,763	35.4	29.96	30.96
Filariasis	31,804	3,911	12.3	28.68	10.29
Trypanosomiasis	7,616	21	0.3	6.87	0.06
Sickle Cell	129	48	37.2	0.12	0.13
Gonococcus	1,550	188	12.1	1.40	0.49
Tuberculosis	3,870	1,603	41.4	3.49	4.22
Onchocerciasis	98	4	4.1	0.09	0.01
Leprosy	87	14	16.1	0.08	0.04
Meningitis	27	3	11.1	0.02	0.01
Urine - Sugar	6,257	189	3.0	5.64	0.50
Schistosomiasis	161	11	6.8	0.15	0.03
Stools	26,054	20,239	77.7	23.50	53.26
Totals	110,880	37,994	34.3		

IV. PRESENT LABORATORY SYSTEM

A. Overview of the Present Laboratory System

There is no single national public health laboratory service in Cameroon, nor is there an organization with a person or persons specifically responsible or concerned with public health laboratory services. There is what has been described as a "network" of laboratories. Actually, a more accurate description would be "networks" since many of the health care delivery programs in the Ministry, such as the Maternal and Child Health Service, operate their own laboratories. As a result, there are many laboratories in Cameroon. These laboratories operate at all levels with little or no standardization of materials, equipment, methodology, or training of laboratory personnel. However, the Ministry is making a considerable effort to develop standard training programs for personnel.

The many disease and health problems (Section III) in Cameroon create a tremendous clinical laboratory support demand. This fact and the fact that no single public health laboratory presently exists to support the preventive and epidemiological needs, causes each health care delivery program to obtain laboratory support wherever it can be found. Although, from a clinical standpoint this may be commendable, it does, in the study team's opinion, tend to fragment laboratory services and require duplication of equipment and under utilization of the already scarce

commodities such as trained personnel and supplies. However, no other workable system seems to be available.

Each laboratory orders materials through the Director of Pharmacy and Technical Equipment in the Ministry of Health. The study team found that as a practical matter medicines and hospital supplies were ordered first and, if any funds were left, laboratory supplies were then ordered. The supply system is described in Appendix A of this report.

Laboratory facilities vary considerably throughout Cameroon. The study team found one hospital laboratory which had no running water and disposed of infectious laboratory materials by throwing them out the back window. The glassware washing system consisted of a series of buckets and pans. Needless to say, hospital physicians did not have much faith in the reliability of test results.

Although the above discussion touches on some of the broad general problems of laboratory services, it by no means covers all of them. Other problems are presented in Section V of this report.

In the following subsections B through D, the study team describes the highlights of the WHO study conducted in 1973; the study conducted by Drs. Atangana and Kaptué in 1974 and Dr. Atangana's Memorandum No. 43 containing recommendations for organization of a national laboratory service; Governmental Decree No. 75/212 in 1975 reorganizing the Ministry of Health and Public Assistance; and the proposed organization and functions of a National Public Health Laboratory Service. Figure 2 is a graphic representation of Dr. Atangana's recommendations for the organization of a National Public Health Laboratory Service. A summary of his recommendations follows Figure 2.

Some of the recommendations of the above mentioned studies are no longer appropriate because of changes that have occurred. However, as previously stated in Section I, this report is largely based on advancements to and in confirmation of findings and recommendations contained in the above mentioned studies.

B. Organization of Laboratory Services in the United Republic of Cameroon by Dr. J. A. Le Viguelloux, WHO Consultant, Issued February 18, 1974

The WHO Report recommended that laboratory activities be divided between clinical and public health. Clinical activities were those that began at the local level consisting of simple direct examinations performed in the Elementary Health Centers, the Developed Health Centers, and the Departmental Centers for Preventive Medicine, as well as dispensaries, such as Tuberculosis Dispensaries, Venereal Disease Dispensaries, and Maternal and Child Health Centers. Results of such tests would be verified in the departmental hospitals. Laboratory examinations which could be performed only by a biologist would be sent to the provincial hospital, Central Hospital at Yaoundé, or the Interdepartmental Laboratory at Douala (now combined with the Chemistry Laboratory at Laquintinie Hospital).

Very specialized examinations would be sent from the provincial level to the Pasteur Institute. The report recommended that the Institute not receive any clinical specimens directly from the health centers. Public health activities were described as preventive medicine laboratory activities which concerned malaria, tuberculosis, gonorrhea,

and other transmissible diseases. Specimens would be acquired at the Elementary Health Centers and the Developed Health Centers. From the Developed Health Centers, which would serve as the centralizing and organizing bodies, specimens would be sent to a higher level, the Departmental Centers for Preventive Medicine, where additional laboratory capability might be found. At this point specimens might be referred to the epidemiology service or the Pasteur Institute.

An additional public health activity recommended was sanitation, including water analysis and food and cholera research. Matters involving legal medicine would go to the Pasteur Institute, which would also carry out surveillance investigations concerning smallpox and yellow fever. It was also recommended that water analysis be performed in the provincial hospitals, taking into account transportation delays.

The WHO consultant made numerous other recommendations, some of which are summarized below:

(1) Development of uniform laboratory techniques;

(2) Creation of a mobile repair team concerned with laboratory equipment repairs;

(3) Training of laboratory personnel on the spot to become microscopists;

(4) Retraining of personnel once each year;

(5) Surveying laboratories to determine the condition of the buildings, equipment, and personnel skills, in order to correct errors and determine which personnel need retraining;

(6) Adding sickle cell testing capability to the Malaria Eradication Service training of microscopists, who are now being trained to perform tests for blood parasites, tuberculosis, intestinal parasites, and gonococcus.

Another major recommendation of the report was the creation of a laboratory service in the Ministry of Public Health which would carry out planning, coordinate activities, and provide technical supervision of laboratory activities. The laboratory itself would be placed under the Direction of Preventive Medicine or the Direction of Pharmacy and Technical Equipment. An alternative to this suggestion was to attach the laboratory to the Malaria Eradication Service (now the Epidemiology and Malaria Service).

Another recommendation was to create a Scientific Advisory Committee to perform the following:

(1) Define needs as a function of the existing situation;

(2) Make recommendations as to the means based on the needs;

(3) Coordinate the realization of these means through the Direction of Public Health;

(4) Coordinate epidemiological problems with those of laboratories.

Another recommendation was that blood banks be organized at the national level. The blood bank functions should be adequately described by proposed legislation and blood banks should be created in provincial hospitals and in the Interdepartmental Laboratory at Douala. Such blood banks would be a standardized type. In addition, it was recommended that the principle of free donors should be maintained everywhere.

In the area of repairing complicated laboratory equipment, it was recommended that the contracts with commercial establishments guarantee repair service after purchase and provide that a repair specialist and supplies be maintained in Cameroon.

Simple repairs to laboratory equipment could be made by mobile repair teams. In addition, such teams should be charged with training repair personnel.

A further recommendation was to the effect that formations which had a biologist on their staff should conduct continuous retraining of the laboratory's personnel. Technicians in rural or isolated areas could be retrained by a person going directly to such laboratories and conducting training onsite.

C. Laboratory Studies by the Ministry of Health and Public Assistance

1. Report of Laboratory Survey by Drs. Atangana and Kaptué in 1974

At the request of the Minister of Health and Public Assistance, Drs. Simon Atangana and Lazare Kaptué conducted a study to determine the conditions of laboratories in Cameroon and to collect the necessary data for the preparation of a text organizing a laboratory unit in the Ministry of Health. All types of laboratories were visited during the study period (February 10 through March 13, 1974).

The principle conclusions from the study were:

a. Total absence of coordination in the organization and activities among the laboratories throughout the country.

b. Insufficient number of personnel in the laboratories visited.

c. Insufficient amount of equipment (much of it obsolete or malfunctioning).

d. No standardization in the techniques used.

e. No maintenance and repair personnel. Often, new machines were inoperable because some small repairs or adjustments were needed.

f. Almost total absence of Cameroonians in research laboratories.

g. Inadequacy in the quality and quantity of laboratory personnel as well as an uneasiness on the part of technical personnel concerning the future of the profession of laboratory technology. They felt chances for promotion were almost nonexistent.

h. A legislative problem concerning conditions for practicing laboratory medicine. One has the impression that conditions, such as those for opening a laboratory, are not well defined. In general, all doctors who set up practice open a laboratory without themselves being physician-biologists. In addition, when they do not hire trained personnel, it causes doubt as to the results of examinations performed in their laboratories.

i. A legislative problem about the regulation of charges for medical transactions. Each laboratory sets its own prices for laboratory services. Doctors Atangana and Kaptué expressed the opinion that the Ministry of Health should set the prices for laboratory services and see to it that those rates are respected by all laboratories.

The recommendations derived from the conclusions enumerated above are as follows:

a. A body is needed to supervise and coordinate laboratories at the central and peripheral levels.

b. Emphasis should be put on personnel training by granting scholarships to doctors, pharmacists, and pure scientists for specialization in biology. It will be necessary to increase the number of technicians trained by Pasteur Institute and CUSS. If those two bodies continue to train technicians at the present pace, Cameroon will not catch up with its needs even in 50 years.

c. Each provincial and departmental laboratory should have at least the following minimum equipment:

Centrifuges (floor model)

Water Bath

Sterilizers

Microscopes

Colorimeter (illuminated)

Spectrophotometer (if possible)

Kline Shaker

Autoclave

Demineralyzer

Precision Balance

Electrophoresis capability for provincial laboratories

Refrigerators

Moreover, all the provincial laboratories should be supplied with culture media. With this minimum material and reagents, each laboratory should be able to perform all current clinical biological examinations.

d. When a National Institute for Medical Research is created, the hiring of Cameroonians in the research laboratories should be promoted.

e. It would be desirable for a group of laboratory specialists to be brought together to perfect some simple, reliable techniques that could be used in all of the laboratories. That would allow quality control to be carried out often.

f. The technical personnel who believe that the profession of laboratory technician has no future should be reassured. The report further states that the laboratory technicians believe that there is no promotion potential and no internal competition for advancement as in other sectors. In addition, the public functions refuse to accept them as a profession, and as a consequence of that attitude, laboratory technicians find employment elsewhere and abandon their profession. Doctors Atangana and Kaptué were of the opinion that the Minister of Health should prepare a clear text regulating the technician profession and granting laboratory technicians all the advantages accorded to other employees.

g. There is an urgent necessity to draw up legislation on the opening and functioning of laboratories for medical analysis. Rates for medical services should not be left to the judgement

of the various laboratories, but should be established by the Minister.

Moreover, the patient who pays for laboratory analysis has a right to expect correct results; that is to say, the state should see to it that all who aspire to run a laboratory have the competence, the personnel, and the necessary equipment to produce correct results.

The state should exercise control over the quality of all laboratories.

h. There is a strong necessity to recruit and train maintenance and repair personnel. Frequently, laboratory equipment dealers prefer to sell new machines rather than repair those that have already been purchased.

2. Memorandum No. 43

In Memorandum No. 43, dated April 26, 1974, Dr. S. Atangana recommended to the Minister of Health and Public Assistance that there be created within the Epidemiology Service of the Under Direction of Preventive Medicine and Public Hygiene a unit called "Laboratory Section."

He further recommended that the Laboratory Section be placed under the authority of a Chief of Service, a Doctor of Medicine and Biologist, assisted by a Deputy, and that it would have as its mission:

a. To develop and improve laboratory services at all levels.

b. To assure in the national plan the necessary coordination among all the laboratories that carry out an activity affecting human health, including research on zoonosis.

c. To participate and lend its assistance within existing structures in the training of qualified personnel and to make recommendations for the creation or improvement of training methods.

d. To promote the normalization and standardization of equipment and techniques, as well as the application of new methods.

e. To prepare a draft text concerning organization and functioning of a national laboratory service in accordance with the scheme below:

   (1) A central level for planning, supervision, and control.

   (2) An execution level composed of:

      (a) A National Institute for Medical Research and Public Health.

      (b) Provincial Laboratories
      Departmental Laboratories
      Arrondissement and District Laboratories
      Health Center Laboratories
      Specialized Public Health Laboratories

f. To prepare a draft text setting forth the conditions for creation and functioning of private and parapublic laboratories.

PROPOSED ORGANIZATION OF A
NATIONAL PUBLIC HEALTH LABORATORY SERVICE
BY DR. ATANGANA

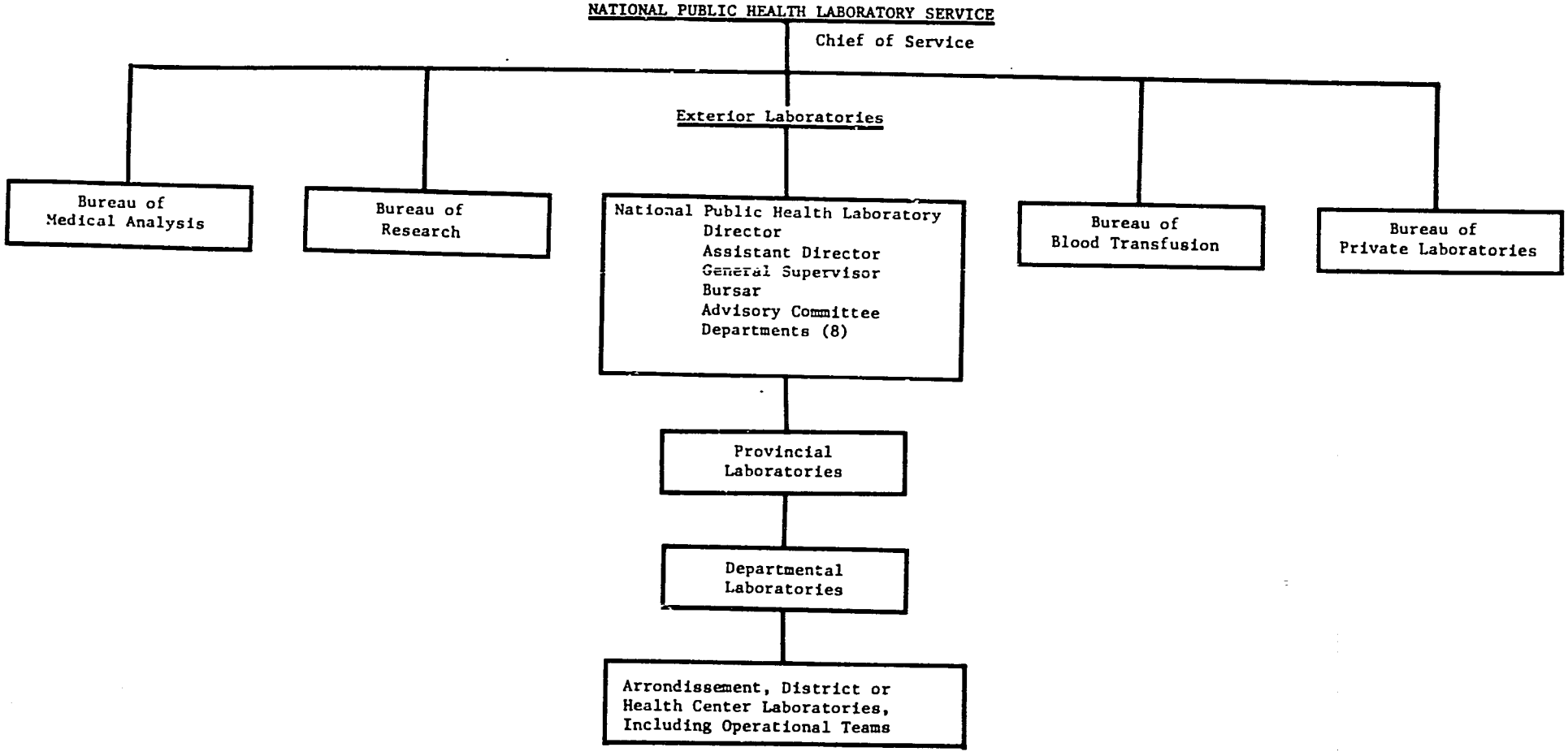


Figure 2

3. Proposed Organization of a National Laboratory Service by Dr. Atangana

a. The National Laboratory Service would be directed by a Chief of Service whose duties and functions would be as follows:

(1) Study, plan, and implement governmental policy regarding health laboratories.

(2) Supervise, control, and coordinate the activities of the public medical analysis and research laboratories.

(3) Exercise technical control of the activities of parapublic and private medical analysis laboratories.

(4) Develop and plan the public services of laboratories which exercise activities related to human health, including research and zoonoses.

(5) Create and extend blood transfusion service throughout the entire country.

(6) Normalize and standardize techniques and equipment as well as the application of new techniques.

(7) Lend support and collaborate with epidemiologist within the framework of the existing structure in the training of qualified personnel.

(8) Make recommendations for improvement in methods of training.

(9) Make recommendations concerning the laboratory personnel regulations.

(10) Prepare, revise, or readjust (in cooperation with the epidemiologist) legislative texts concerning

epidemiological surveillance of transmissible and social diseases as well as the conditions for the creation and functioning of private or parapublic laboratories.

b. There are four bureaus:

(1) Bureau of Medical Analysis

(2) Bureau of Research

(3) Bureau of Blood Transfusions

(4) Bureau of Private Laboratories

c. Exterior structure of the laboratory is composed of:

(1) National Public Health Laboratory

(2) Provincial Laboratories

(3) Departmental Laboratories

(4) Laboratories for Arrondissements, Districts or Health Centers

(5) Laboratories for Specialized Formations as well as the operational teams for epidemiology and intervention (mobile teams). Figure 2 depicts the above outlined organization.

d. Functions of the exterior structure of the laboratory:

(1) National Public Health Laboratory functions:

(a) To aid and identify as well as resolve important public health problems by communicating precise and reliable information to the authorities.

(b) To produce biological products.

(c) To assure hygiene of food products as well as control of water pollution and quality.

(d) To promote coordination between the health laboratories on the one hand and the research institutes/laboratories on the other.

(e) To establish useful relationships with the institutes of legal medicine to carry out basic and applied research in public health matters and in addition serve as a reference laboratory.

(f) To render administrative services as follows:

(i) Director

(aa) He should be a physician-biologist with polyvalent biological training.

(bb) He is responsible to the Director of Public Health through the channel of the National Laboratory Chief of Service.

(cc) He has full responsibility for the establishment of scientific, technical and administrative plans.

(dd) He is Chief of Personnel.

(ee) He is especially charged with continuous program planning and evaluation and establishment and execution of the budget.

(ff) In addition, he assumes liaison with all exterior health programs in the laboratory field of activity.

(gg) He is responsible for security rules being strictly enforced.

(ii) Assistant Director

(aa) Exercises supervision, control and coordination of the various scientific departments.

(bb) Fills in for Director in Director's absence.

(iii) General Supervisor

(aa) Responsible for maintenance and supply, carrying out regulations and supervision of laboratory personnel in performance of their work.

(iv) Technical and Scientific Committee

(aa) Constitutes Advisory Committee for:

1. Definition of priorities.
2. Amplitude of an organization of programs as well as the quality of their execution.
3. Execution of the budget.
4. Coordination of research activities and of training set up with other public or private entities (Ministries of Agriculture, Plans, National Education, Animal Husbandry).
5. Justification, nature, and importance of subsidiary services, such as Blood Transfusion Services.

6. Regulations applied to the laboratory.

7. Advice to Ministry when requested.

(bb) Committee composed of:

1. Director of Public Health (President)

2. Director of the National Public Health Laboratory

3. Director General of ONAREST or his representative

4. Under Director of Preventive Medicine and Public Hygiene

5. Under Director of Health Formations

6. Under Director of Pharmacy and Technical Equipment

7. Director of General Administration in Ministry of Health

8. Bursar of the National Public Health Laboratory

9. Laboratory Chief of Service (Permanent Secretary)

10. Chief, Epidemiological Services

(v) Departments (Specialized Services)

(aa) National Public Health Laboratory is composed of:

1. Department of Microbiology (Bacteriology, Parasitology, Virology, and Mycology)

2. Department of Hematology, Immunology, and Serology
3. Department of Biochemistry (Basic and Chemical Biochemistry and Radio Isotopes)
4. Department of Pharmacology and Toxicology
5. Department of Epidemiology (Transmissible Diseases, Environmental Hygiene, Habitat, Nutrition, and Study of Foods)
6. Department of Anatomic Pathology (Anatomy, Histopathology, and Cytology)
7. Department of Production (Culture Media, Serum Vaccines, Solutions, Animals, Packing, and Quality Control)
8. National Blood Transfusion Center

(2) Provincial Laboratories:

(a) Under authority of Director, assisted by General Supervisor.

(b) Integrated into Provincial Hospital Services but has budgetary autonomy.

(c) Composed of several sections:

(i) Microbiology Section (Bacteriology, Parasitology, Mycology)

(ii) Bio-chemistry Section (Chemical Bio-chemistry, Expert Advice and Toxicology)

(iii) Anatomic Pathology and Histopathology and Cancer Studies

(iv) Epidemiology Section (Endemic Diseases, Transmissible Diseases, Environmental Hygiene)

(v) Blood Transfusion Section

(3) Departmental Laboratories:

(a) Under authority of Chief assisted by General Supervisor.

(b) Laboratory charged with current expertise in medical analysis and toxicology.

(4) Arrondissement, District or Health Center Laboratories, and Operational Teams for Epidemiology:

(a) Under authority of a lab technician or an assistant lab technician who performs simple medical analysis, particularly those for tracking transmissible diseases.

D. Organization of Ministry of Health and Public Assistance

The Minister of Health and Public Assistance (MHPA) is responsible for protecting the health of the citizens of Cameroon. Detailed responsibilities are set forth in Governmental Decree No. 75/212, a summary of which is set forth as Appendix B of this report.

Although a National Laboratory Service is not established by the Decree, the responsibility for the organization, functioning and technical control of all preventive medical services, which the study team believes includes Public Health Laboratory Services, is delegated to Preventive Medicine and Public Hygiene.

A point of uncertainty on the study team's part relates to the present location of the laboratory service in the organization chart of the

Ministry of Health and Public Assistance. The organization chart indicates that the Laboratory Service is located under the Director of Public Health. The organization chart of the Direction of Public Health is shown as Figure 3 (page 96). However, Dr. Atangana's Memorandum No. 43, dated April 26, 1974, the same date as his and Dr. Kaptué's study report, recommends that there be created within the Epidemiology and Malaria Service of Preventive Medicine and Public Hygiene a unit called "Laboratory Section." We are uncertain as to whether this recommendation has ever been officially adopted. A summary of this document is set forth in Section IV, C, 2 of this report.

For this report, we have assumed that the document setting forth the organization of a National Laboratory Service as well as its location in the Epidemiology and Malaria Service of Preventive Medicine and Public Hygiene is in effect.

Figure 2 reflects the proposed organization of a National Laboratory Service according to the function statement set forth in Section IV, B, (3). The function and purpose of a National Laboratory Service are the subject of detailed discussion in Section VI of this report.

E. Description of Present Laboratory System

In its broadest sense, the overall responsibility of the Ministry of Health is to protect the public health. The Ministry of Health in its recent programs, such as sanitation and health education, has recognized its responsibilities by attempting to deal with Cameroon's disease problems on an increasingly preventive basis. Although there have been some delays in executing some portions of the Ministry of Health's plans

(such as hospital construction), other developmental activities have gone forward toward goals established by the Ministry of Health. These are:

(1) To increase the ability of the people of Cameroon to participate in development activities by providing comprehensive curative, preventive, and health education services throughout the country.

(2) To direct the focus of services to the rural population towards preventive medicine.

(3) To increase both the quality and quantity of health manpower development.

(4) To increase the quality and quantity of health facilities.

(5) To decrease the morbidity and mortality of disease so that life expectancy is raised from 43 to 55 years by 1980.

(6) To promote medical research and data collection.

Although the above health goals are general, examination readily reveals that in order to attain them an adequate national laboratory system is necessary.

As a general rule, a national health laboratory system consists of a group of laboratories which form a well-defined network. This network is headed by a central laboratory, usually located in the nation's capital.

Other laboratories in the health laboratory service network are usually provincial hospital, district hospital, and peripheral dispensary laboratories. Such hospital laboratories have their primary responsibility to the hospital, and many of them might not even realize that they are performing any public health function or that they belong to any health system other than that of their own hospital. However, even the smallest hospital

laboratory is performing an important health laboratory function if it identifies diseases of public health significance and reports its findings to proper health administrators. A peripheral laboratory may be limited to a few procedures, but if the results can be trusted they may provide very valuable epidemiological information which could be used as a basis for epidemiological surveillance and preventive health planning to control local health problems.

Peripheral laboratories in Cameroon are generally not capable of doing any bacterial identification beyond microscopy. In addition, there is a great variation in district or departmental hospital laboratories' ability to perform bacterial identification. Although the normal procedure might suggest that special cultures should be forwarded to an intermediate laboratory, in Cameroon this would vary by location because of transportation conditions and the qualifications of laboratory personnel at a given laboratory facility. When an intermediate laboratory cannot perform the required test, such specimens should be referred directly to a central or national public health laboratory. Unfortunately, many of the same problems relating to transportation and qualifications of laboratory personnel would apply even to a national public health laboratory in the nation's capital.

Another problem in Cameroon, and probably in the other West African nations, is the custom of sending patients, not specimens, to laboratories. Although transportation throughout rural areas during the rainy season is almost impossible, transportation from the rural areas to Yaoundé or another central location is equally difficult except when air service is available. Therefore, the custom of sending the patient, rather than a

specimen, to a laboratory is necessary because no specimen transit system exists. If an adequate nationwide transportation system existed, specimens could be shipped to a central laboratory for testing if packaged properly to survive transit. Of course, an adequate transportation system is also important in reporting results, though less so since telephone service is available to many of the rural villages.

Increased rail service may help some rural areas, but most of the larger urban areas soon to be served by the improved rail service are already served by air service.

Basically, public health laboratory services in Cameroon are provided primarily from a clinical health care delivery standpoint at seven levels:

(1) Central and provincial hospitals,

(2) Departmental hospitals,

(3) Arrondissement or district hospitals,

(4) Departmental centers for preventive medicine (including specialized dispensaries),

(5) Developed health centers,

(6) Elementary health centers, and

(7) Mobile health teams.

Although these various categories of laboratories are referred to as "levels," in actual fact the distinctions among them are theoretical. In many cases, an apparently higher level laboratory will do no more than a health center or dispensary level laboratory. What a laboratory does is frequently determined by the training and capabilities of its personnel, and even more frequently by the equipment, reagents, and other supplies the laboratorian has at his disposal.

In addition, the various "levels" are not all under the same administrative or technical supervision; they function under various Under Directions and Services, which creates fragmentation and duplication of services. Most health officials believe there is a correlation between the tests performed and services offered and the disease problems existing throughout the nation and that, therefore, the laboratories are responding as needed. These officials do, however, envision additional services and tests at each level.

Laboratory work is also carried out at some of the Maternal and Child Health Centers (PMI's), at Leprosy Centers, Tuberculosis Centers, Venereal Disease Centers, and various urban dispensaries. There are, in addition, a large number of missionary hospitals and dispensaries, many of which are in selected inaccessible regions of the country, that provide laboratory services, though most of their work is in such areas as curative services, health education, maternal and child health, and vaccinations. It is difficult to ascertain the total number of laboratories existing in Cameroon; however, the number may reach as high as 300. The Epidemiology Service alone supervises 129 laboratories.

Below we discuss the various levels of public health laboratory services. These statements are, however, generalities only and there are many exceptions.

(1) Central and Provincial Hospital Laboratories

There is a provincial hospital in each of the seven provinces. Laboratories in these hospitals generally provide biochemistry, including examination of blood, urine and spinal fluid specimens; limited bacteriology; syphilis serology; hematology; parasitology; and miscellaneous tests and

services, including blood banking. Categories of services as well as particular tests vary from hospital to hospital. For example, Central Hospital at Yaoundé does not perform bacteriology or parasitology onsite, but sends such work to Pasteur Institute. In addition, not all hospital laboratories offer blood banking.

(2) Departmental Hospital Laboratories

Each of the 40 departments has a hospital, but only 36 have laboratories. Laboratory services and tests in these laboratories differ because of many factors, such as history of the area, personnel and equipment available, and disease problems.

(3) District Hospital Laboratories

Laboratory services of district laboratories and lower level laboratories do not differ much. Some of these laboratories are more developed than others. Generally, district hospital laboratories perform those tests which the personnel at a given location are capable of performing. Many such laboratories are directed by nurses who do not require or see the need for laboratory services because most of the diagnoses are clinical. These nurses have many other responsibilities, such as consultation, health education, disease surveys, as well as the normal clinical duties, leaving little time for performing laboratory work.

Tests performed at this level are generally blood chemistries such as blood sugar, hematocrit and sickle cell; bacteriology slides, syphilis serology; hematology, particularly blood parasites; and stool specimen parasitology.

(4) Departmental Centers for Preventive Medicine

These centers carry out preventive medicine functions, including vaccination campaigns, under the supervision of the Epidemiology Service (Under Direction of Preventive Medicine and Public Hygiene). They are frequently near a Departmental Hospital, and may duplicate some of the hospitals' clinical laboratory function. In general, they perform urinalyses, blood parasite tests, vaginal/urethral smear examinations, and examinations for tuberculosis and leprosy. These centers are similar to the other rural dispensaries.

(5) Developed Health Center Laboratories

These laboratories and the elementary health center laboratory services are basically the same except some of the Developed Health Centers have beds. In addition, all have at least one microscope but not all have personnel with formal laboratory training. Tests performed at this level are generally urines, blood smears and stool parasites.

(6) Elementary Health Center Laboratories

There are approximately 311 Elementary Health Centers in Cameroon; some are national, while others are local. However, only 78 of these have laboratory equipment (microscope, sometimes hand centrifuge, and reagents for stains). Usually the laboratory personnel consists of one microscopist who has had no formal training but has been trained on the job to do certain tests.

Laboratory tests generally performed at these centers are urinalysis for albumin and sugar, thick smears (blood) for filariasis, trypanosomiasis, and malaria, and fecal specimens for intestinal parasites. Here again, there are some tests performed at some locations which are not performed

as a general rule in other Health Centers. Examples would be testing for anemia, or testing for sleeping sickness in certain areas where it is prevalent.

(7) Mobile Health Teams

Mobile medical teams frequently need laboratory support when they travel into areas which are inaccessible except on foot. Necessary laboratory equipment is backpacked into the area where tests are performed onsite. Usually such teams are screening patients for a particular disease. Mobile teams may work out of the Departmental Centers for Preventive Medicine, the Developed Health Centers, or the Elementary Health Centers.

V. PROBLEMS AND SOLUTIONS

In this Section, we have provided our recommendations for solutions to the many problems which were related to us during our interviews and onsite visits, as well as some we noted in our laboratory tours. Although many of the problems are interrelated, we have grouped them into five categories for convenience. Also for convenience, we have presented them in chart form with recommended time frame necessary for implementing solutions, and have given a general idea of the resources required for resolution. We believe this chart serves as an overview of the entire study and that it can be used effectively for planning purposes.

A. Coordination and Other Management Problems	Recommendations/Solutions	Implementation					Resources Required
		Immediately Phase I	Within 2 Years Phase II and III	Within 5 Years Phase IV, V and VI	Long Range		
There is no one presently appointed to post of Director, National Public Health Laboratory Service. Therefore, no one individual is responsible for the national coordination of laboratory services.	Appoint an Acting Director. Begin search for or training of a qualified Director.						a) Salaries for Acting Director, Secretary and Clerk. b) Office space and office equipment. c) Training funds.
There is no staff available to provide assistance to a laboratory director in coordinating a national laboratory service.	Provide secretary and clerk as beginning staff.						
There is no one available to feed into or monitor what goes on around the nation in the field of laboratory medicine.							
There is no one with the responsibility to examine the ability of laboratorians to function as a team.							
There is no one at the national level with the responsibility for determining the quality of work being done in the laboratories or the degree of supervision that is necessary to keep work at an acceptable level of competence.	(See Section VI. B. and C. p. 75, 81)	X					
The information system is inadequate. There is some national reporting of examinations, but it is far from complete and it is not analyzed from an epidemiological standpoint. At present it mainly reflects where work is being done.	Acting Director begins receiving all laboratory workload reports.						

A. Coordination and Other Management Problems (continued)	Recommendations/Solutions	Implementation: Immediately / Phase I	Implementation: Within 2 Years / Phase II and III	Implementation: Within 5 Years / Phase IV, V and VI	Implementation: Long Range	Resources Required
Statistics on the nation's health problems, prevalence of diseases by geographical areas, or vital statistics, including the causes of deaths are inadequate for planning purposes.	Begin compiling disease statistics by using laboratory workload reports and data.					
No data exists on the total numbers of the various types of laboratories in Cameroon, the types of services and tests offered in each, and the number of personnel in each.	Establish contact with all laboratories; compile basic laboratory data. (See Section VI. B. and C. - pp. 75, 82)	X				None
A good laboratory specimen referral system, from either the curative or the preventive point of view, does not exist.	Begin developing specimen referral system in each Province. (See Section VI. C. - p. 82, 83 and Section VII, p. 107)		X			Specimen containers must be purchased and distributed to all laboratories.
Few laboratorians are aware of the need for implementation of quality control measures. Standards and internal quality controls are not available.	Implementation of quality control procedures. (See Section VI. D. p. 105)					
Insufficient guidance is available to laboratorians. In most laboratories, written current procedures are not available for reference. Microscopists have no one they can turn to for help. No one is available to answer their questions.	Packages of guidance material should be developed and provided to each laboratory. This material should include standards and internal quality controls. The Training Specialists should visit laboratories and check to insure that guides are being used and followed. (See Section VI. C. p. 94 and D. p. 105)			X		a) Salaries for Director, Training Specialists and other staff. (p. 86) b) Office space and office equipment. c) Travel funds.
Public health aspects of laboratory operations receive too little emphasis; clinical aspects predominate.	A public health laboratory should focus on preventive medicine. The basic purpose of a national public health laboratory is assisting in the identification and control of all problems of public health significance. (See Section VI. A. - p. 68)	X				None

A. Coordination and Other Management Problems (continued)	Recommendations/Solutions	Implementation				Resources Required
		Immediately Phase I	Within 2 Years Phase II and III	Within 5 Years Phase IV, V and VI	Long Range	
Communication is inadequate, both between the national level and the lower levels, and between laboratories of the same level.	The Acting Director should serve as the contact person in the Ministry for communications between lower levels and the national level. He should develop a list designating contact person in each laboratory. This list should be distributed throughout the country. (See Section VI. C. - p. 81)	X				Clerical and printing.
Guidance is needed on the sequence for improvement efforts; i.e., start from bottom or top.	We recommend starting at the peripheral level because the greatest improved medical care delivery can be made at this level with the current or slightly increased resources. (See Section VI. C. - p. 82)		X			Reagents, supplies, additional training of current staff.
Laboratory needs have been identified by technical people but management people are required to develop plans for meeting these needs.	Previous laboratory studies were taken into account. Plans for meeting management needs are set forth in this study.	X				None
Legislative control of all laboratory operations is needed. Requirements for opening, staffing, and operating a laboratory are not well defined and laboratories are free to set prices charged for their services.	Not a public health laboratory problem; therefore, not covered by this study.					

B. Supplies, Equipment, and Facilities	Recommendations/Solutions	Implementation				Resources Required
		Immediately Phase I	Within 2 Years Phase II and III	Within 5 Years Phase IV, V and VI	Long Range	
The lack of an adequate supply system is one of the fundamental problems in all laboratories. All laboratorians interviewed were out of some basic supplies that they needed in their routine work.	Acting Director should coordinate acquisition and distribution of supplies with Pharmacy. (See Section VI. C. - p. 82)	X				None
	Employment later of a Supply Specialist who would assume these functions for public health laboratories. (See Section VI., p. 87)			X		Salary
The infrequent distribution, generally once a year, and the lack of a system for redistribution creates a perpetual problem of shortages.	The Acting Director, in conjunction with Pharmacy, should provide better acquisition, including quantities, and distribution, of laboratory supplies actually needed at given locations. (See Section VI. C. - p. 82 and VII. - p. 107)	X		X		
No provision is made for a reserve stock of supply and equipment items to meet emergencies. Replacement stocks of supplies and spare parts for equipment are not available from local suppliers. Transfers of supplies between organizational subdivisions can seldom be made.	The Acting Director, in conjunction with Pharmacy, should establish and maintain a small reserve stock of laboratory supplies for unforeseen emergencies. Laboratory supply problems relating to transportation or to inability to transfer supplies between organizational subdivisions should be the subject of a future study.	X				Additional funds for emergency supplies.
There is a constant shortage of funds for purchasing adequate supplies. A low priority is often assigned to laboratory supplies and equipment compared to priorities given to other medical supplies and equipment.	An Acting Director should assist Pharmacy in ordering appropriate supplies needed, therefore helping to eliminate any waste through long shelf deterioration. However, laboratories need a larger share of the budget for reagents and supplies.	X				None
There is no standardization of supplies and equipment. Machines and other equipment come from all over the world, much of it as gifts.	Equipment should be standardized first. Standardization of supplies will be determined to an extent by the equipment. (See Section VI. B. and C. - p. 75, 91)			X		Funds for equipment and supplies.

B. Supplies, Equipment, and Facilities (continued)	Recommendations/Solutions	Implementation: Immediately Phase I	Implementation: Within 2 Years Phase II and III	Implementation: Within 5 Years Phase IV, V and VI	Implementation: Long Range	Resources Required
Few laboratories have space to store supplies properly. None we saw had a central storeroom for reagents and supplies, and no place was adequate from the standpoint of inventory control and prevention of unauthorized use.	Proper storage of laboratory supplies should be part of the training of laboratorians. Closer attention should be given to storage instructions and shelf life.					
Many laboratories are using supplies beyond the recommended expiration date. Some of the reagents and chemicals have no expiration date on them, but the labels are brown with age--they appear to be too old for proper use.	(See Section VI.C. - p. 92)			X		None
Ordering of laboratory supplies once a year and delivery approximately one year after date of ordering causes a deterioration in reagents. Some are near or past the expiration date when received from abroad.	Little improvement in the existing system can be made until suppliers have local representatives and the overall medical supply system can shorten delivery date.			X		None
Most microscopists are not trained to know the quality of reagents or how to assist the pharmacists in ordering them.	Some training should be given to microscopists in how to assist the pharmacist in ordering and judging the quality of supplies needed for each year. (See Section VI. C. - p. 93)	X				None
There is no one assigned in a laboratory to control reagents, keep up with expiration dates and keep a fresh supply on hand.	Each laboratory, with assistance of the Supply Specialist, should establish a reagent control system. (See Section VI. C. - p. 91-93)			X		None
When laboratories run out of a particular reagent, the laboratorians may substitute another reagent which can produce inaccurate results or they stop performing the test altogether.	An emergency reagent supply should be established and put under control of Acting Director for distribution as needed.	X				Additional funds for emergency supplies.

B. Supplies, Equipment, and Facilities (continued)	Recommendations/Solutions	Implementation							Resources Required
		Immediately	Phase I	Within 2 Years	Phase II and III	Within 5 Years	Phase IV, V and VI	Long Range	
Inadequate records are kept on supplies and equipment.	Each laboratory, with assistance of the Supply Specialist, should establish a supplies and equipment control system.					X			None
Suppliers of reagents and vaccines in Cameroon are needed.	The Ministry will have to give foreign suppliers sufficient volume to encourage a representative to be located in Cameroon.							X	None
There is a language problem with chemicals, reagents, and other supplies and equipment. Names of chemicals, instructions on labels, etc., are frequently in a language unknown to the laboratorian.	When considering standardization of supplies, language problems should be a prime consideration.					X			None
Equipment is inadequate in most laboratories. First of all, there is generally not enough equipment, particularly in the larger laboratories; and second, much of what exists is obsolete, and 30-50% is completely broken down, not calibrated properly, or not functioning properly for other reasons. Sometimes new equipment is received with missing parts. Lack of something as simple as a screw can cause a machine to be inoperable.	Replace old, unworkable, and unreliable equipment first where such equipment is most critical to the physician and patient. Establish priority list. New equipment for new laboratory testing procedures should be added as resources permit. (See Section VI. C. - p. 85)					X			A large capital outlay would probably be required over a period of several years.
Equipment is sometimes improperly used or even unusable because suppliers fail to provide operating and maintenance manuals. Efforts to obtain manuals from abroad after equipment has been delivered and installed leads to long delays and inevitable frustration.	Acting Director should be contact person in Ministry to order needed operational manuals, etc. (See Section VI. C. - p. 81)	X							None

B. Supplies, Equipment, and Facilities (continued)	Recommendations/Solutions	Implementation							Resources Required
			Phase I	Within 2 Years	Phase II and III	Within 5 Years	Phase IV, V and VI	Long Range	
Maintenance contracts are too expensive. Sometimes contractors ruin equipment purposely in order to get the government to buy new equipment. There is a lack of ability to repair laboratory equipment. Frequently, it is necessary to have repairman come from the country which furnished the equipment. Cameroon has to pay all the expenses of such a trip, and if the repairman does not have the right part when he arrives he has to go back and get it. High costs and delays result.	Need to train more maintenance crews. As equipment is standardized, problems should be greatly reduced. (See Section VI. C. - p. 91)		X						None
Electronic machines are almost impossible to keep going in Cameroon due to the humidity. In the past they have had to get service from Gabon, which has not always proved satisfactory. Mechanical equipment is more satisfactory than transistorized.	Extra care should be taken by those responsible for ordering equipment not to acquire, even by gift, equipment which is unsuitable for the climate.		X						None
Microscopes must be sent to Yaoundé for repair and sometimes can be replaced from Yaoundé from a small stock of replacement microscopes and spare parts. But, getting them to and from Yaoundé can present almost insurmountable difficulties.	Laboratorians should be given some preventive maintenance and minor repair training for laboratory equipment as part of their technical training. There is nothing laboratorians can do about national transportation problems. However, the establishment of the repair teams in each province, as is currently being done, should assist this problem considerably. (See Section VI. C. - p. 94 and D. - p. 105)			X					Additional training funds of a limited amount.

B. Supplies, Equipment, and Facilities (continued)	Recommendations/Solutions	Implementation							Resources Required
		Immediately	Phase I	Within 2 Years	Phase II and III	Within 5 Years	Phase IV, V and VI	Long Range	
Laboratory slides must be used over and over again for all types of specimens, and sometimes there are no cover slips. Eventually, slides get scratches which are then seen under the microscope and create confusion for the microscopist.	Can eliminate through better acquisition procedures for supplies and equipment, as previously identified.	X							Additional funds for slides, etc.
There is no adequate repair and preventive maintenance system.	A repair system is currently being developed. Laboratories should be visited on a regular basis for preventive maintenance as well as repairs of laboratory equipment.	X							Additional funds for travel and spare parts, supplies, etc.
In many laboratories, the personnel could do more sophisticated levels of tests if they had the necessary supplies, and equipment, such as an incubator. The lowest level laboratories only need a microscope, reagents for staining the slides, and equipment to draw blood, but often they do not have even this.	Acquisition of any new equipment will depend primarily on availability of financial resources. However, adequately trained personnel is also essential. Acting Director should see to it proper supplies are available at lower levels.	X							Additional funds must be available.
Equipment sometimes does not work properly because of fluctuations in the electrical current.	Local problem that must be resolved on individual basis.								
Laboratory facilities need to be improved. Most of the buildings are old and in varying stages of deterioration, which makes them difficult to keep clean.	Although many of the laboratory quarters are old, nevertheless, considerable improvement can be made with the establishment of proper cleaning procedures.	X							None
The standards for cleanliness of the laboratories need to be elevated to prevent contamination of tests and to prevent infection of the workers.	Laboratorians need to be better trained in aseptic techniques and the importance of a clean laboratory environment.	X							None

B. Supplies, Equipment, and Facilities (continued)	Recommendations/Solutions	Implementation							Resources Required
		Immediately	Phase I	Within 2 Years	Phase II and III	Within 5 Years	Phase IV, V and VI	Long Range	
There are no means or inadequate means of sterilizing slides, tubes, and other glassware and items used. Plentiful supplies of hot water, detergents, and disinfectants are all lacking.	All laboratories should be supplied with disinfectants and detergents and a sterilizing method. Without this ability, laboratories should not even attempt to operate.	X							None
Few are aware of the need for air flow regulation to protect specimens being tested from contamination by airborne materials, and to protect the laboratorians from this hazard. There is no air conditioning or control of humidity.	Adequate air handling systems should be planned when new laboratories are constructed.							X	A very expensive item requiring budget increases.
Few laboratories have demineralized and/or deionized water available.	Larger hospital laboratories need equipment for producing demineralized and deionized water.			X					Some additional resources required.
Blood banks are not well equipped. Refrigeration usually consists of a small food-type refrigerator. Some laboratories also need portable facilities for blood collection.	Blood banks with adequate equipment, especially refrigeration, should be established in district hospitals and above the district level. Mobile blood collection facilities, due to restricted areas of mobility, appear long range.			X					Additional resources required and should be given high priority.

C. Service Levels	Recommendations/Solutions	Implementation: Immediately Phase I	Within 2 Years Phase II and III	Within 5 Years Phase IV, V and VI	Long Range	Resources Required
Large areas of the country are not covered by laboratory services at all.	Continue efforts to establish and staff laboratories in existing health centers which do not now have laboratories. However, resources should be used to improve currently existing laboratories first.				X	Additional resources for training personnel, acquisition of facilities, equipment and supplies.
Many laboratories do not have electricity or running water, which therefore, limit their testing capabilities.	Running water is probably of a higher priority in most peripheral laboratories. This should be one of the first improvements to existing laboratories.		X			Additional resources required.
A national reference laboratory does not exist.	A referral system should be established, where possible, whereby specimens would be sent from a lower level laboratory to a higher level laboratory. The provincial hospital laboratories should serve as the principal reference laboratory in each province. This referral system should be maintained even after a central reference laboratory is established. (See Section VI. B. - p. 78-80 and C. - p. 82)		X			Additional resources needed for specimen containers.
Laboratory capability is needed for the control of water supplies and water quality for both human and animal populations. The same is true for food and food production, occupational health, and toxicology for pesticides. Sanitation and monitoring of the environment receive little attention now.	a) It is recommended that water bacteriology be first in this area and be performed at the provincial level with food to follow as soon as possible. b) Toxicology, occupational health and water chemistry procedures will probably have to wait until an adequate central reference laboratory is available. (See Section VI. B. - p. 78 and C. - p. 84)		X		X	Would require some additional laboratory resources at provincial hospitals as well as sanitation personnel. Equipment to perform toxicological and occupational health examinations requires expensive laboratory equipment and highly skilled personnel. This work would only be practical in a central reference laboratory.
The Central Hospital, Yaoundé, has no place to send certain specimens such as those from persons suspected of having toxoplasmosis, so the laboratory sometimes misses the diagnosis.	This diagnosis should be a provincial hospital laboratory capability along with that of other serologies. (See Section VI. C. - p. 84, 85)			X		This will require additional resources for trained personnel plus the necessary equipment and supplies.

C. Service Levels (continued)	Recommendations/Solutions	Implementation							Resources Required
		Immediately	Phase I	Within 2 Years	Phase II and III	Within 5 Years	Phase IV, V and VI	Long Range	
The Central Hospital laboratory does not have the means, materials, or personnel to perform bacteriology.	Central Hospital should have the capabilities to perform bacteriology for the hospital as well as provide a reference service for the Province. (See Section VI. B. & C. - p. 78, 85)						X		In addition to additionally trained personnel and equipment, etc., additional laboratory space would be needed because laboratory space is already very limited.
OCEAC cannot get some of the laboratory tests done that they need, such as cholesterol, because there is no national or local laboratory which performs such tests.	Where possible, Central Hospital laboratory should serve as a back-up laboratory for OCEAC.						X		Once Central Hospital laboratory reaches the level of the provincial reference laboratory, little or no additional resources would be required.
There is a need for a laboratory to study and fight animal diseases and serve as an analytical laboratory as well as produce vaccines.	This appears to be an ONAREST function.								
The laboratory at Garoua has been trying to get a bacteriologist (physician) for over a year. It would be useful if such a person could do anatomical pathology also as there is not enough work in Garoua for a full-time pathologist. The pathologist would also need to supervise the training of nurse personnel to perform certain laboratory technical procedures. The laboratory at Garoua (provincial hospital) could not perform cultures because they did not have the necessary supplies and equipment.	a) The laboratory should have bacteriology capabilities. b) We assume the new laboratory will have the necessary supplies and equipment, but finding adequately trained personnel, including a pathologist, will be difficult.				X			X	Trained personnel.
The hospitals at Ngaoundéré and Maroua do not have hospital laboratories. Maroua is a 200-bed hospital. Ngaoundéré, Maroua, and Yagoua hospitals do send some specimens to the provincial hospital at Garoua by plane.	All hospitals should have a laboratory which offers basic laboratory services for in patients. Other tests should be referred to the provincial laboratory, Garoua.						X		Complete staffing, equipment and supplies.

C. Service Levels (continued)	Recommendations/Solutions	Implementation: Immediately Phase I	Within 2 Years Phase II and III	Within 5 Years Phase IV, V and VI	Long Range	Resources Required
Proficiency testing is practically nonexistent.	A nationwide proficiency testing program is not in the foreseeable future. However, when the central reference laboratory is staffed with a Training Specialist, some internal quality control measures may be instituted.			X		Training Specialist travel funds for laboratory consultation.
Examination procedures are not standardized.	It is difficult to standardize examination procedures unless equipment and supplies are standardized first. After the central laboratory obtains a staff, applied research should be performed to accomplish standardization in coordination with laboratory training schools.			X		Research materials would be needed as well as teaching materials.
Service levels vary substantially between laboratories at the same level in the organizational hierarchy. On the other hand, frequently laboratories at different levels are performing the same services.	The Acting Director will begin identifying laboratory services performed in each laboratory (workload data). He can determine what tests should be performed at each level and coordinate services.		X			No additional resources.
The specimen referral system is inadequate.	Begin to develop specimen referral system, instructions for use and acquiring a supply of containers.		X			Initial cost of specimen containers.
Another problem is a tendency to do some research in all clinical laboratories.	The tendency to perform research in all clinical laboratories should be discouraged unless it is applied research toward specific laboratory services. Examples are better methodology, handling specimens, testing reagents, etc.					
Applied research is needed.			X			Small amount of additional resources.

D. Personnel and Training	Recommendations/Solutions	Implementation							Resources Required
		Immediately	Phase I	Within 2 Years	Phase II and III	Within 5 Years	Phase IV, V and VI	Long Range	
Students see a bleak future for laboratorians; they see more future in business and other professions and generally consider those persons engaged in laboratory work as a "down-trodden" group. They further believe that raising the professional level of laboratorians is a governmental policy matter, since the civil service system seems to offer more opportunity for advancement in other fields.	Raising the professional levels of laboratorians is a governmental matter. Until adequate training of new and recycling of existing personnel can be accomplished, opportunities for advancement will continue to be limited. The civil service should take steps to upgrade this profession commensurate with other professions. A job classification system could be the subject of a future study.						X		
Some laboratorians do not receive much job satisfaction and are subject to much frustration due to the lack of equipment and supplies in the laboratories where they are employed. They also feel that they may be stuck forever in one place with no possibility for advancement. They regard the nursing profession as giving more hope for satisfaction and advancement.							X		Funds for training and upgrading salaries.
The quality of the laboratory work being performed depends largely on the training of the individual or individuals involved. Many laboratorians are not sufficiently trained for the work they do.	Obtaining a Training Specialist to evaluate the needs for training and retraining should help resolve this problem. (See Section VI. C. at p. 86, 93)						X		Additional funds for training.
There is a need for personnel from abroad to help train laboratorians.	Training assistance could possibly be obtained through WHO, CDC, and others to assist in establishing training courses.				X				Funds could possibly be obtained from outside sources.
Cameroonians should be sent outside the country for training in electronics, equipment repair, etc.	When standardization of equipment takes place, Cameroonian maintenance personnel should be sent to the country that manufactures the equipment for necessary training.						X		Additional resources for foreign training travel.

D. Personnel and Training (continued)	Recommendations/Solutions	Implementation				Resources Required
		Immediately Phase I	Within 2 Years Phase II and III	Within 5 Years Phase IV, V and VI	Long Range	
Laboratory personnel are not trained for maintenance, and many do not know how to take care of their equipment. There is a need for at least one maintenance person in each hospital.	Routine laboratory equipment maintenance and repairs should be a part of training courses. Maintenance teams are currently being trained for each province. In long range planning, enough people may be trained to have such a person in each hospital.			X	X	Additional resources will be needed for maintenance and repairs as well as necessary personnel.
Eventually, laboratory personnel need refresher courses but in peripheral or health center laboratories such facilities would have to close operations since there is usually only one person in the laboratory. Many of these people never have the opportunity for further formal training and refresher training once they are placed in a job.	Plans should be developed to conduct onsite training at all levels. The proposed Training Specialist should develop and distribute packages of written guidance materials prior to onsite training. (See Section VI. C. - p. 94)			X		Some additional funds for development of training materials, guidance packages and travel.
Reliability of laboratory performance would improve if laboratorians were given short-term retraining. However, they should not be trained on obsolete equipment, or without the necessary supplies. They need to learn on good equipment and then use that same type equipment in their laboratory work.	Short-term retraining should be provided to laboratorians who can be spared from day to day laboratory operations. This training should take place at a central location and should use as near as possible the same type equipment, etc., that the laboratorian uses in his own laboratory. (See Section VI. C. at p. 93)			X		Additional resources needed, especially travel funds and per diem for trainees.
To obtain upper-level laboratory personnel of high qualifications such personnel may need foreign training.	To obtain specific highly specialized personnel, foreign training may be necessary to fill such requirements in the immediate future. Eventually, such persons should be trained in Cameroon.			X		Additional funds would be required for foreign travel and training.

D. Personnel and Training (continued)	Recommendations/Solutions	Implementation					Resources Required
		Immediately Phase I	Within 2 Years Phase II and III	Within 5 Years Phase IV, V and VI	Long Range		
There is a difficulty in getting nurses to train for laboratory work. Since there are not enough laboratory technicians, some of the nurses have to be compelled to do laboratory work, especially in the peripheral formations. Sometimes even ward servants have to become laboratory technicians. Sometimes hospital nurses who cannot do a good job on the curative side are put in the laboratory and this causes internal problems.	Where it is necessary for nurses to perform laboratory tests, such persons should receive onsite laboratory training. However, nurses should not be expected to perform laboratory tests when a trained laboratorian is available.			X			Some additional funds for development of training materials, guidance packages and travel.
Nurses are not trained in Cameroon to use the laboratory for diagnosis and, consequently, do not consider laboratory work important.	A part of nurse training should include explanations as to the significance of laboratory examinations and their use in diagnosis.	X					None.
Certain laboratory problems noted which are probably due to lack of proper training in laboratory technique are: (a) laboratory specimens do not always have tape with the patient's name attached to the specimen; (b) sharp needles are not always used for drawing blood; (c) much of the glassware is not properly cleaned; and, (d) inadequate attention is given to safety.	All of these relate to training in good laboratory practices. Guidance materials should include some instructions and suggestions concerning laboratory practices.	X					None.

E. Other Problems of Finances, Transportation and Communications	Recommendations/Solutions	Implementation: Immediately / Phase I	Implementation: Within 2 Years / Phase II and III	Implementation: Within 5 Years / Phase IV, V and VI	Implementation: Long Range	Resources Required
The problems of distance, transportation and communication relate to the availability of laboratory services in Cameroon. Practically all laboratory tests required must be performed on the spot because of the need for prompt results and of the difficulties in transporting specimens or patients and communicating examination results.						
Lack of money is a constant problem that is felt in every aspect of laboratory service.	These problems are the basis for our recommendation that laboratory services be improved first at the lower level by improving the supplies, equipment and training of existing personnel onsite. Where little or no increase in the availability of funds can be anticipated, adequate supplies and existing equipment kept in working order will bring about the greatest improvement in health care delivery.	X				Additional financial resources will be required for almost any laboratory improvement. The amount of improvement will be in direct proportion to the amount of resources available up to a point. At that point, other improvements beyond the control of the Ministry, such as transportation, must take place.
	As the development of a specimen referral system becomes a reality and the Cameroonian transportation system improves, a great demand will develop for a central reference laboratory with preventive medicine capabilities far greater than existing laboratories now possess. In the meantime, a specimen referral system within each province is recommended.	X			X	Although at present the availability of a national public health laboratory would be of considerable benefit to the areas served by adequate air transportation, the full potential cannot be realized until many of the limitations mentioned in this report have been eliminated. However, adequate plans for resources to develop the needed facilities should begin as soon as possible.

VI. PROPOSED NATIONAL PUBLIC HEALTH LABORATORY SERVICE

A. Purpose of a National Public Health Laboratory

The basic function and purpose of a national public health laboratory should be aiding and assisting in the identification and control of all problems of public health significance. The laboratory should be capable of providing reliable information on the nature of the problems; be able to respond completely and without undue delay to all reasonable requests for services by health officials and, in the case of transmissable diseases, to any qualified member of the medical profession, including the private practitioner.

While the above statement is extremely broad and general, it is nevertheless the basic reason for the existence of almost any public health laboratory. Variations as to purpose and functions are determined by many factors, especially the particular public health problems that exist in the country.

There are many other factors which have an influence on a public health laboratory, such as the availability of transportation; budget; disease prevalence; availability of trained personnel; existence of facilities, equipment and supplies; health goals and objectives; legal requirements and restraints; and many others. However, the spectrum of disease activity should be the beginning point. In this respect, Cameroon appears similar to other Central West African countries. The disease problems have previously been discussed in Section III of this report. A 1974 AID report ranks

these conditions, in order of descending morbidity rates, as follows:

Gastroenteritis and dysentery

Respiratory infections

Measles

Malaria

Complications of pregnancy and childbirth

Intestinal parasites

Malnutrition

Skin diseases

Trauma

Tuberculosis

Leprosy

Goiter

If a high morbidity and mortality is caused by an infectious disease, this disease then without doubt constitutes the country's most important health problem. Consequently, this would constitute the most important problem with which the health laboratory service of the country must be able to cope.

It appears that the health laboratory services needed most in Cameroon, at least at the clinical level, are bacteriology, parasitology, and serology. However, bacteriology and serology are nonexistent at the lower clinical levels and almost nonexistent at some of the upper levels. Other functions of the health laboratory services may range from simple drinking water bacteriology to complicated virology, mycology and toxicology.

When considering the development of a national public health laboratory in Cameroon, it appears of particular importance to bear in mind the difference between a public health laboratory (or a national public health laboratory) and a clinical laboratory. The basic difference is that a public health laboratory is expected to provide information on community-wide health problems, such as the etiology and magnitude of epidemics and endemics, while the latter's basic function is to aid in the diagnosis and treatment of the individual patient. There is no sharp difference between these two groups of medical laboratories, but the difference in Cameroon becomes extremely important when attempting to improve the existing national laboratory system and develop a national public health laboratory. The need for clinical laboratory services in Cameroon is tremendous. However, the same test that confirms a clinician's suspicion of a communicable disease may also be used by the Minister of Health and Public Assistance to assess the success or failure of disease control measures.

In planning for a national public health laboratory, the great clinical need should not be allowed to overlap and obliterate the purpose and functions of a national public health laboratory. A national public health laboratory must truly be national in scope and not allow itself to become another local clinical laboratory of limited scope and local service.

As previously pointed out in Section IV A, Cameroon does not have a national public health laboratory in the sense described in the previous paragraph. Cameroon does have a rather well-defined

network of public health laboratories at the provincial and local levels, but these laboratories exist under the various branches of the Ministry of Health, and at present lack coordination at the national level. While the Pasteur Institute formerly acted and was recognized as the public health laboratory of Cameroon, performing preventive medicine and sanitation laboratory support services as well as clinical laboratory services, its mission has changed. The Institute is no longer a branch of the French Pasteur Institute. Now the Pasteur Institute is organizationally attached to the Office National de la Recherche Scientifique et Technique (ONAREST), which is not a part of the Health Ministry. Two-thirds of the Institute's work load is described by its director as clinical, while the remaining one-third is research. This is not meant to be critical of the Institute's mission and functions, but to emphasize that the Institute can no longer be considered the national public health laboratory of Cameroon. The following sections set forth the steps necessary to develop an adequate national public health laboratory system in Cameroon.

B. Development of a National Public Health Laboratory System in Cameroon

A substantial amount of resources are currently being devoted to providing laboratory support for the nation's health care services. As a result of studies made to determine the adequacy of this laboratory support, combined with observations and experiences of health officials, major efforts are being made to improve the

scope, availability, and quality of laboratory services. Unfortunately, these efforts are not fully productive because they are not adequately coordinated. The point that there is no single national public health laboratory service in the nation has already been made in Section IV of this report. The existing laboratory system has been described in Subsection E of Section IV.

Development of a National Laboratory Service for Cameroon is dependent on many factors, some of which are outside and beyond the Ministry of Health and Public Assistance's jurisdiction or ability to control. Although much progress has been made in recent years toward identifying laboratory problems and needs, other improvements must occur before or at least simultaneously with an adequate national laboratory system in order to improve health care delivery in Cameroon.

As previously pointed out in this report, Cameroon has tremendous disease problems. According to laboratory workload figures the study team obtained, almost 85% of all laboratory tests currently performed are for parasitic diseases (malaria and stools). Over 80% of all stool examinations are positive.

While various parasitic diseases are transmitted differently, many in Cameroon are transmitted through unsanitary drinking water created by unsanitary human waste disposal. In short, it is hard to visualize that the existence of a national laboratory system, where laboratories are capable of identifying diseases, will make much improvement in the health of Cameroonians when the cause continues to exist. In other words, from a public health viewpoint,

it would appear little progress would have been made when a physician, through laboratory examination, is able to tell a mother her child is infected with intestinal parasites if the child returns home after the cure is completed, drinks from the same water supply, and becomes infected again.

While the study team recognizes that the above example may be an oversimplification of the problem, it does demonstrate that there are many other improvements that need to be accomplished before or simultaneously with development of a national laboratory system.

In addition to environmental and sanitation problems that relate to national laboratory system development, there are others. We have previously mentioned the problems relating to the need for an adequate budget, staff and laboratory facility. However, there is another problem that, in our opinion, will exist even if an adequate budget, staff and laboratory facility become available in the near future. That problem is the lack of an adequate transportation system, including specimen shipping containers, to send reference laboratory specimens to a central national public health laboratory. Except in urban areas where surface transportation is available to nearby surrounding villages, the only other transportation system that is adequate is air transportation. Eventually, the rail system from Douala through Yaoundé to the north may be of some help. It is questionable at present whether or not central reference laboratory services could serve as much as 25% of the population of Cameroon.

During the course of the study, we posed the hypothetical question of whether or not the interviewees would refer specimens to a central laboratory (Yaoundé) if an adequate laboratory were available. The replies we received did not indicate that there was a strong immediate need for such reference capability, but a greater and more demanding present need for improved laboratory services at local levels. We received the impression that the lack of adequate transportation was one of the major causes for this attitude.

In order to develop an adequate national public health laboratory system in Cameroon, these four essential elements must be present:

(1) a governmental commitment;

(2) an adequate budget;

(3) a qualified staff; and

(4) an adequate reference laboratory.

In the opinion of the CDC study team, the latter three elements do not presently exist. Although there does seem to be a sincere commitment on the part of the government, sufficient funds are not presently available to construct an adequate facility for a central reference laboratory or employ the necessary staff. Those persons interviewed expressed doubts that qualified personnel are now available for adequately staffing a central reference laboratory if the necessary funds could be allocated.

The steps proposed in this report as a means of improving laboratory services at the most rapid rate that is feasible are based on the assumption that available funds and other resources

will not be substantially increased in the near future. As a practical matter, the only logical approach appears to be the development of the best laboratory system that can be provided at existing or slightly increased budget levels with existing laboratory personnel and without a central reference laboratory facility.

The first steps in developing an adequate laboratory system are to:

(1) Appoint an Acting Director and clerical staff;

(2) Consolidate the existing laboratory netoworks under the Direction of Public Health into a single national system for technical supervision and assistance;

(3) Permit the Acting Director to coordinate the management of a laboratory system with the Directions of Health Facilities, Preventive Medicine and Public Hygiene, Pharmacy and Technical Equipment in relation to:

   a. Training of laboratory personnel;

   b. Acquisition and distribution of laboratory supplies and equipment;

   c. Standardization of laboratory examination procedures and equipment;

   d. Preventive maintenance and repair of laboratory equipment;

(4) Improve the system for reporting workload volume;

(5) Monitor laboratory workload reports for the prevalence of disease organisms of an epidemiological or public health significance.

It is not anticipated that the individual appointed "Acting Director" initially would necessarily have to be totally qualified as the eventual National Public Health Laboratory Director. The study team was advised such a qualified person does not now exist in Cameroon, and such a person may even have to be trained abroad. Therefore, in order to begin developing a national laboratory system and begin improving health care delivery, it may be necessary to appoint a temporary "Acting Director" who may not be medically qualified. However, if such be the case, the Acting Director should be administratively qualified and a good organizer.

The above "Acting Director" procedure would have the following advantages:

a. Permit the beginning of a National Public Health Laboratory System directed from the Ministry;

b. Provide a person in the Ministry responsible for coordination of laboratory activities, including reports, supplies, and equipment;

c. Allow time for recruitment or development of a qualified laboratory director and staff;

d. Allow for assembly of additional and better laboratory information to assist in development of plans for future; and

e. Allow accomplishment with minimal increase or reduction of funds for salaries.

We have recommended that the greatest improvement in health care delivery, under present constraints, can be accomplished now by improving the supplies, equipment and training of laboratory personnel at existing laboratories.

Following improvement to the supply system for supplies and equipment, including equipment repair, the next attempted improvement should be the upgrading of existing laboratory test capability at all levels. Priorities should be defined for each level, and possibly for each province, to meet any special needs of a province. As an example, the test capability of all elementary centers should include blood slides (malaria and trypanosomiasis) and stool parasites; tests for anemia; urines, especially albumin and sugar in pregnant women; sputum for tuberculosis, and skin snips for filariasis and leprosy.

At this same time and in addition to the above, Developed Health Centers should be able to perform blood groupings.

District hospital laboratories, in addition to all of the above, should be able to perform at least blood chemistries, such as blood sugars, hematology, syphilis serology, and urethral/vaginal smears. These hospitals should have a small blood bank (refrigeration essential) and perform blood transfusion tests.

If a district hospital is located near a departmental or provincial hospital laboratory, the district hospital laboratory should limit its laboratory services in those areas where duplication would result. For example, one well-equipped blood bank would probably serve the needs better than two ill-equipped blood banks; of course, actual existence and location depends on distance, transportation, personnel and equipment available in a given location.

Departmental hospital laboratories should have the capability to perform cholesterol, electrolytes and transaminase. However,

due to the need for some very expensive equipment for some of these tests, such as a spectrophotometer, addition of these tests will be difficult. In addition, over an extended period, departmental hospital laboratories should increase their capabilities in bacteriology, clinical chemistry and pathology if the hospitals are not located near a provincial hospital where these capabilities are already available.

Provincial hospital laboratories, as well as Laquintinie and Central hospitals, should provide a wide range of laboratory testing capabilities. These laboratories should provide all of the tests other laboratories provide plus additional and more sophisticated clinical tests. These laboratories should serve as the provincial reference laboratory and plan, in the future, to serve as provincial public health laboratories performing water and food analysis and assisting in epidemiology surveillance. Their first priority, in the gradual upgrading of their services, should be the capability of handling the laboratory work for the most significant disease problems of that area. In cases where a disease problem is fairly well confined to one province, that laboratory could serve as an interim reference laboratory for that disease for the other provinces, if it is possible to transport the specimens. For instance, it would be logical for Laquintinie Hospital at Douala to have specialized capability in cholera work. Eventually, when a central national public health laboratory is available which offers additional clinical and epidemiological services, provincial hospitals will be able to refer specimens to the central laboratory for identification or

confirmation. However, care should be taken not to allow the central national public health laboratory to become overloaded with clinical specimens for those tests that may not be yet available in all provincial hospital laboratories.

It is our opinion that a central reference laboratory would start out slowly with a small laboratory workload consisting mostly of bacteriology which is not presently available in most laboratories throughout Cameroon. In addition, such a reference laboratory would probably service those health programs in the general area of its locality. If so, there is, in our opinion, the danger of such a laboratory becoming primarily a clinical rather than a preventive laboratory with an epidemiological service to that part of the national public health system which is responsible for the exercise of continuing scrutiny of the prevalence and spread of diseases.

In our opinion, a central reference laboratory (National Public Health Laboratory) must strongly support rural health in its use of preventive techniques and epidemiological surveillance and control. The ability to accomplish this will take place over an indefinite period of time, depending upon the occurrence of at least some of the other things discussed above.

It is our further opinion that for now and in the immediate future, elementary, developed, and district hospital laboratories should, as a general rule, utilize the laboratory capabilities at the next higher level for tests such laboratories cannot perform. In other words, stay within the province--from the elementary health

centers up to provincial hospital laboratories. Furthermore, it is our opinion that this line procedure should continue into the future even when a national public health laboratory becomes available. Except in special situations, such as epidemics or unusual health problems, most referral laboratory specimens, both clinical and public health, should be sent from the provincial hospital laboratories to the central public health laboratory.

We recognize that this is basically the same referral system recommended in the WHO study. Under present conditions and limitations as previously discussed in this report, we do not believe any other system is possible. It is our opinion that increases in supplies, equipment, training of additional personnel for local level laboratories, and at the same time beginning a program of replacement of old, useless, antique laboratory equipment at all levels where possible, will produce the greatest amount of improvement in the Cameroonian health care delivery system. While these changes are occurring with minimal or additional resources that are presently available, plans for a central public health laboratory should be proceeding to that time when a qualified staff is available to establish and operate a central public health laboratory in Yaoundé. We recommend Yaoundé because in addition to being the nation's capital and the seat of the Ministry of Health, most of the Cameroonian air routes pass through Yaoundé.

In the next section, we outline the development of the laboratory system in phases based on a time frame that allows a gradual improvement in services from the lowest level to the highest without sudden

large budget increases. The time frame is also open-ended. Improvements in services, changes in services, and additions to services can and should continue indefinitely and at whatever rate of speed resources permit. It should be evident that if funds were received from an outside source, the whole process could be speeded up and elements from various phases could be achieved simultaneously.

C. Steps in the Development of a National Public Health Laboratory System

Phase I

Implementation--Immediately

1. Appoint an Acting Director of the National Public Health Laboratory
2. Employ staff
   a. Secretary (1)
   b. Clerk (1)
3. Begin search for or training of a qualified Director
4. Budget
   a. Salaries for: Acting Director
      Secretary
      Clerk
   b. Office space and equipment
   c. Training funds for qualified Director
5. Duties and functions
   a. Acting Director would be designated person at the MHPA as the contact person for all public health laboratories in Cameroon concerning needs and requests for assistance.

b. Acting Director would coordinate with the Under Direction of Pharmacy and Technical Equipment the acquisition and distribution of supplies and equipment, including repairs. No changes are recommended at this time in the present supply and repair system.

c. Acting Director should be designated as the person to receive all public health laboratory monthly workload reports and monitor such laboratory activities from a supply and equipment needs as well as disease surveillance and prevalence of diseases by geographical areas. Workload reports would then be sent to Direction Etudes, Planification et Statistiques for distribution of national health statistics for planning purposes.

Phase II

Implementation--Within first year following employment of Acting Director

1. Increase existing laboratories' capabilities at Elementary and Developed Health Centers to include tests for anemia; urines; albumin and sugars in pregnant women; sputum for tuberculosis; and skin snips for filariasis and leprosy. Departmental Centers for Preventive Medicine should continue and increase, where funds and resources allow, their preventive medicine activities.

2. Begin study to develop a specimen referral system.

3. Staff

Present staff could be trained onsite to perform some of the above additional tests.

4. Budget

Increase necessary for reagents and supplies for laboratories with existing personnel. Additional increases would be necessary for staffing with properly trained personnel those centers not presently staffed and for the necessary supplies and equipment to perform tests.

5. Duties and functions

Acting Director of the National Public Health Laboratory would be responsible for coordinating acquisition of supplies and equipment; assisting in determining which and what additional onsite as well as technical training is needed; assisting in determining what laboratory tests could be added at the lower levels and how to develop a specimen referral system from lower to higher level laboratories within the province.

Phase III

Implementation--During the second year

1. Increase existing laboratories' capabilities at the District Hospitals to include the laboratory testing capabilities of Elementary and Developed Health Centers, plus at least blood chemistries, such as glycemia; hematology; syphilis serology; and urethral/vaginal smears. Departmental Hospital Laboratories should begin to add such capabilities as testing for

cholesterol, electrolytes, and transaminase and elementary bacteriology. Depending on location and proximity to one another, one or both of these should have a small blood bank, if refrigeration is available.

2. Staff

   a. Additional laboratory staff with appropriate training would have to be trained and assigned.

   b. A specially trained individual would probably be required for blood bank capabilities.

3. Budget

   a. Additional funds would be needed to purchase supplies and equipment and to provide time or personnel to train onsite for increased testing capabilities.

   b. Necessary equipment for blood banks.

4. Duties and functions

   At this point, the Acting Director of the National Public Health Laboratory is not expected to have the capabilities or staff to provide the necessary training, but this person could possibly arrange through the MHPA or CUSS to provide onsite training of personnel on a temporary or intermittent basis.

Phase IV

Implementation--During 2nd and 3rd year

1. Improve laboratory testing capabilities of provincial hospitals, including Central and Laquintinie, to provide complete bacteriology, particularly water examinations.

Present testing capabilities should first be improved, however, by beginning a selective program of replacing old or worn out laboratory equipment. The first new equipment should be acquired for performing tests in those areas where laboratory confirmation is most critical to the physician and patient. In other words, establish a replacement priority list.

2. Staff

   Existing staff plus assistance from program officials in Ministry could be used.

3. Budget

   This would require a very large budget appropriation to accomplish in 1 or 2 years. Nevertheless, equipment replacement should be begun as soon as possible and continue for as long as necessary.

4. Duties and functions

   a. The Acting Director and his staff should begin an inventory of all equipment in provincial hospital laboratories, including information necessary to establish a priority replacement list. Factors other than age or whether the equipment is working, such as affect on health care delivery, should be considered.

   b. Increase the variety of tests available in provincial hospital laboratories, especially diagnostic bacteriology and examinations of drinking water supplies.

Phase V

Implementation--During third year

1. Obtain a qualified Director of the National Public Health Laboratory and certain staff personnel. It has been anticipated that a search for or training of a person to become Director would have been going on since Phase I. Such a person should be available during the third year, if possible. He should be knowledgeable in both general and laboratory medicine. Equally important to a sound medical knowledge is an understanding of the principles and practices of management and the ability to apply these successfully.

   In addition to a qualified Director, the beginning of a qualified staff should also be available. The Director will need the assistance of certain specialists in order to expedite the rate at which improvements are made to laboratory operations. Three specialists should be added to the staff as soon as funds permit. These are a Planning Specialist, a Supply Specialist, and a Training Specialist. The titles used in this report are to illustrate the purpose of these jobs; the actual titles used should be those that conform to the Cameroonian pattern of titles. The main purpose of each of these specialists would be to assist the Director in carrying out the duties of the Director's Office. Principal duties of the Office of the Director are outlined below in Subsection 4.

Changes in direct or line supervision of laboratories in the networks that exist in Cameroon are not anticipated. The Director cannot exert direct or line supervision over every public health laboratory in Cameroon. However, he can and should be responsible for the technical aspects of laboratory operation and should be authorized to coordinate the management of the laboratory systems with the Direction of Health Facilities, Preventive Medicine, and Pharmacy.

2. Employ staff

   a. Director

   b. Secretary (1)

   c. Clerks (2)

   d. Planning Specialist (1)

   e. Supply Specialist (1)

   f. Training Specialist (1)

3. Budget

   a. Salaries for staff

   b. Office space

   c. Travel funds for Director and Training Specialist

4. Major Duties of the Director, National Public Health Laboratory

   Major duties of the Director, with the assistance of his staff, should include:

   a. Know health goals, objectives, and priorities of MHPA.

b. Prepare and present plans for the public health laboratories to assist in attaining goals and objectives of MHPA.

c. Determine resources (budget, personnel, supplies and equipment, facilities) required to meet goals and objectives.

d. Translate plans and resources into public health laboratory services to assist and improve health care delivery.

e. Monitor and evaluate public health laboratory services to determine the extent to which actual services are in agreement with those planned, taking corrective actions when necessary.

f. Obtain and analyze laboratory workload data for epidemiological surveillance of transmissable and social diseases.

g. Collect statistical data and information to show the relationship between prevalence of disease problems and delivery of laboratory services.

h. Modernize and standardize laboratory equipment, supplies and techniques on a continuing basis.

i. Make recommendations for improvement in methods of training and coordinate training and retraining of laboratory personnel.

j. Provide consultation on laboratory medicine to health programs within the MHPA as well as others.

k. Begin planning for the time when funds will be available to construct a national central laboratory facility.

5. Principal Duties of the Planning Specialist

Thorough and effective planning requires a substantial amount of time and particular skills. While planning is a major function of the Director, assistance in carrying out the details of this planning should be provided the Director at an early date. We recommend employment of a Planning Specialist, who has been trained in the collection, evaluation, and use of data and in management analysis and systems development. Principle duties of the Planning Specialist are primarily to assist the Director in formulating plans for laboratory services. More specifically, his duties are concerned with 4. b. through g. and k. above.

This will also involve working closely with Direction Etudes Planification et Statistics to insure that any assistance available from it is used and to avoid needless duplication of effort.

In addition to the above, the Planning Specialist will be directly responsible for the following:

a. Identifying deficiencies in the existing reporting system and developing proposed measures for correcting or, at least, alleviating deficiencies; implementing approved corrective measures. This duty would include working with those responsible for the design and processing of reporting forms and actual design or redesign of individual reporting forms and reporting systems.

b. Developing data to show costs for opening a new laboratory at each level in the organizational structure (national, provincial, departmental, district, local). These costs would include personnel, supply, and equipment costs.

c. Developing data on laboratory workload performed and costs of individual tests. Bringing these data to the attention of the Director for use in establishing priorities, such as between opening laboratories at new dispensaries and adding and/or improving existing hospital laboratories.

d. Studying the existing communications and transportation systems and making plans to use them as effectively as possible in communications and transportation related to national medical laboratory services; making recommendations to the Director concerning needs for improved communications and transportation services and how these improvements might be obtained.

6. Principal Duties of the Supply Specialist

Actual procurement of equipment and laboratory supplies is now the responsibility of the Department of Pharmacy in the Ministry of Health and Public Assistance. The present supply system is described in Appendix A.

We do not propose that the Supply Specialist duplicate the work of the Department of Pharmacy. We do not propose any procurement responsibilities for the Supply Specialist.

Instead, we propose that the Supply Specialist give attention to evaluating how well the supply system is serving the needs of laboratories, to advising laboratorians with regard to how they can better use the existing supply system, and to providing, after approval by the Director, suggestions to the Department of Pharmacy, for improving the supply system as it relates to serving laboratories. Previous studies of the national laboratory system have identified equipment standardization, repair, and maintenance as major problems. Corrective action has already been started. An equipment repair specialist in the Department of Pharmacy is training teams of repair specialists to be stationed as two-man teams in the headquarters of each province; the teams will travel about the province repairing laboratory and other equipment used by medical services.

More specifically, the duties of the Supply Specialist would include:

a. Becoming informed, through study of existing records and reports and visits to laboratories, of the existing supplies and equipment in use, including the equipment repair and maintenance system, and the extent to which the system meets the needs of the laboratories served; recording deficiencies in the existing system and establishing priorities for their correction.

b. Establishing and maintaining records of the existing system to show types and volumes of supplies and equipment used. Determining usage rates.

c. Developing records to show how major items of equipment perform under actual conditions and which items give the best service; developing lists of problems encountered in repair and maintenance of equipment by manufacturer and model; making recommendations to return for credit or a refund those equipment items that are currently in demand, but which are inoperable and cannot be repaired in the Republic of Cameroon.

d. Working with the repair and maintenance personnel of the Department of Pharmacy to develop lists of recommended equipment that give the best service, to standardize equipment items, and to develop preventive maintenance programs.

e. Working with the proposed Planning Specialist and Training Specialist to develop a list of supplies and equipment required for each test actually performed.

f. Developing recommendations for storage of supplies where special precautions are needed to avoid contamination or deterioration due to heat, humidity, or other unusual conditions. Developing reagent control system.

g. Learning existing and potential sources of supplies and equipment, with emphasis on those located in the Republic of Cameroon. Making recommendations for use of these sources to meet emergency requirements.

h. Working with the Training Specialist and with Supply and Equipment Specialists in the Department of Pharmacy

to develop plans for training laboratorians on use of supplies, including how to procure these supplies, and on preventive maintenance and repair of equipment items.

i. Observing the operations of the supply and equipment distribution systems, identifying situations where overages and shortages have occurred, and making recommendations for redistribution in accordance with needs.

j. Working with the schools that train laboratorians to insure, to the extent feasible, that supplies and equipment used in training laboratorians are of the same type that will be used when the laboratorians are placed in jobs.

7. Principal Duties of the Training Specialist

The principal purpose of the Training Specialist should be to study the national needs for laboratory personnel and to develop plans and recommendations for securing this trained personnel and maintaining this force of trained personnel at the desired level in terms of numbers and proficiency. Specific duties and responsibilities of the proposed Training Specialist include:

a. Developing information on sources of initial training and of refresher training and continuing education available to train personnel of the national laboratory system. This should include sources of specialized

training that might be obtained from other African nations and other nations of the world. Developing plans for using these sources of training.

b. Obtaining information on how well the training received by laboratorians is meeting needs and working with those who train the laboratorians on measures to improve training. This includes better training in what is being done and training in new and improved procedures.

c. In cooperation with the Planning Specialist, the Supply Specialist, and members of the staffs of schools training laboratory personnel, preparing procedural packages to guide laboratorians working in laboratories at each level in the national medical laboratory system; distributing these procedural packages and checking at each laboratory visited to insure that these packages are on hand and properly used; instructing laboratorians in the use of these procedural packages.

d. Evaluating needs for training laboratory personnel to do simple routine preventive maintenance and minor repair of equipment and on how to use the supply system. This will involve working closely with and obtaining advice from the Supply Specialist and from supply and equipment maintenance specialists in the Department of Pharmacy.

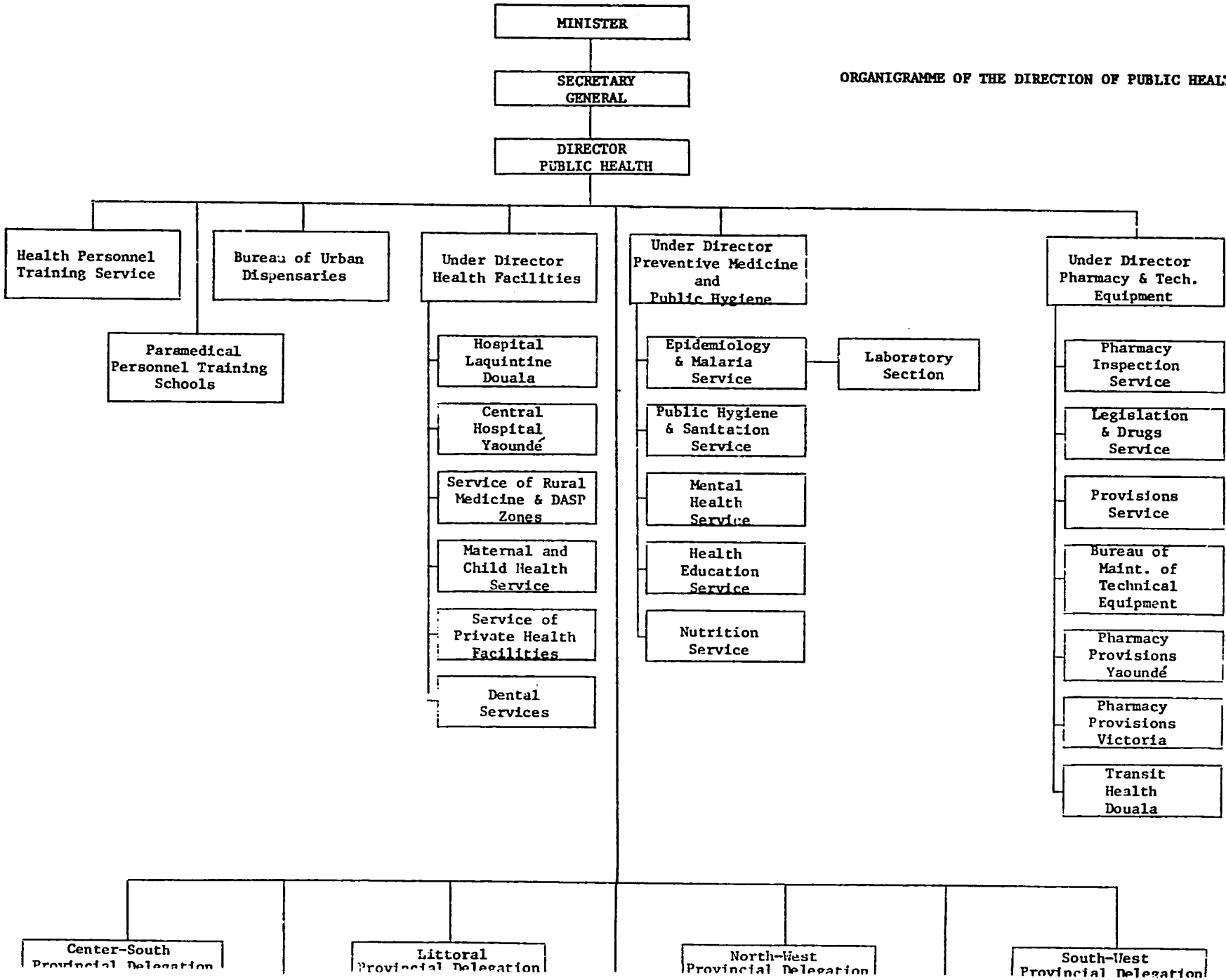
Phase VI

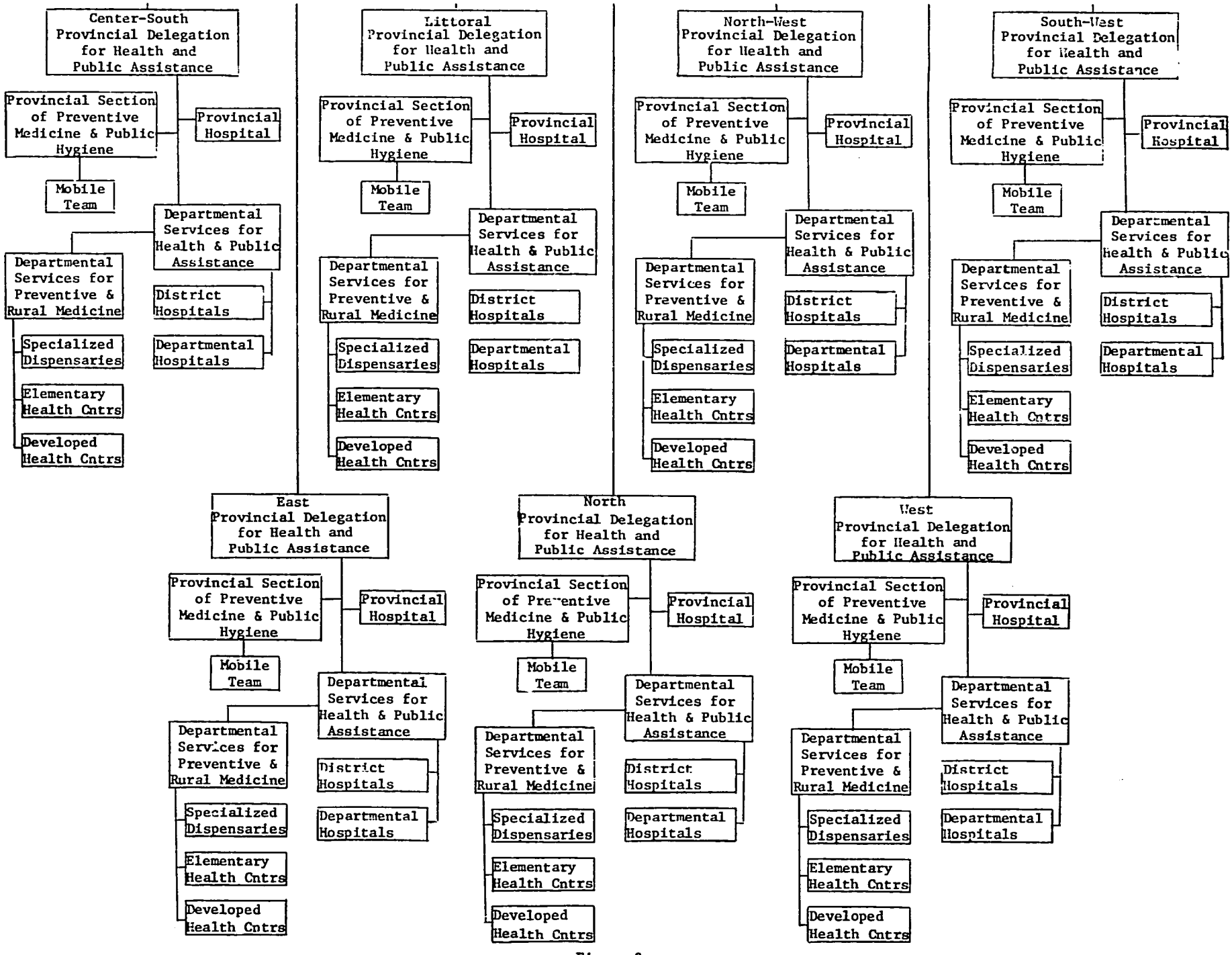
Implementation--as soon as funds/personnel/adequate laboratory facility become available

1. It was recommended under Phase V that a qualified Public Health Laboratory Director be obtained with a beginning staff. It is now recommended that a Chief, Laboratory Services, be appointed as the focal point for the national laboratory system at the Under Direction level. Although, to this point we have recommended that the National Public Health Laboratory remain under Epidemiology and Malaria in Preventive Medicine, we now recommend that the above change take place in the MHPA organizational structure when the four essentials to develop an adequate national public health laboratory system are in place (see Part VI, Section B, page 74 of this report).

   The Laboratory Service should be at a level equivalent with Under Directions of Health Facilities, Preventive Medicine, and Pharmacy and Technical Equipment. As the organizational chart of the Direction of Public Health (Figure 3, page 96) shows, most of the health programs which require laboratory support services are contained in these three Under Directions. Therefore, in order for laboratory assistance and support to be available, the Laboratory Service must be aware of the program needs and must participate in such plans.

ORGANIGRAMME OF THE DIRECTION OF PUBLIC HEALTH




Center-South Provincial Delegation for Health and Public Assistance
Provincial Section of Preventive Medicine & Public Hygiene
Provincial Hospital
Mobile Team
Departmental Services for Health & Public Assistance
Departmental Services for Preventive & Rural Medicine
District Hospitals
Specialized Dispensaries
Departmental Hospitals
Elementary Health Cntrs
Developed Health Cntrs
Littoral Provincial Delegation for Health and Public Assistance
Provincial Section of Preventive Medicine & Public Hygiene
Provincial Hospital
Mobile Team
Departmental Services for Health & Public Assistance
Departmental Services for Preventive & Rural Medicine
District Hospitals
Specialized Dispensaries
Departmental Hospitals
Elementary Health Cntrs
Developed Health Cntrs
North-West Provincial Delegation for Health and Public Assistance
Provincial Section of Preventive Medicine & Public Hygiene
Provincial Hospital
Mobile Team
Departmental Services for Health & Public Assistance
Departmental Services for Preventive & Rural Medicine
District Hospitals
Specialized Dispensaries
Departmental Hospitals
Elementary Health Cntrs
Developed Health Cntrs
South-West Provincial Delegation for Health and Public Assistance
Provincial Section of Preventive Medicine & Public Hygiene
Provincial Hospital
Mobile Team
Departmental Services for Health & Public Assistance
Departmental Services for Preventive & Rural Medicine
District Hospitals
Specialized Dispensaries
Departmental Hospitals
Elementary Health Cntrs
Developed Health Cntrs
East Provincial Delegation for Health and Public Assistance
Provincial Section of Preventive Medicine & Public Hygiene
Provincial Hospital
Mobile Team
Departmental Services for Health & Public Assistance
Departmental Services for Preventive & Rural Medicine
District Hospitals
Specialized Dispensaries
Departmental Hospitals
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Developed Health Cntrs
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Provincial Hospital
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Departmental Hospitals
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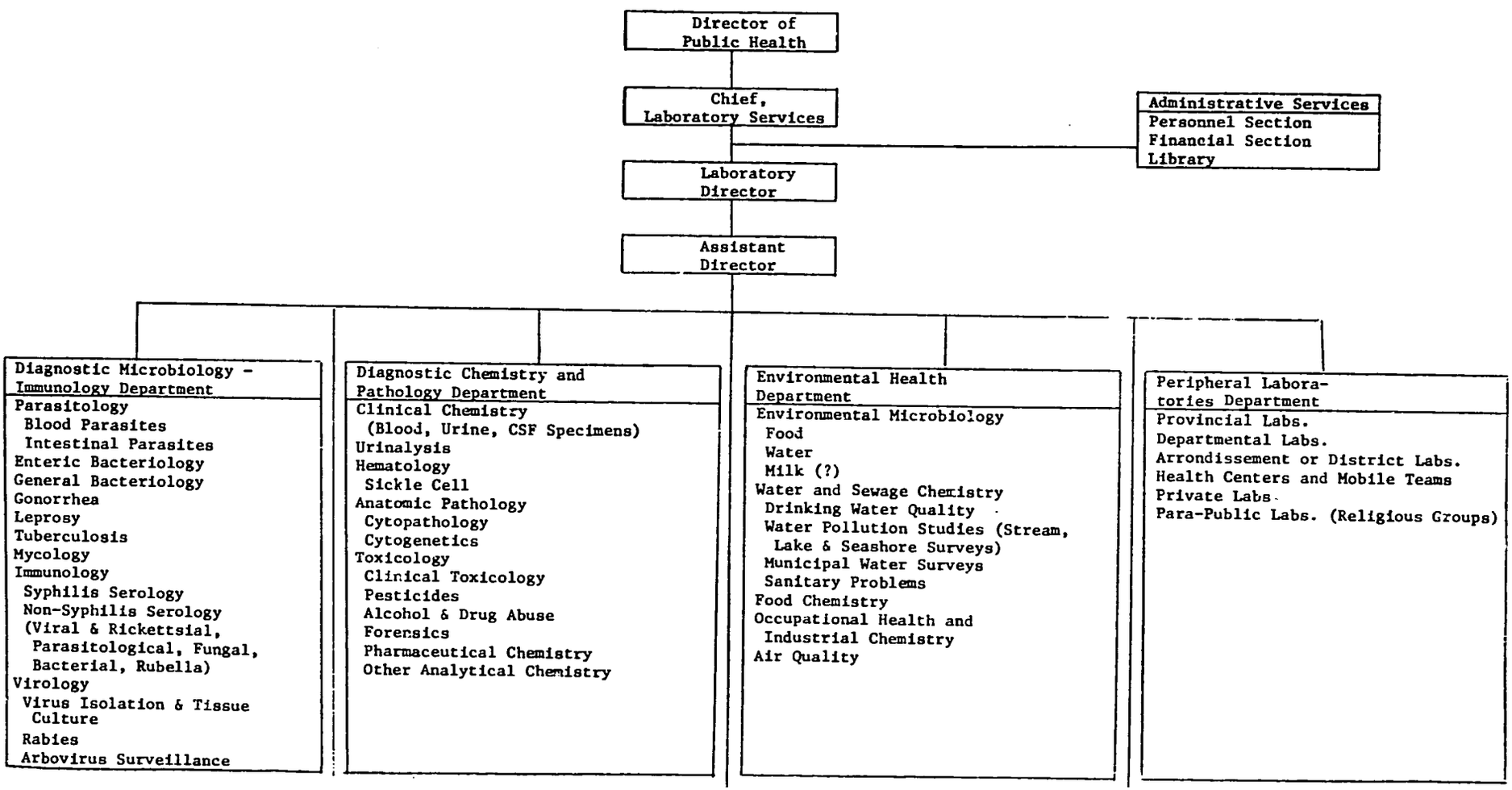
Provincial Section of Preventive Medicine & Public Hygiene
Provincial Hospital
Mobile Team
Departmental Services for Health & Public Assistance
Departmental Services for Preventive & Rural Medicine
District Hospitals
Specialized Dispensaries
Departmental Hospitals
Elementary Health Cntrs
Developed Health Cntrs

Figure 3

Once the essentials are in place, laboratory services can be expanded in other areas. The study team is aware of the broad services contemplated for future growth. Figure 4, page 98, represents what the study team envisions as long-range growth for a central laboratory. In this suggested laboratory organization, there are eight departments reflecting the type of services each department would be responsible for. These services may not be all inclusive, nor are they fixed. The main purpose of Figure 4 is to illustrate a goal with an illustration of the growth features for planning and expansion purposes.

2. Expand Laboratory Service capabilities to offer a central laboratory reference service on a national basis.
3. Employ additional staff:
   a. Chief, Laboratory Services (1)
   b. Microbiologist (1)
   c. Biochemist (1)
   d. Serologist (1)
   e. Other technical, support, and administrative personnel, as necessary and when financial resources become available.
4. Budget
   a. Salary for Chief, Laboratory Services, at the Under Direction level
   b. Salary for microbiologist (1)

PROPOSED LONG-RANGE GROWTH FOR A NATIONAL PUBLIC HEALTH LABORATORY SERVICE UNITED REPUBLIC OF CAMEROON



Technical Support Department

Records and Reports
- Specimen Registration
- Preparation and Distribution of Reports
- Filing, Tabulation, and Analysis of Records
- Statistical Studies
- Epidemiological Surveillance of Transmissible and Chronic Diseases

Services and Supplies
- Supplies and Equipment - Procurement, Distribution, Maintenance, Storage, Installation and Repair, Inventory
- Specimen Outfit Preparation
- Janitorial Services
- Mail and Courier Services
- Printing and Duplication Services
- Building Maintenance
- Security
- Motor Vehicles

Scientific Services
- Media Preparation
- Glassware Cleaning and Sterilizing
- Laundry
- Animal Breeding and Care

Consultation and Training Department

Training Programs
- Short Courses
- Individual Training
- Training of Other Students in Microbiology, etc. (Medical Students, Nurses)
- Training of Lab. Assistants, Technicians
- Laboratory Inspection and Evaluation
- Proficiency Testing
- Training Aids
- Publications

Applied Research Department

- Development and Testing of Procedures
- Zoonoses
- Research on Disease Problems of Cameroon
- Research Regarding Laboratory Test Methodology
- Research Regarding Laboratory Equipment, reagents and Shipping Containers

Blood Bank and Biological Products Department

- National Blood Bank Service
- Blood Derivatives
- Bacterial Vaccines
- Viral Vaccines
- Testing and Control
- Reagents Preparation
- Product Analysis
- Immunohematology

Figure 4

c. Salary for biochemist (1)

d. Salary for serologist (1)

e. Salaries for necessary support and administrative personnel for above, plus equipment and supplies.

f. Salaries and support for other professionals as resources available will permit expansion beyond this point.

5. Major Duties of the Chief of Service

a. Study, plan, and make recommendations through the Director of Public Health concerning proposed health care delivery programs requiring laboratory services and support.

b. Implement governmental policies with regard to health laboratories.

c. Coordinate activities of the National Public Health Laboratory Service with other health activities.

d. Coordinate activities between health laboratories and research and teaching institutions.

e. Integrate reports into the national disease surveillance system.

6. Duties and Functions of the National Public Health Laboratory

a. Perform those duties and functions, except those of coordination at the MHPA level, previously described in Phases I through V, plus the additional duties that follow.

b. Perform laboratory tests which are directly related to public health goals and programs of the Ministry.

c. Provide those tests required to assist provincial hospital laboratories in their programs of control of transmissible diseases. It is not anticipated that the National Public Health Laboratory become primarily a clinical laboratory, but will serve to confirm tests and identify isolates. It will also perform tests that are not available elsewhere.

d. Through the Chief, Laboratory Services, coordinate the identification of bacterial and viral isolates with the international (WHO) reference laboratories.

e. Assist in the continuous training and recycling of laboratory technicians.

D. Synopsis of Managerial Considerations in the Laboratory System

The conduct of a national public health laboratory system, as pointed out throughout this report, involves management considerations of many types and in many areas of operation. Those persons chosen to direct and guide the various aspects of the laboratory system through its various phases into a cohesive, viable, and serviceable organization will be presented with many challenges and opportunities to use a great many skills. Although they will need some management training, much of their management knowledge will have to come from on-the-job experience through the exercise of their responsibilities. We discuss below some of the more important management considerations with which they will be concerned.

1. Definition of line authority, staff authority, and technical authority. Line authority involves a supervisor and his

subordinates who are part of the vertical chain of authority and all of whom contribute directly to the services of the organization. As an example, a laboratory technologist is responsible to his immediate department head, who in turn is responsible to the Laboratory Director. The Laboratory Director is responsible to the Chief, Laboratory Services, and he is responsible to the Director of Public Health, who is responsible to the MHPA. In staff authority, workers function in advisory capacities. They generally facilitate the work of those in line authority, such as personnel administrators and budget personnel.

Technical authority involves the authority to dictate test methodology, qualifications of personnel, training needs, and equipment, reagents, and other supplies to be used. It relates only to technical matters and does not involve any line type of supervision. As previously pointed out on page 87 , the Director of the National Public Health Laboratory cannot exert direct or line supervision over every public health laboratory in Cameroon. He can and should be responsible for the technical aspects of laboratory operation. This concept is depicted in Figure 5, page 102.

LINE AND TECHNICAL SUPERVISION IN THE
NATIONAL PUBLIC HEALTH LABORATORY SERVICE

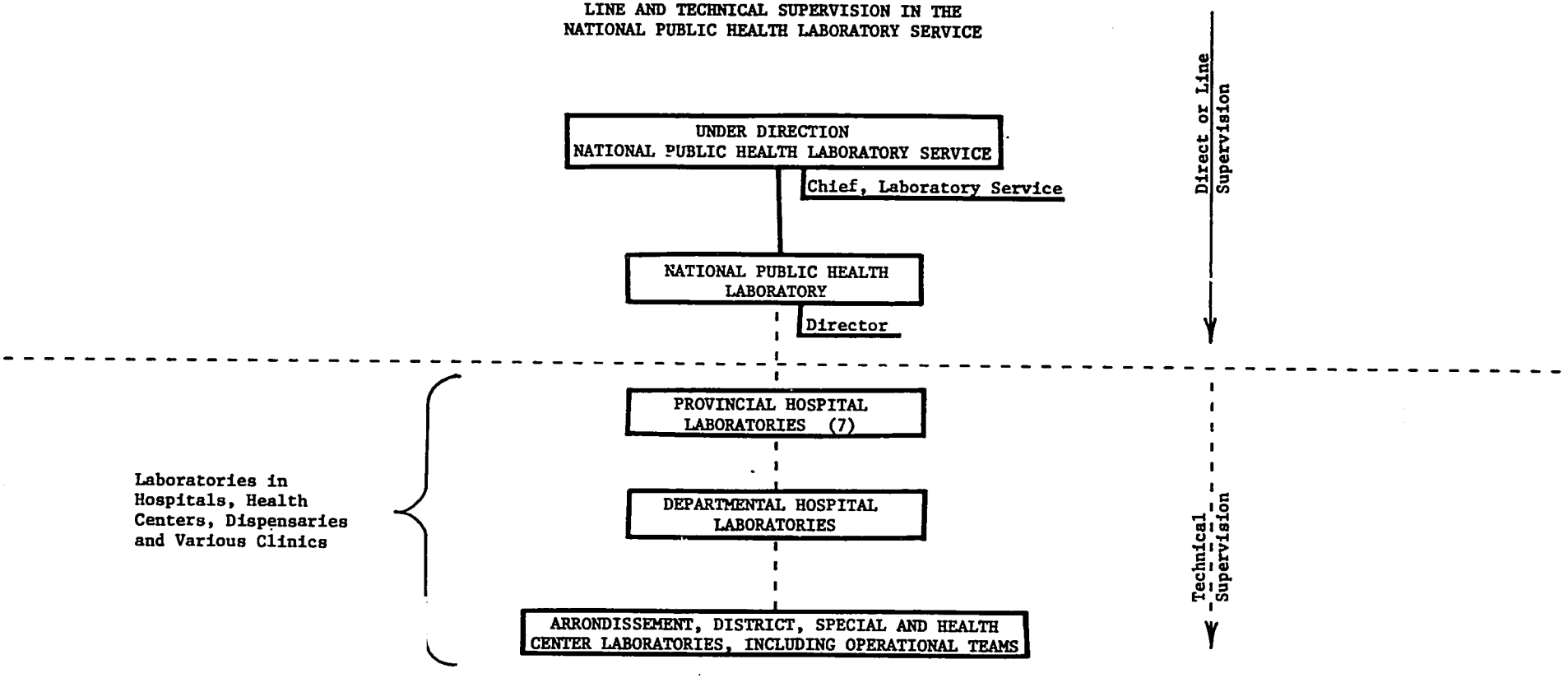


Figure 5

2. Setting Priorities and Objectives. This is one of the manager's most important duties and one of the first to be performed. Decisions must be made as to what the national public health laboratory wants to accomplish, objective by objective, and in what priority order. These objectives should be specific, such as providing proper reagents to all peripheral laboratories by a certain date. Then, decisions must be reached as to how these objectives can be reached. Having plans with specific objectives makes it easier to justify budget requests to outside authorities who do not necessarily understand the technical aspects of health care. Seeking opinions and viewpoints before setting priorities and objectives from such diverse groups as peripheral level employees, other managers in the Ministry of Health, private health care providers, and the general public also helps.

3. Coordination. This is another of the very important managerial considerations. Since the Laboratory Director and Chief of Service will have to coordinate laboratory plans with many levels of administration and will have the technical control of many levels of laboratories throughout the nation, the public relations aspect of the position cannot be too strongly emphasized. This will involve setting up and maintaining communications with all of these groups, informing them of all aspects of the laboratory's

plans and programs, such as standardized procedures, standardized equipment and supplies, and the current objectives. Feedback from them should be invited.

4. Information System. The collection of data is vital to the management of the laboratory system. A laboratory workload reporting system which includes all laboratories in the nation should be set up and maintained. With reliable workload data plus other statistical data, such as morbidity and mortality data, management will be able to assess the health needs of the population and the role the laboratory system must play in meeting these needs. This information must be used in formulating the priorities and objectives discussed above. It can also be used to back up requests for funds, both from the national budget and outside sources. Information is also needed for evaluating the success or failure of various programs, to determine how resources are being used, to analyze costs in terms of benefits received, and to avoid or eliminate duplication and waste in order to make the most effective use of whatever resources are available.

5. Forms Design. Forms must be designed to collect the desired data and distributed to all laboratories with detailed instructions on the tabulations and reporting of their data. Timely submission of reports is essential to the system, so every laboratory must be encouraged to meet deadlines. Standardized specimen forms should also be used uniformly throughout the country.

6. Procedural Guidance. The Laboratory Director and/or the Chief of Service will need to oversee the preparation of policy and procedural guidelines for both technical and nontechnical personnel. The use of policy manuals, manuals showing organization and functions, and administrative manuals will make the management functions of coordination and standardization much easier. First priority, however, should probably be given to the preparation of laboratory "packages" of information for the various levels of laboratories in the system. A package would contain instructions on each test to be performed at that formation, and the specific procedure recommended for each test. A procedures manual should be provided; it should contain illustrated step-by-step procedures for each test to be done, a list of the supplies needed for each test, and the equipment to be used. Lists should also be provided of total supplies and equipment needed and of personnel needed, by number and training, at each level. The package should also contain written instructions for performing preventive maintenance and minor repair of equipment. Instructions should also be given to all laboratories on how to refer specimens to a higher level laboratory, how to record and report examination results, and how to report workload volumes. They should have technical information on procedures for washing and sterilizing laboratory glassware, quality control procedures, and procedures concerning laboratory safety.

Examples of how procedures might be prepared to guide those working in laboratories at the elementary level are shown by procedures covering two examinations: stool examinations for parasites and blood examinations for malaria. These are contained in Appendix C of this report. They illustrate how procedures should be written for the packages to be distributed to each laboratory. These procedures were prepared by personnel in CDC's Laboratory Training Division and are to be regarded as examples only, not as recommendations for procedures to be used.

7. Supply System and Training. Most of the managerial considerations in these areas can be derived from previous sections, particularly the description of the duties of the Supply Specialist and the Training Specialist. Activities in these two areas will require a team effort, as well as coordination with other Directions and Services.

VII. CLOSING REMARKS

In this report, we have discussed health problems in Cameroon, laboratory services now available, problems experienced in carrying out these services, recommendations for handling these problems, and proposals for the development of a national public health laboratory system.

In brief, we have recommended that improvements begin with the appointment of an Acting Director, who will be responsible for coordinating and directing the system. Improvements in laboratory services should begin at the local level in the peripheral areas and progress on up through the district, departmental, and provincial levels. A provincial hospital laboratory should serve as the reference laboratory for the province. Improvements at the local levels should begin with furnishing all laboratories with adequate supplies, adequate equipment and maintenance of equipment, and sufficient training for the laboratory work that is needed at each facility. Once these improvements have been made, efforts can be directed toward constructing and staffing a national public health reference laboratory at Yaounde.

We have not discussed in depth many aspects in the development of a national public health laboratory system because we believe that they may not be pertinent to the beginning phases of the development. Officials of the MHPA, however, may request further details as needed. Booklets, manuals, bibliographies, and other printed materials on many topics can be furnished. Upon request, future studies might be done in such areas as supply systems, job classification, facilities planning, forms design, training, and technical procedures.

A P P E N D I C E S

Appendix A

The Present Supply System

The procedure for determining laboratory supplies and equipment to be ordered on an annual basis and for purchasing, receiving, storing, and distributing supplies and equipment to the eventual user is as follows:

1. A credit limit is established for each medical facility. A facility can place an annual order for supplies, medicines, and equipment, subject to the credit limit established for it. In May of each year, each health facility is furnished a list of supplies that may be ordered.

2. The physician in charge of medical services in the area sends to each medical installation a copy of the list of supplies and equipment available and requests that quantities of each item desired be determined, recorded on the list, consolidated, and returned.

3. Each medical installation having a pharmacist depends on the pharmacist to determine the quantity of each laboratory supply and equipment item that should be ordered and records these quantities on the order form. Orders for all types of medical supplies and reagents, in addition to laboratory supplies and equipment, are also determined and recorded on standard order forms.

4. The medical officer in charge of the installation reviews the combined order for all types of medical equipment and supplies and

makes changes as necessary to conform to the supply and equipment budget and as seems desirable to properly allocate supplies and equipment between the several using organizations.

5. Supply and equipment budgets are consolidated and reviewed and changes are made at each successive level in the organizational hierarchy until the budget for the entire Ministry of Health is prepared by the Under Direction of Pharmacy in June.

6. In July of each year, the Ministry of Health is informed of its budget. Vendors are then informed of the types and quantity of each item in the Ministry's budget and given an opportunity to submit bids which must be submitted by mid-November.

7. A commission meets in mid-December to consider the bids that have been received. The Ministry of Health can choose the vendor on bids of less than 10 million francs. Bids of 10 to 20 million francs must be approved by the Ministry of Finance, and bids of 20 million and over must have approval from the Ministry of Health, Ministry of Finance and National Council. This approval normally requires 3 to 4 months and a recheck with the selected vendor to determine whether prices have changed since the bid was submitted. The whole process for purchases of 20 million francs or more requires about one year. However, equipment and supply orders of less than 10 million francs are normally placed in December and are received and placed in a central warehouse by June.

8. Equipment and supplies are then distributed from the central warehouse once annually. More frequent distribution has been considered but rejected due to inadequate means of transportation. The Ministry of Health does not have its own vehicles for making distribution and uses the services of the Ministry of Transportation. Delays due to impassable roads during the rainy season are common. Initial distribution is made from the central warehouse to the departmental level. Then the department medical officer must get the supplies and equipment delivered to lower levels in the organizational hierarchy at the sites where they are to be used. This distribution is frequently difficult to carry out due to shortage of transportation equipment.

Appendix B

*Governmental Decree No. 75/212

A. Minister of Health and Public Assistance

Charged with organization of the Direction and administration of Directors, Services, and Public Establishments that set into practice policies for health and social protection.

Vice-Minister

Propels social action and directs services to that end.

B. The Central Administration

Secretary General

(1) Executes policies of the Minister and Vice-Minister;

(2) Coordinates activities of Directors;

(3) Responsible for material organization and harmonious function of all services within MHPA;

(4) Responsible for permanent training of personnel.

C. The Director of Public Health

(1) Charged with coordination of medical and pharmaceutical services through three Under Directors;

(a) Health Formations;

(b) Preventive Medicine and Public Hygiene;

(c) Pharmacy and Technical Equipment;

(2) Public relations with professional organizations;

*Note: This is an outline of the organization of the Ministry of Health and Public Assistance as the organization depicts the Director of Public Health and his responsibilities.

(3) Regulation of doctors, dentists, surgeons and paramedical professions;

(4) Control, through Under Director of Pharmacy and Technical Equipment, of professional pharmacists;

(5) Control of schools for development of health personnel;

(6) Control of legal and occupational medicine in collaboration with other Ministerial Departments;

(7) Responsible for Health Advisory Committees.

Deputy Director

Responsible for training health personnel; liaison with foreign and international training organizations; particularly training health personnel at CUSS.

D. Under Direction of Health Formations

Responsible for:

(1) Defining government policy on basic health services;

(2) Study internal and technical organization of hospital services;

(3) Study implementation of hospital policy;

(4) Participation in preparation of launching of construction conducted by Direction of Studies, Planning and Statistics;

(5) Define programs to supply and equip health formations planned in close liaison with Under Director of Pharmacy and Technical Equipment;

(6) Technical control of fixed public and private health formations;

(7) Collection and management of inspection and activity reports from above formations;

(8) Maternal and Child Health;

(9) Development of Dental Services.

The following services are under the Direction of Health Formations:

(1) Service of Rural Medicine and Demonstration Zones in Public Health (DASP Zones)

(2) Maternal and Child Health Services

(3) Dental Services

(4) Service of Private Health Formations

(5) Bureau of Urban Dispensaries

(6) Central Hospital Yaoundé

(7) Laquintinie Hospital Douala

E. Under Direction Preventive Medicine and Public Hygiene

Responsible for:

(1) Organization, functioning and technical control of all preventive medical services;

(2) Technical control of private formations specializing in prevention and prophylaxis;

(3) Case finding, prophylaxis, endemics, epidemics, and socia diseases;

(4) Study of the implementation of governmental policy in regard to environmental and alimental hygiene;

(5) Promotion of health and nutrition education;

(6) Execution of sanitary measures provided by International Convention, especially the protection of sea, air, and land frontiers;

(7) Elaboration of plans for supply of preventive medicine services.

The following services are under the Direction of Preventive Medicine and Public Hygiene:

(1) Epidemiology and Malaria Service

(2) Public Hygiene and Sanitation Service

(3) Health Education Service

(4) Mental Health Service

(5) Nutrition Service

F. Under Direction Pharmacy and Technical Equipment

Responsible for:

(1) Elaboration of plans and programs for replenishing pharmaceutical and technical equipment for the public health services in liaison with Under Directions of Health Formations and Preventive Medicine;

(2) Elaboration of pharmaceutical legislation and liaison with Direction of Studies, Planning and Statistics;

(3) Organization, coordination, and supervision of execution of (1) and (2) above;

(4) General inspection of the pharmaceutical services of public and private health formations, private pharmacies, medical depots;

(5) Control of narcotics and carrying out international conventions as regards narcotics.

The following services are under the Direction of Pharmacy and Technical Equipment:

(1) Pharmacy Inspection and Certification Service

(2) Legislation and Narcotics Service

(3) Supply Services:

a. Pharmacy Supply, Yaoundé

b. Pharmacy Supply, Victoria

c. Transit Health, Douala

(4) Bureau of Materials and Technical Equipment

G. Provincial Delegate for Health and Public Assistance

Responsible for:

(1) Coordination and control of all health entities, both public and private, existing in his province;

(2) Planning of means and services in his province;

(3) Coordination of all medical-social activities;

(4) Health education;

(5) Public hygiene and sanitation;

(6) Inspection of all public and private health formations in his province;

(7) Responsible for various administrative duties and personnel actions.

Provincial Delegations for Health and Public Assistance (7 Provinces)

Composed of the following:

(1) Provincial section of Preventive Medicine and Public Hygiene

a. Mobile Teams

(2) Provincial section of Health Formations and Nursing Care

(3) Provincial section of General Administration

(4) Provincial section of Social Affairs

(5) Provincial section of Pharmacy

(6) Provincial section of Translation

H. Chief, Operational Teams for Epidemiology and Intervention (Mobile Teams)

Responsible for:

(1) Technical directives from the central organisms through the intermediary of the Provincial Delegate;

(2) Elaborates with the assistance of the Departmental Service of the province under the supervision of the Provincial Delegate for plans and programs for vaccinations, public hygiene, sanitation, health and nutrition education;

(3) Submits for approval of the Provincial Delegate preventive plans and programs, organizes their execution and supervision;

(4) Centralizes health information and results of investigations for transmission to the interested central services;

(5) Assures continuous training of his personnel in preventive medicine and public hygiene (training and recycling);

(6) Organizes and oversees execution of programs for health, social, and nutritional education in close cooperation with Chief, Departmental Services for Health and Public Assistance.

I. Departmental Services for Health and Public Assistance

Responsible for:

(1) Coordination, supervision, and control of all health and social services in the Department;

(2) Assures proper function of all medical-social formations, both public and private in Department;

(3) Jurisdiction over Departmental Services for Rural and Preventive Medicine.

J. Departmental Services for Rural and Preventive Medicine

Responsible for:

(1) All medical-sanitation activities;

(2) Supervision of public and private rural health centers;

(3) Implementation of fixed programs in the fight against transmissible diseases;

(4) Following activities in specialized dispensaries, leprosy hospitals, tuberculosis dispensaries, and venereal disease centers located inside the Department;

(5) Centralizes and transmits directly to MHPA (Direction of Studies) statistics from all Health Formations, both public and private, of the Department.

Appendix C

Parasitology Procedures

I. STOOL EXAMINATIONS

A. Collection of Specimens

1. Give patient a waxed cardboard box, an empty glass jar or a plastic box.
2. Specimen must be at least 4 to 5 cmm. (about 1 teaspoon size)
3. Specimen must not be contaminated with water, urine, or dirt. These things will interfere with accurate identification of parasites.
4. Specimens must reach the laboratory immediately after passage--within 1 hour.

B. Examination of Specimens

1. Examine liquid and soft specimens first. These may contain protozoan trophozoites which will die within a few hours outside the body.
2. Examine formed specimens after all liquid and soft specimens have been examined.
3. Keep specimens in a shaded cool area. Do not leave them in direct sunlight. The heat will destroy the organisms.

C. Techniques for Examining Stool

1. Prepare a simple direct mount in physiological saline (.85 or .9%) as follows:

    a. With a medicine dropper or pipette place a drop of saline on a glass slide.
    b. Pick up a small amount of feces on the end of a toothpick or applicator stick.
    c. Mix the feces with the saline. Be sure to mix thoroughly. The density of the suspension is important. It should be thick enough to barely read fine print clearly through it. See Figure 1. Too thick or too thin preparations are not satisfactory.
    d. Place a coverslip over the suspension, and check the density as shown in Figure 1.
    e. Examine with the low power (10X) objective of the microscope in a systematic manner as indicated in Figure 2.
    f. Helminth eggs can usually be identified with this magnification. Higher magnifications will be needed for protozoa.

2. Nuclei of protozoa will not be visible in saline mounts. Iodine must be used to demonstrate nuclei of cysts.

   a. Place a drop of iodine on the slide and prepare a fecal suspension mount as described for saline.
   b. Examine as described for saline.

D. Equipment and Materials Needed

1. Microscope
2. Lens paper (to clean lenses of microscope)
3. Applicator sticks or toothpicks
4. Physiological saline. See attached formula. (I, page 126)
5. Iodine. See attached formulas. (II, III, and IV, page 126)
6. Dropping bottles (small bottles with pipettes fitted) Figure 3. Or, small bottles with stoppers or screw caps and medicine droppers. Each laboratory should have 1 bottle for saline and 1 bottle for iodine. Extra bottles should be available in case one should be broken. Bottles should hold about 30 ml or 1 oz of solution.
7. Coverslips--22 mm square. #1 thickness preferred. #2 thickness can be used but are not as satisfactory as #1.
8. Glass slides. 3-inch x 2-inch size preferred. Both saline and iodine preparations can be placed on same slide. 3 x 1-inch can be used but are not as satisfactory as 3 x 2-inch.
9. Glass marking pencil to label slides.
10. Containers for collecting fecal specimens.
11. Disinfectant solution such as Lysol, Amphyll, or similar solution. Prepare a 1% solution, put in pan or large jar. Put used slides in this solution.

II. BLOOD EXAMINATIONS

A. Preparation of Smear

1. Use a very clean 3 x 1-inch slide which does not have fingerprints or lint on it. Pre-cleaned slides should be wiped with a clean dry cloth towel before using. Hold slide by edges so there will be no fingerprints on glass. If the slide appears dirty, wash it in alcohol and wipe dry. Clean slides should be stored in a dust-proof box.

2. Wet a piece of gauze with 70% alcohol and clean the end of the patient's finger. Wipe dry with gauze.

3. With a hemolet (or lancet), prick the finger and allow a large drop or globule to form. If the finger is dry, the drop will stand up and not run down the finger.

4. Touch the glass slide to the blood so a small drop will adhere to the glass. The drop should be about 1/2 inch from the end.

5. With a second slide, spread the blood into a thin film. Figure 4.

6. Prepare a thick film by touching the under surface of a slide to the drop of blood. Rotate the slide in contact with the blood to form a round film about 1 cm in diameter.

   or

   Touch the slide to the drop of blood on the finger and pick up a drop. With a second slide, spread the drop of blood to a round area about 1 cm in diameter. The thick film should be thick enough so fine print can just be read through it. Figure 5. Two thick films should be made from each patient. They may be placed at opposite ends of the same slide.

7. Label the smears with the patient's name or number and let dry in a horizontal position. Dry thoroughly. Thin films will dry in a few minutes (5 to 10 minutes); thick films will require longer (from 1 to 2 hours or more). Thick films may be dried overnight but they must be protected from flies, roaches, other insects, dust, and moisture.

8. Stain thin smears as follows:

   a. Fix the smear in methyl alcohol. Do this by holding the slide at an angle and dropping the alcohol onto the blood with a pipette.

   b. Let the smear dry thoroughly, preferably by leaning it against a pan or jar to keep it upright.

   c. <u>If there are 5 to 10 slides to stain</u>, use a vertical stain jar (coplin jar) which has grooves to hold slides. To 20 ml of buffered water (pH 7.0) in the stain dish, add 1 ml of stock Giemsa stain. Mix thoroughly. Buffered water can be prepared in advance according to attached directions.

   d. Place dry fixed thin film in stain dilution and stain for 20 minutes.

   e. Remove slide from stain, rinse briefly in buffered water and let dry. Stand slide upright to dry.

   f. <u>If there are less than 5 slides</u>, stain them on a staining rack. This can be prepared by placing 2 rods (wood or glass) across a pan so the slides can be laid across and supported by the rods.

g. Prepare 4 ml of stain dilution per slide. Add 1 drop of stock stain, with a medicine dropper to each ml of buffered water (4 drops per 4 ml). Mix thoroughly.

h. Cover the slide (lying across the rods) with the stain dilution and let stain for 20 minutes. (30 minutes is also satisfactory.)

i. Drain stained smear and rinse briefly with buffered water. Let dry in a vertical position.

9. Stain thick films as follows:

a. DO NOT FIX.

b. If there are 5 to 10 slides to stain, prepare stain dilution by adding 1 ml of stock stain to 50 ml buffered water. Pour into a staining dish.

c. Put smears in stain dilution and stain for 50 minutes.

d. Remove slides and put in buffered water (use a stain dish) for 5 minutes.

e. Remove and let dry in a vertical position.

f. If there are less than 5 slides, stain slides on a rack as described above using 1 drop of stain to 1 ml of buffered water. Rinse stained smear briefly.

10. Stained blood smears should be examined with the oil immersion lens.

B. Wet Mount of Blood (Trypanosomes and Microfilariae)

1. Prick finger as described for making smears.
2. Touch slide to blood to pick up a small drop. Either a 3 x 1-inch slide or a 3 x 2-inch slide may be used.
3. Add a drop of physiological saline. Mix.
4. Cover with coverslip and examine with low power (10X) of the microscope.
5. If organisms are found, make stained smears as described in Section A.

C. Equipment and Materials

1. 3 x 1-inch slides.
2. Methyl alcohol.
3. Dropping bottle with pipette, or a small bottle with stopper or screw cap and a medicine dropper (for dispensing methyl alcohol).
4. Medicine droppers.

5. Serological pipettes--1 ml capacity.
6. 50 ml, 100 ml and 1,000 ml graduates.
7. Bottle with glass or cork stopper--1,000 ml capacity.
8. Coplin jars (staining dishes).
9. Flat enamel pan, approximately 8 x 10 inches (1 inch deep) or similar size.
10. Glass rods to fit pan lengthwise.
11. Stock Giemsa stain.
12. Buffers--tablets of pH 7.0
    or
    a. Disodium hydrogen phosphate (Solution V, A, page 127).
    b. Sodium dihydrogen phosphate (Solution V, B, page 127).
13. Gauze square 2 x 2 inch size.
14. 70% alcohol (or 95% to be diluted to 70%).
15. Small bottle with screw cap or cork stopper to hold small quantity of alcohol for working use.
16. Lancets for pricking fingers.
17. pH paper (or a pH meter).
18. Buffered distilled water (Solution VI, page 127)

III. QUALITY CONTROL

A. Solution

1. Iodine solution for fecal mounts--prepare fresh each 2 weeks.
2. Saline--examine a drop of the saline from the small bottle (used daily for fecal mounts) at intervals of 1 month for free-living organisms. If present, saline is contaminated and should be discarded and replaced with fresh saline.
3. Stock saline--keep in tightly closed bottle.
4. Stock potassium iodide (for preparing iodine solution)--keep in tightly closed bottle away from direct sunlight. Solution is stable and will last for 6-10 months.
5. Stock Giemsa stain--keep in tightly closed bottle away from direct sunlight. Pour a small quantity into a small stoppered bottle for daily use. Do not put pipette into stock bottle. Moisture will ruin Giemsa stain; ALWAYS use a DRY pipette for measuring amount to use in stain dilution for smears.
6. Buffer solutions (NaH_2PO_4 and Na_2 HPO_4)--if used, may be stored for months in glass stoppered bottles.
7. Buffered water, pH 7.0, will keep for several weeks in tightly closed bottle.

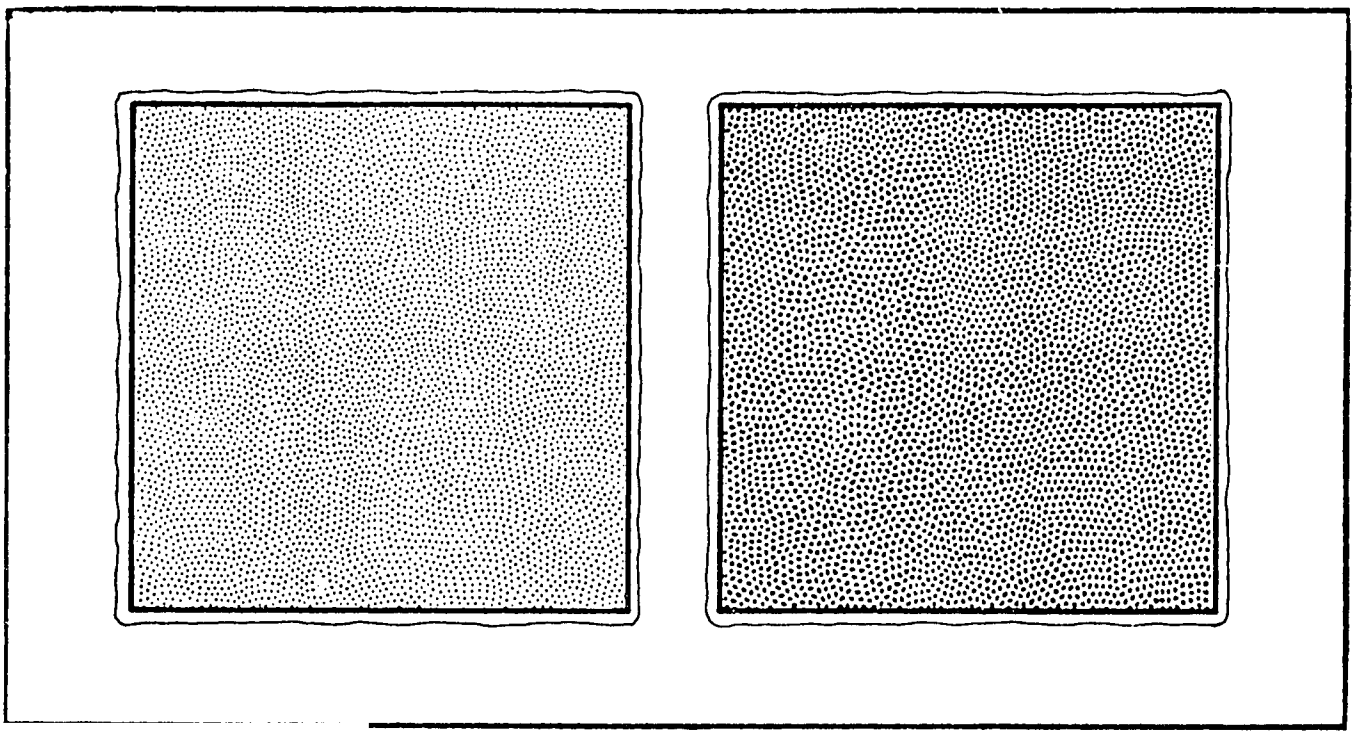


Figure 1

Wet Mount Preparations
Saline and Iodine - Density

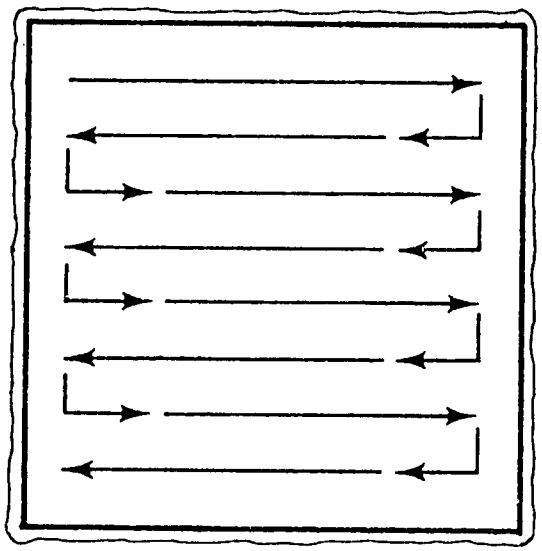


Figure 2

Systematic Examination of Wet Mount

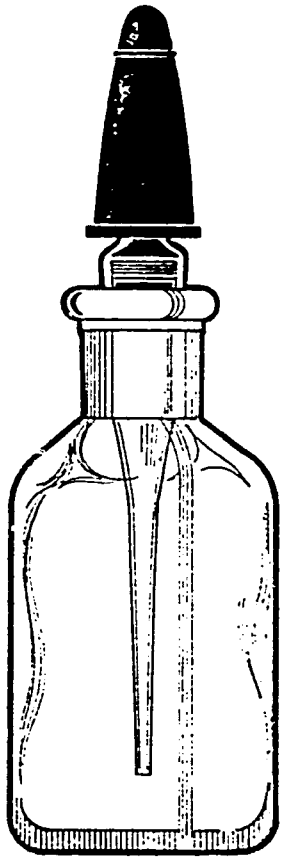


Figure 3

Dropping Bottle

Use for
Saline and Iodine

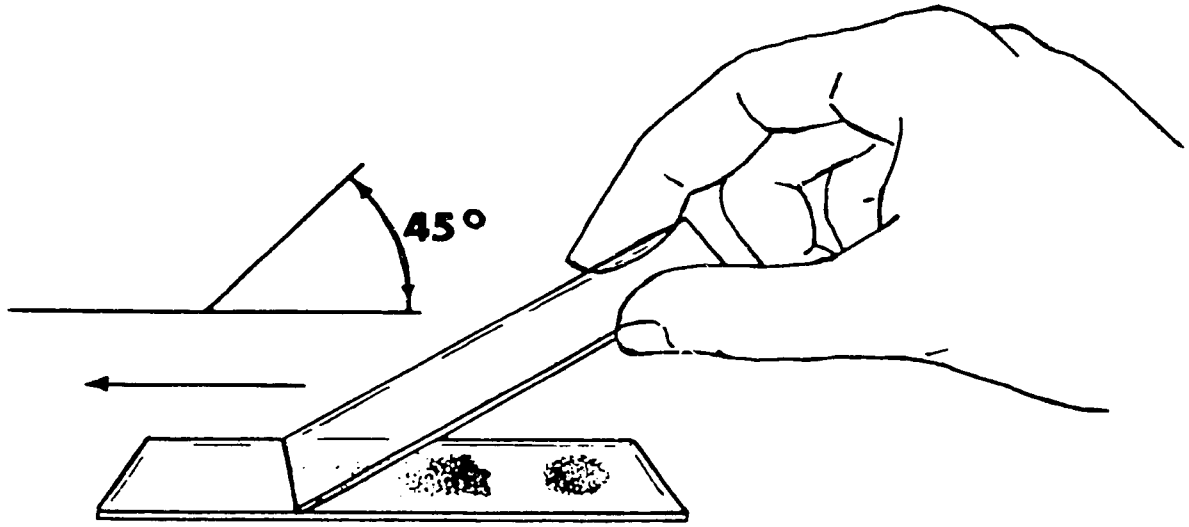


Figure 4

Technique of Preparing Thin Blood Film

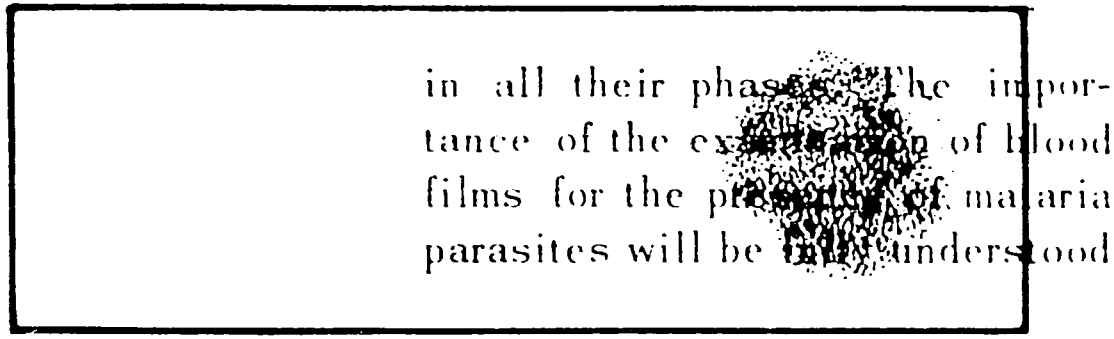


Figure 5

Size and Density of Thick Blood Film

FORMULAS FOR SOLUTIONS

I. Saline, Physiological

A. Weigh out 9 grams of sodium chloride (NaCl).
B. Dissolve in 1,000 ml of water (preferably distilled water).
C. Store in glass or cork stoppered bottle.

II. Potassium iodide solution, 2%

A. Weigh out 20 grams of potassium iodide crystals (KI).
B. Dissolve in 1,000 ml water, preferably distilled water.
C. Sto. in glass or cork stoppered bottle, away from direct light.

III. Iodine, Dobell's (1% iodine solution)

A. Weigh out 0.3 gm iodine crystals (I_2).
B. Measure out 30 ml of 2% KI solution. Pour into a small beaker or flask.
C. Add I_2 to KI. Shake. Let stand until dark tea color--about 10 minutes. Shake every 2 to 3 minutes.
D. Let I_2 crystals settle to bottom of beaker. Decant fluid into dropping bottle for daily use.
E. This solution must be prepared each 14 days.

IV. Lugol's iodine may be substituted for Dobell's. Prepare as follows:

A. Potassium iodide solution, 5%

1. Weigh out 50 grams of KI crystals.
2. Dissolve in 1,000 ml water.
3. Store in glass or cork stoppered bottle, away from direct sunlight.

B. Iodine solution, 5%, Lugol's Iodine

1. Weigh out 1 gram of iodine.
2. Pour 20 ml KI solution into a small beaker or flask.
3. Shake until most of iodine crystals are dissolved. Solution will be dark brown. This is "Lugol's Iodine."
4. Store iodine solution in a brown bottle away from direct sunlight. Solution can be kept for about 1 month.

C. Iodine solution for preparing mounts

1. Measure 5 ml of Lugol's iodine into a small beaker.
2. Add 20 ml saline or water to give 1:5 dilution of Lugol's iodine.
3. This dilution must be prepared fresh each 14 days.

NOTE: Undiluted Lugol's iodine is too strong and will cause feces to clump and may trap organisms in clump. Dilute Lugol's 1:5, as described, for wet mount preparation.

V. Buffer Solutions

A. Disodium hydrogen phosphate (Na_2HPO_4), alkaline buffer

1. Weigh out 9.5 grams of Na_2HPO_4 (anhydrous).
2. Dissolve in 1,000 ml distilled water.
3. Store in glass stoppered bottle.

B. Sodium dihydrogen phosphate (NaH_2PO_4), acid buffer

1. Weigh out 9.2 grams of $NaH_2PO_4 \cdot H_2O$,
2. Dissolve in 1,000 ml distilled water.
3. Store in glass stoppered bottle.

C. Note: 9.07 grams of potassium dihydrogen phosphate (KH_2PO_4) can be substituted for the NaH_2PO_4.

VI. Buffered Distilled Water

A. Prepare from dry mixture of buffered salts OR from buffer solutions (see V)

1. From Dry Phosphate Mixture (Preferred Method)

a. Mixture

1. Weigh out 6.0 grams of disodium hydrogen phosphate, anhydrous (Na_2HPO_4).
2. Weigh out 5 grams of potassium dihydrogen phosphate (KH_2PO_4).
3. Mix thoroughly in a mortar. Weigh out 1 gm quantities of this mixture and store in small well-stoppered vials.

b. Buffered Water

1. Measure 1,000 ml water. Pour into bottle or flask.
2. Add 1 gram of phosphate mixture.
3. Dissolve the phosphate mixture in the distilled water. Check the pH; it should be about 7.0.

2. From Buffer Solutions

a. Measure 61 ml of ALKALINE buffer solution (Na_2HPO_4). Pour into 1,000 ml bottle or flask.
b. Measure 39 ml of ACID buffer solution (NaH_2PO_4).
c. Measure 900 ml water. Add to buffer solutions. Mix.
d. Check the pH. It should be about pH 7.0.

VII. Giemsa Stock Stain--purchase already prepared.

VIII. Methyl Alcohol, absolute. Purchase in 500 ml size bottles. Larger quantities tend to become contaminated with moisture.

IX. 70% ethyl alcohol.

1. Measure 70 ml of 95% ethyl alcohol in a 100 ml graduate.
2. Add water to the 95 ml level. Mix.
3. Store in glass or cork stoppered bottle.

X. Distilled water. If distilled water is not available, collect and store rain water for use in solutions. Rain water should be collected in clean containers in the open. Do not collect water that drips off trees, other plants, or the roof of the house.