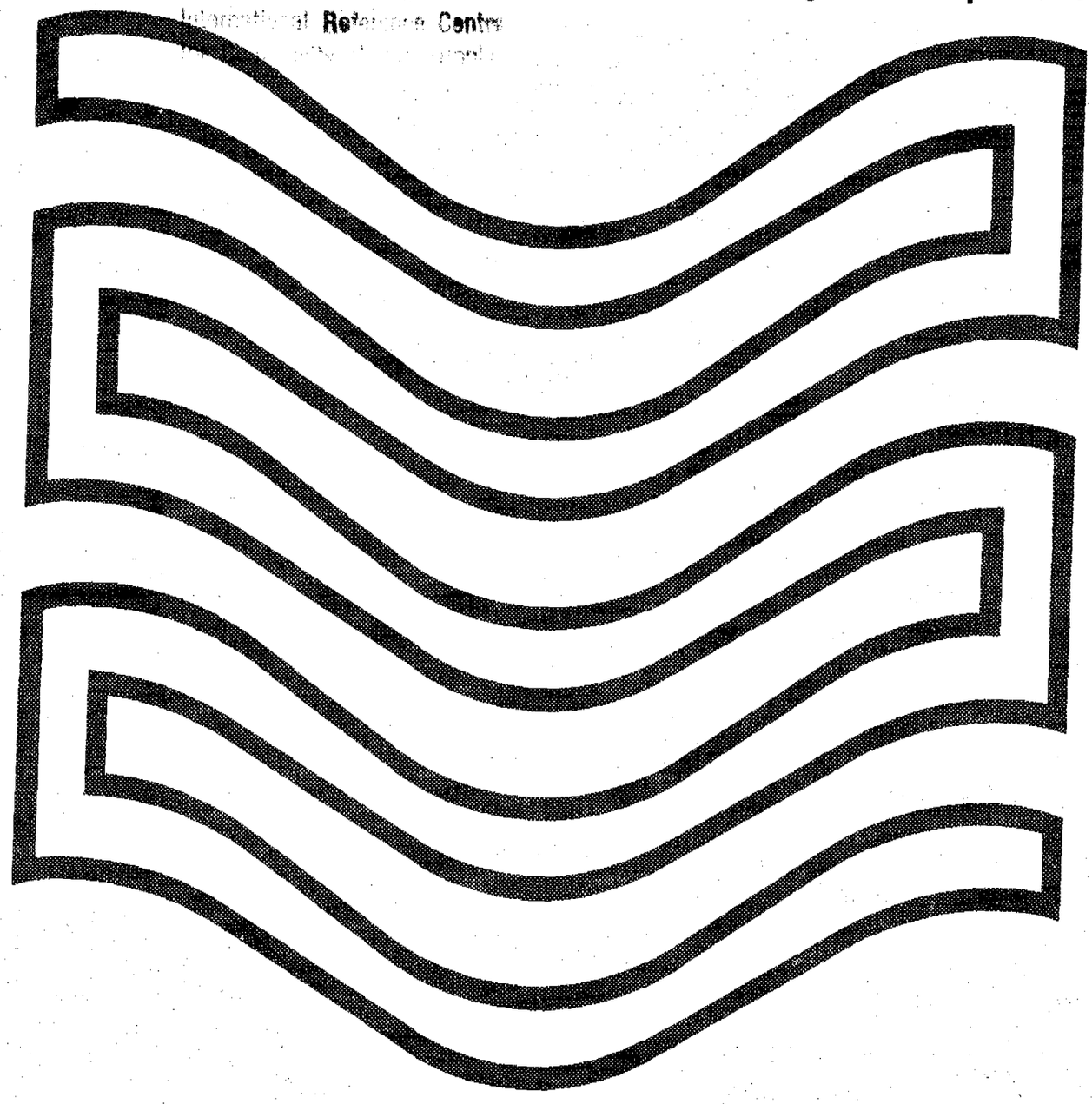
WHO international reference centre for community water supply

parkweg 13, the hague, the netherlands

the story of c-pheri



bulletin no. 4

E R R A T U M

Page 8, second line from the bottom: U.S.$3,652,000.- should read U.S.$5,952,000.- through 1971-1972.

Page 10, line 4 : engineers, chemists, microbiologists, biologists, physicists, ...

line 7 : Rs 3,800,000.- should read Rs 5,000,000.-

Page 22, paragrph 2: The Institute publishes a quarterly "The Indian Journal of Environmental Health",.....

WORLD HEALTH ORGANIZATION

INTERNATIONAL REFERENCE CENTRE FOR COMMUNITY WATER SUPPLY

BULLETIN NO. 4

THE STORY OF C-PHERI

SEPTEMBER 1972

THE HAGUE - THE NETHERLANDS

C O N T E N T S

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P R E F A C E

In October 1970 an International Conference on Research and Development in Community Water Supply was held in Dubrovnik, Yugoslavia. This conference was sponsored by the Yugoslavia Federal Administration for International Technical Co-operation, the World Health Organization and the United States Department of Health, Education and Welfare.
The purpose of the Conference was to explore ways in which educational and research organizations can contribute to the practical solution of water supply problems in their respective countries, and in particular to methods of overcoming the twin obstacles of inadequate finances and insufficient skilled staff.
The group was representative of both developing and developed countries.

During the Conference a proposal was made that the International Reference Centre would publish a case history of a country that was successful in the set-up of a research centre in the field of community water supply. Such a story was considered to be beneficial for Governments in exploring ways for the realization of a sound organization for research and development in community water supply.

It is with great pleasure that within this context I.R.C. is able to present this paper, which describes the history of the Central Public Health Engineering Research Institute (Nehru-Marg, Nagpur, India) from the very beginning.
We trust that "The Story of C-PHERI", composed at the Institute itself, will be of interest to many workers in this field and that it in some cases will support the set-up of similar institutes in other countries.

The Hague, September 1972

Drs. J.M.G. van Damme
Manager

1. INTRODUCTION

In India, like in almost all developing countries, the provision of adequate, wholesome supplies of water and sanitary collection, treatment and disposal of human wastes are prime needs in the nation's programme of social, economic and industrial development. In addition, the problems of waste discharges, air pollution and occupational hazards which accompany industrial growth must be solved if industrialization is to produce maximum benefit for the community.

The needs of India are especially great because of its vast size and population. It is estimated that out of some 2,540 cities and towns in India, only about 1,200 have a modern water supply. Of these, less than 200 have underground drainage, and of the 20 most populous cities, only two have complete sewage treatment plants. Problems of water supply and waste disposal are even more severe in the rural areas of India, where about 75% of the nearly 540 million (1970 estimated figure) people live.

2. INCEPTION OF THE INSTITUTE.

A number of committees and commissions, set up by the Government of India, has surveyed these problems from time to time between 1952 and 1956 and has drawn the attention to their increasing severity. A conference of public health engineers held in New Delhi in August 1956, under the auspices of the Ministry of Health, stressed the need for a Central Research Institute to provide the background knowledge required if satisfactory progress in the development of adequate water supplies and sewage disposal schemes was to be achieved. But the real "thrust" for setting up the C-PHERI was provided by the incidence of water pollution arising out of contamination by sewage of the waters of River Jamuna, which serves as a source of raw water supply for the Delhi Metropolitan Area. Before the authorities could take necessary action, a part of the population that consumed that water developed infectious hepatitis. Since the hepatitis epidemic in New Delhi in 1955, attributed to the gross pollution of the water supply by sewage, attention has been drawn particularly in India to the public health significance of viral pathogens in sewage and to their control.

Realizing the importance of such incidents, and with a view to preventing their recurrence, the Government of India set up and inquiry committee to go into this affair and also to recommend suitable measures for prevention of such large scale water pollution. As a result, it was proposed that a National Institute on Public Health Engineering Research be set up under the Council of Scientific and Industrial Research (CSIR) and appointed a sub-committee to draw up concrete proposals for the suggested Institute. The sub-committee, after going into the pros and cons of the whole problem, submitted a report in 1957 recommending urgent establishment of such an organization and defined the function of the Institute in the following terms:

> "Generally the Research Institute will conduct research in laboratory on problems of public health engineering interest (chemical, bacteriological and biological nature) and later transfer the results to field tests; help in advancing the general field of public health engineering; encourage indigenous industrial research and development; provide research facilities which are beyond the resources of States; maintain liaison with national and international organizations in India; and disseminate knowledge on the subject for the general benefit of the community".

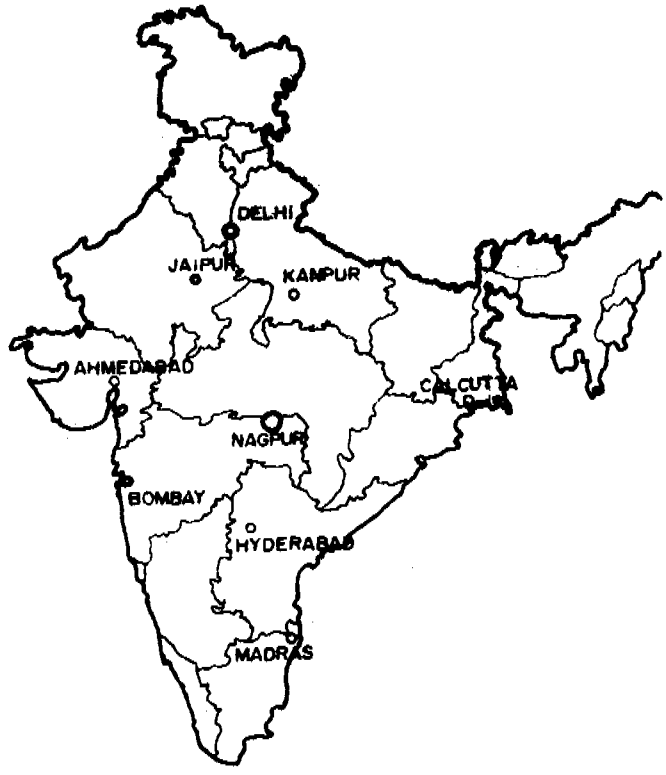
As immediate problems to be dealt with, the sub-committee listed: supply and treatment of water; sewerage and sewage treatment; and refuse disposal. A variety of other areas of activities were envisaged as work expand. Somewhat later, in August 1957, this sub-committe, now called the Committe on Public Health Engineering Research, recommended the establishment of the Research Institute and immediate planning for it.

Accordingly, in September 1957 the Board of Scientific and Industrial Research approved the establishment of the Central Public Health Engineering Research Institute as one of its chain of nearly 37 national research institutes/laboratories. In May 1958, Nagpur (Maharashtra Estate) was designated as the site for the Central Laboratory.

Like a good number of other commissions, committees or sub-committees, the success reached here was largely the result of the firm leadership, unstinting efforts and limitless devotion of one or two men with remarkable foresight.

3. UNDP ASSISTANCE

After having decided upon setting the Institute, the Government of India soon realized that there would be difficulties in acquiring within the country the right type of equipment and other tools necessary to start the research activities adequately . Accordingly, in 1959 after the necessary preparatory work, the Government of India submitted to the United Nations Special Fund a request for aid in obtaining the necessary equipment and instruments. This request, after due processing and after receiving the support of W.H.O., obtained the approval of the Governing Council of the United Nations Special Fund in 1960. W.H.O. was assigned the role of Executing Agency. After further detailed elaboration of the project, a tri-partite plan of operation was signed by the Government of India, the U.N. Special Fund and W.H.O. It provided for: the summary of special scientific instruments, experimental equipment and research material by the Special Fund; the provision of land, building, furnishing, staff and the payment of operating expenses by the Government of India; and on behalf of the Special Fund the procurement of instruments, equipment and materials, the provision of expert technical assistance in the use of supplies and assistance in the training of the staff by W.H.O. As against the UNDP Special Fund allocation of US $525,000 the Government of India's counterpart contribution would be equivalent to US $3,652,000 through 1967-1968.



The institute serves the Nation through Nagpur & Zonal Laboratories.

4. C-PHERI SET-UP - SCOPE AND FUNCTIONS

C-PHERI is one of the National Laboratories functioning under the Council of Scientific and Industrial Research, Government of India. The Institute, with its Headquarters at Nagpur and network of 8 Zonal Laboratories, spread all over the country (see map), is engaged on a wide variety of research problems and investigations connected with:

- Water treatment and distribution
- Sewage treatment and disposal
- Industrial waste treatment
- Water pollution control
- Air pollution control and industrial hygiene
- Rural Sanitation
- Solid Wastes disposal
- Instrumentation

The Institute also organizes training programmes, brings out publications and renders consultation and extension services.
The Institute is the only one of its kind in India and perhaps in the whole of South-East Asia and its scope and functions include the following:

1. To conduct research in various fields of public health engineering, such as water supply, sewage disposal, industrial wastes treatment, control of water pollution, air pollution and industrial hygiene, rural sanitation, solid wastes disposal, food sanitation and radiological health.

2. To act as a clearing house for the latest available knowledge and know-how relating to the design, construction and operation of the various public health engineering works.

3. To maintain liaison with local, national and international agencies engaged in similar activities.

4. To co-ordinate research work of all interested agencies in the country and encourage research by offering suitable grants-in-aid, fellowships to suitable men in the profession.

5. To provide consultation services to organizations in the public and private sectors and extend known methods to improve rural and urban sanitation and prevent water and air pollution.

6. To disseminate results of research and experiments through publications, seminars, symposia, and make available to the profession an up-to-date technical library and museum.

7. To train technical personnel, teachers and research workers in public health engineering.

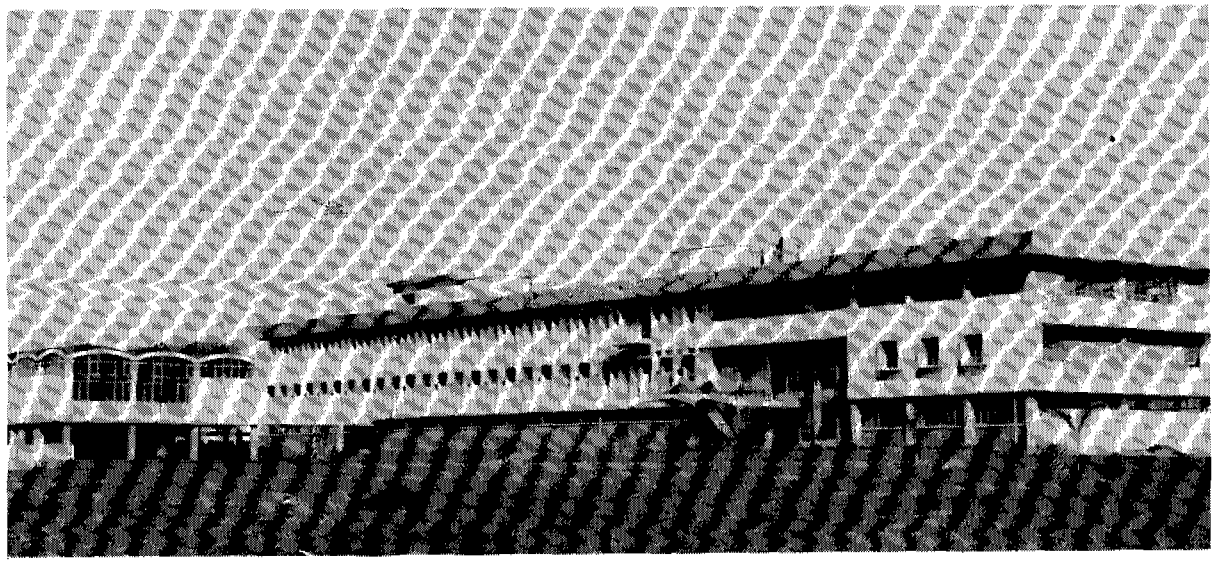
Being unique in its scope and functions, the Institute occupies a prominent position in the national scene.

The Institute has a total staff strength of nearly 450, which include public health, civil and chemical engineers, physicists, a statistician, a medical doctor and supporting technical and administrative staff.

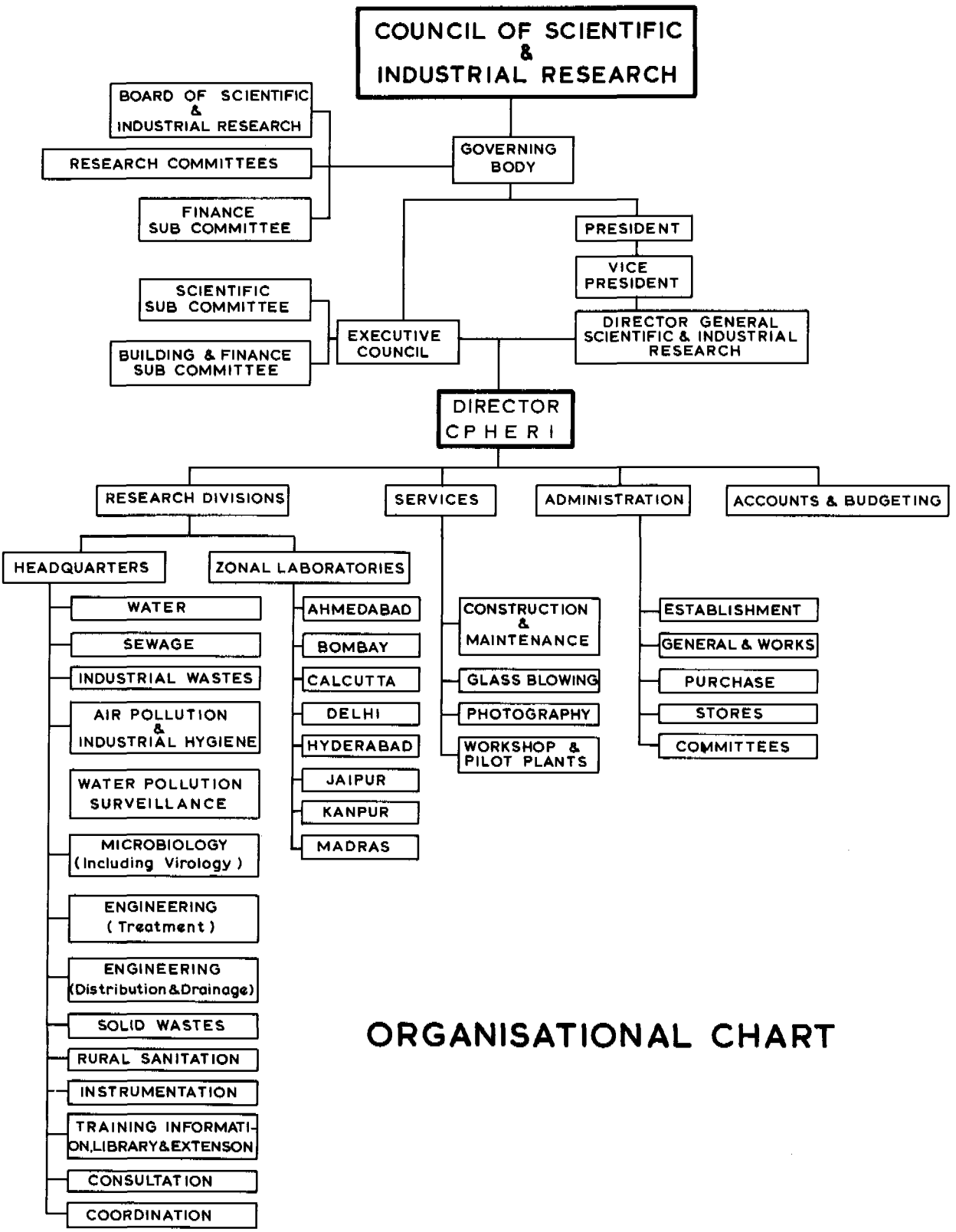
With the generous aid received from UNDP and the budget allocation from the Government (nearly RS 3,800,000 per annum as Government share), the Institute is well equipped with modern and sophisticated equipments for carrying out research in the field of public health engineering.

The Institute's campus at Nagpur is spread out on a spacious area of about 110 acres donated by the Government of Maharashtra. The Institute has a 3 storeyed main building, a cafeteria, a new library and auditorium, a guest-house and trainees hotel, pilot plants, ample space for new plants, experimental sewage farms, animal house and workshops. The Institute also has its own ancillary facilities, such as water supply, sewage disposal, electrical generator, gas plant, compressed air supply etc.(see also pages 12 & 13)

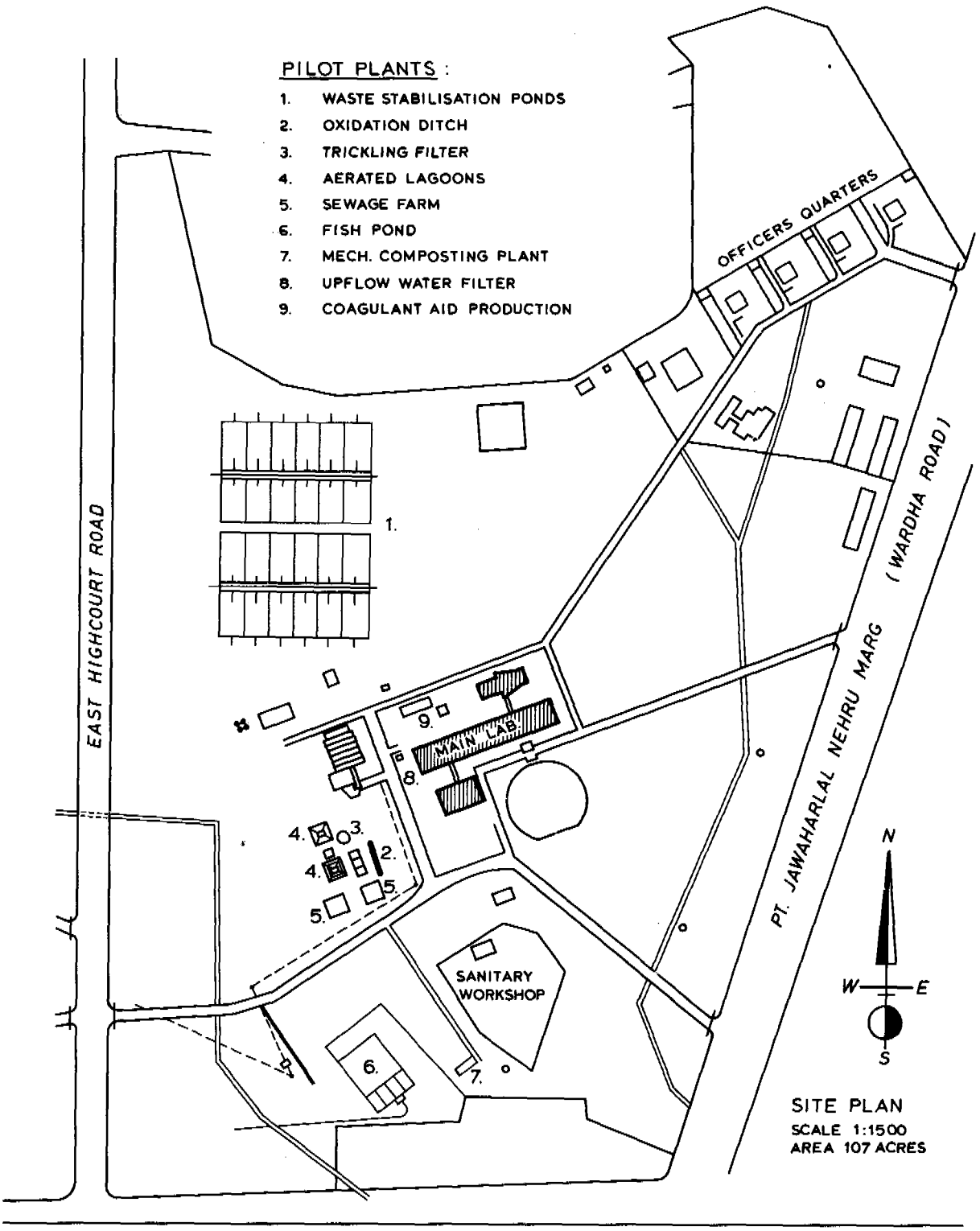
The organizational set-up of the Institute showing the relationship with CSIR, its various research divisions and the zonal laboratories is shown on the opposite page.



The Building of C-PHERI



ORGANISATIONAL CHART


PILOT PLANTS :
1. WASTE STABILISATION PONDS
2. OXIDATION DITCH
3. TRICKLING FILTER
4. AERATED LAGOONS
5. SEWAGE FARM
6. FISH POND
7. MECH. COMPOSTING PLANT
8. UPFLOW WATER FILTER
9. COAGULANT AID PRODUCTION
OFFICERS QUARTERS
EAST HIGHCOURT ROAD
PT. JAWAHARLAL NEHRU MARG (WARDHA ROAD)
MAIN LAB.
SANITARY WORKSHOP
N
W
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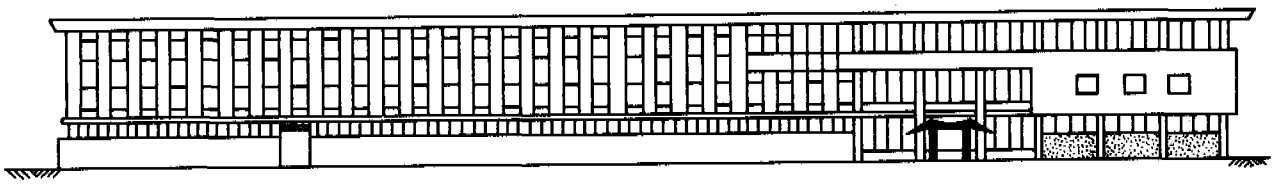
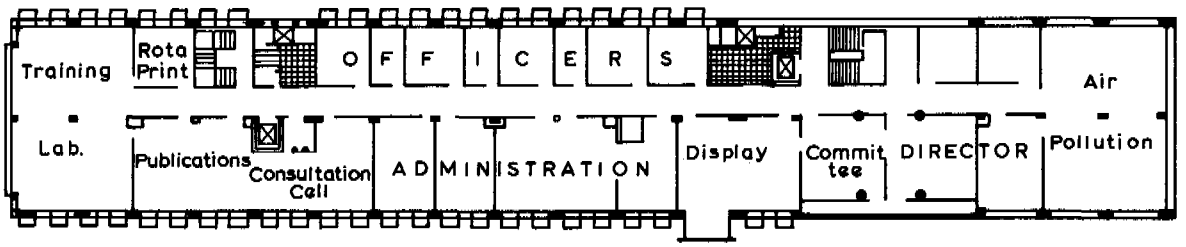
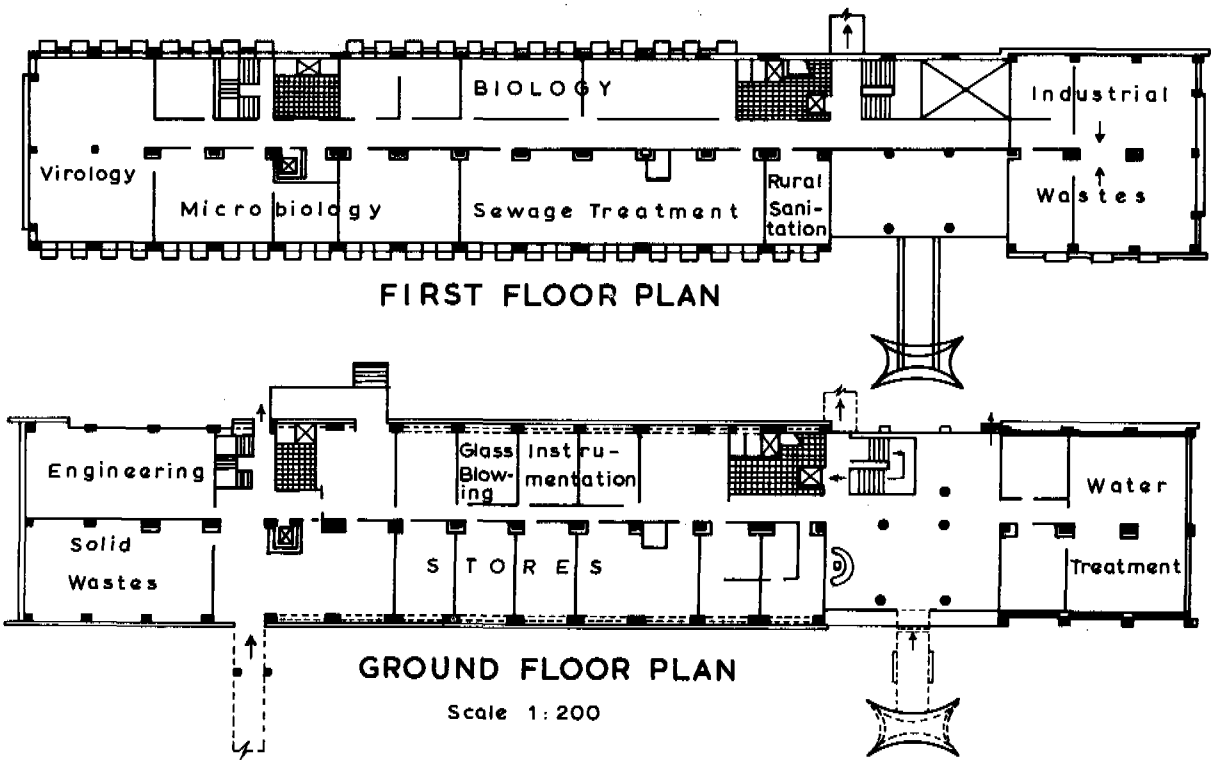
SCALE 1:1500
AREA 107 ACRES



FRONT ELEVATION



SECOND FLOOR PLAN



FIRST FLOOR PLAN

GROUND FLOOR PLAN

Scale 1: 200

MAIN LABORATORIES

5. CURRENT RESEARCH PROGRAMME

The Institute undertakes research programmes that are primarily oriented towards development of economical and efficient methods for water, sewage and industrial waste treatment, solid wastes disposal, air pollution control, rural sanitation, etc., making maximum use of indigenous materials and equipment to suit the tropical environment of the country. The major past and current research programmes are given below.

5.1 Water

The area of research in this field covers:

a) development of indigenous defluoridating material for removal of excessive fluorides from drinking waters;
b) preparation of indigenous coagulant aids to reduce aluminium consumption in water treatment and thus help reduce sulphate requirements for water industry;
c) chlorine, iodine and double-action tablets for on-the-spot disinfection and clarification of individual waters;
d) development of synthetic membrane filters for quick bacteriological analysis of waters and waste waters to substitute the imported ones;
e) iron and manganese removal units;
f) development of indigenous medium for bacteriological analysis to substitute imported MacConkey broth; and
g) development of filter aids.

Work of the Institute on six of these listed projects has given rise to complete "know-how", suitable to Indian conditions. Such "know-how" is under patent.

Besides the above-mentioned projects, the Institute has also developed the "know-how" for the so called "package plants". These are mostly compact, prefabricated complete plants which can be made available to populations of 1000 to 2000 people. The advantages obtained from these plants are:

a) immediate availability from stock without delay of construction;
b) comparative ease of installation;
c) these are of proved design;
d) economy in cost because of standardized design components and mass production technique, and
e) high level of treatment and efficiency.

A few plants have been installed and are working satisfactorily.

The work on a project sponsored by the WHO has successfully originated a booklet "Disinfection for Small Community Water Supplies", wherein all the available information on disinfection techniques is included.

Another piece of work taken up for the benefit of water works authorities is "ready-reckoner" on "Nuisance causing Organisms in Water Supplies".

5.2 Sewage

The "turn-key" solutions to the problems of sewage treatment which were being used hitherto were on empirical basis and not found satisfactory under Indian conditions. This conventional "know-how" was also costly, owing to mechanical equipment, which likewise created difficulties on the score of lack of trained personnel. C-PHERI has worked on several low-cost waste treatment methods, such as waste stabilization ponds, "Pasveer-type" oxidation ditch, aerated lagoons, etc. Waste stabilization ponds are found to be economical and efficient in comparison with the conventional facilities. They are well-suited to Indian conditions and have an added advantage on account of availability of plenty of sunshine all through the year. The Institute has recently published a manual on "Waste Stabilization Ponds: Design, Construction and Operation in India", to serve as a guide to all those who seek this mode of sewage treatment.
C-PHERI studies show that the treated effluents can be advantageously used for irrigation.
Currently the Institute is engaged on a survey of sewage farms in India to assess the health status of the workers.

The Institute has developed design criteria under Indian conditions for sewage treatment processes that are simple and inexpensive.
The capital costs have been slashed down by as much as 80% and running costs by 90% compared with those incurred in conventional plants in the case of small population. Already more than 30 such plants have been built in the past 6 years and are operating successfully in widely scattered places such as Bhilai, Vijayawada and Lucknow.
The Institute can provide both the design of these low cost waste treatment methods as well as the equipment needed for their successful operation. It can also undertake studies on various methods of efficient utilization of sewage and sullage water in agriculture and pisciculture.

5.3 Industrial waste treatment

An instance of a thorough, specific investigation by the Institute with direct relationship to immediate development is the study and design project relating to the treatment of wastes from a large installation for the production of a variety of synthetic pharmaceuticals now in operation at Hyderabad. A full design of this scheme, as developed by this Institute, was accepted by the mangement of the factory complex, as providing a satisfactory and economical solution to their waste treatment problem. It was the first concrete instance wherein the Institute's know-how" has created ade-

quate confidence to go in for it. The Institute has to-day characterized varied types of industrial wastes, such as fertilisers, pulp and paper, steel plants, plating shops, distilleries, sugar, textiles, rayon, milk, food processing and canning, tanneries, certain chemicals and pharmaceuticals etc. and can provide economical methods for their treatment with due preliminary laboratory and pilot plant studies wherever necessary. Due attention is also given to by-product recovery which can lower down the cost of waste treatment. The Institute has done work, for instance, on recovery of zinc from viscose rayon wastes, potash recovery from distillery wastes, etc.
Industrial wastes vary immensely in their characteristics and amenability to treatment. Preliminary laboratory studies are, therefore essential, before embarking upon a full-scale treatment facility. On account of lack of such facilities, Indian firms at large are reluctant to bid on the construction of such treatment facilities. The ability of C-PHERI to conduct such studies with the help of equipment provided through the UN Special Fund, and to present suitable flow-sheets and design criteria for treatment of the wastes has today made a sufficient impact on adoption of the indigenous "know-how", thus bringing in self-reliance.

5.4 Water Pollution Surveys

One of the continuing basic activities of C-PHERI is the exploratory survey of the chemical and biological characteristics of as many of the large rivers and other water sources in India as possible. Analyses for the determination of important chemical and biological characteristics are being carried out periodically and at various locations for each major source under investigation. As a result, detailed background information is becoming available, not only on the quality of Indian waters at any one place or time, but also on seasonal variations and changes in quality as the water flows. Such background information is of great importance in planning and design for water supply and water treatment works, in judging adequacy and suitability of the water necessary for industrial development, in assessing the present extent of pollution of contaminated waters and the types of waste treatment facilities needed, and in planning for optimal development and utilization of water resources.

5.5 Air Pollution Studies

The Institute conducts air quality investigations in industrial premises and environments in the vicinity upon request, and furnishes findings and remedial measures to the sponsors. This is a continued activity of the Institute and a large number of industries and factory inspectorates have availed of this facility.
Besides this, the Institute conducted short-term air quality studies at selected places in 4 major cities of India, viz: Delhi, Bombay, Calcutta and

Kanpur to arouse consciousness in concerned authorities to the growing air pollution problems in these cities on account of industrialisation. The authorities were convinced of the fact that there is an air pollution problem, worth a detailed investigation. In fact, quite a few of the city corporations have sponsored detailed air pollution surveys. These surveys have already yielded background information on present levels of pollution. Such data could give rise to air quality standards by specifying the maximum permissible levels of air pollutants and ultimately for controlling air pollution. In view of a long-felt need to have threshold limits for various common air pollutants, the Institute has established a national air sampling network to collect comprehensive data on common air pollutants.

In due recognition of the concerted efforts being put in by the Institute to ameliorate the air pollution hazards, the World Health Organization has designated C-PHERI as a WHO Regional Reference Centre on Air Pollution in its global network.

The Institute has brought out a publication entitled "How to conduct Air Pollution Surveys", to help the agencies who would be willing to carry out these surveys themselves.

5.6 Solid Wastes Disposal

In India, primitive methods of solid wastes disposal are being practised even at present in many towns and cities. These are highly unhygienic and unsatisfactory involving manual handling of wastes in loading, unloading and landfilling or composting operations. Most of the smaller towns in India dispose of solid wastes by storage pits (often along with nightsoil) to convert them into compost.

To avoid interdiscriminate dumping of night-soil and its unhygienic handling on farms in raw condition, the Institute has been working on night-soil and cow dung digesters with a view to reduce the health hazards involved as well as to recover useful end products. The advantages of this sytem are:

a) it oxidizes the organic matter;
b) it renders the material free from obnoxious odour;
c) it eliminates most of the pathogenic organisms;
d) it provides sludge with fertili er value; and
e) it yields gas which may profitably be used in rural areas not served by electricity.

The Institute has undertaken elaborate studies to characterize refuse from many cities since characteristics are the prime requisite to devise economical and efficient methods.

It is a matter of pride to quote here that the Institute has recently completed comprehensive feasibility studies of garbage disposal from Calcutta City - the first ever carried out for an Indian city.

Recommendations to install a composting plant of 200 tons/day capacity have been accepted by the Calcutta Municipal Corporation.

5.7 Engineering (Treatment, Distribution and Drainage)

The Institute examines various engineering aspects of water treatment processes, such as sedimentation, filtration etc. Two-layer filtration with indigenous high grade bituminous coals, as substitute media for anthracite, overlying sand are seen to offer the advantages of higher rates of filtration than conventional methods. Other studies being pursued include up-flow filtration, comparison of surface wash and conventional backwash systems, performance of roughing filters, optimalization of filter construction costs, standardi ation and pre-fabrication of water treatment plants, etc.

It is estimated that about 10% to 40% of water supplied to the urban population is wasted by way of undetected leaks. The Institute has developed methods of surveying and estimating leakage, and is now capable of assessing and giving training for such surveys to staff of municipalities. Recently the Institute has conducted one such training programme for the benefit of the Bombay Municipal Corporation in collaboration with WHO.

These courses are being repeated every year in one of the major cities of the country. Similarly, the Institute is also attempting to have a rational and economic design of distribution network.

Another stimulating piece of work put in by the Institute is to show suitability of plastic pipes for transmission of potable water in place of the conventional pipes. The Institute will soon publish a brochure on this aspect for ready use by the public health engineering personnel.

Upon request, the Institute extends service to State Government Departments, Municipal Corporations and other public bodies by way of on-site investigations and performance studies of existing water works so as to facilitate modifications, wherever necessary, to improve the throughput.

5.8 Rural Sanitation

Rural water supply and sanitation are an important problem of the majority of India's population. This problem, however, is complicated by the need for extreme simplicity of the schemes, the need for funds and lack of motivation among the rural population for either maintaining the schemes properly or paying for them. Several agencies are actively engaged in this field and the Institute is also trying to do its bit.

Towards improving rural sanitation, the Institute has developed sanitary-wares, finalized designs of night-soil wheel-barrows, cow dung gas plants. Efforts to popularize these are in progress.

5.9 Training Programmes

The need for adequately trained personnel is rather obvious for a developing country like India. With a view to achieve this, the Institute has recently established a full-fledged training laboratory to offer training in various

aspects of the public health engineering all through the year, rather than giving this intermittently and on a sporadic basis as was hitherto being done. The various training courses being offered either by the Institute exclusively or in collaboration with organizations such as the Central Public Health Engineering Organization, the Corrosion Advisory Bureau, etc. cover: water and waste water analysis, water works supervisors training, sewage farming, city refuse disposal, structural engineering for public health engineers, corrosion control in water and waste water engineering, plastic plumbing, sewage treatment plant operators training, process design in waste treatment and air pollution control.
In addition to these, the Institute proposes to organize soon advanced training courses in: process design in water treatment, management of water distribution systems, modern instrumentation in analysis and control, computer usage for public health engineering problems; productivity in public health engineering, environmental microbiology, rural sanitation and housing, and virus detection and enumeration.

The purpose of running these training programmes and refresher courses is two-fold: firstly, to fill a gap in the existing facilities in the country for training engineers, public health workers and auxilliary personnel, and secondly to help in disseminating the latest findings and enable the field personnel to update their knowledge of the subject. It has been heartening to find that every course offered so far had overwhelming response. Personnel from other countries are also taking advantage of this facility of the Institute.
The Institute has a guest house and a trainees hostel for the participants of the training courses.

5.10 Symposia and conferences

The Institute organizes symposia and conferences normally once in two years, with a view to providing a common platform to a cross-section of scientists, engineers, industrialists and other concerned people in the field to discuss out their prolems. These symposia and conferences have proved very useful media for dissemination and co-ordination of the available information in the field of public health engineering. During preceeding years, the Institute organized the following symposia:

1. Public Health Engineering Education, 1963
2. Water Treatment and Waste Disposal at High Altitudes, 1964
3. Problems in Water Treatment, 1965
4. Water Pollution Control, 1965
5. Community Water Supply and Waste Disposal, 1966
6. Low-Cost Waste Treatment, 1969

The Institute convened a conference of research workers and experts in the field during January 1971 with a view to having a meaningful and realistic programme of research and development and to discuss specifically the research and development needs in some areas of public health engineering.
The conference provided an opportune forum, and very useful suggestions came forth from the delegates to draw up a research programme with priorities laid down for this decade.
The discussions and recommendations made at the conference have been brought out in the form of a booklet entitled "Research and Development Needs in Public Health Engineering in India".

Guest House and Hostel

6. INSTRUMENTATION

As indicated before, the Institute has been fortunate enough to receive, under UN Special Fund assistance, all the modern and sophisticated equipments, which have given a good start and accelerated Institute's research programmes. The Institute has a separate division, manned with qualified staff to look after maintenance and repairs of these equipments.

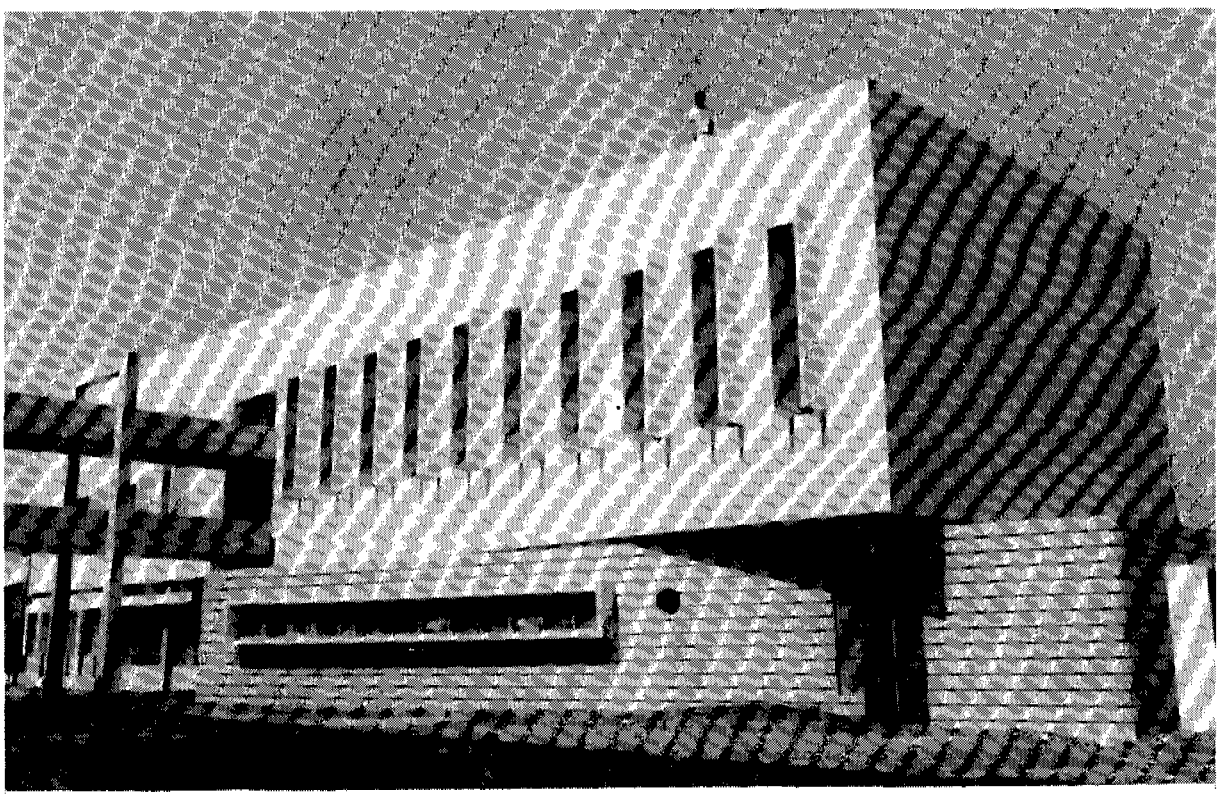
The Institute has developed a variety of instruments needed in research in public health engineering. The following are a few examples:

1) Chloroscope - for residual chlorine measurement
2) Wind Detection Recorder
3) Wind Speed Recorder } - for air pollution surveys
4) Screw pump - for conveying sludge and liquids
5) Glassware - used for research labs. engaged in PHE fields
6) Sampler for air borne dust
7) Multigas sampling kit } - for air pollution

7. LIBRARY AND DOCUMENTATION FACILITIES

The Institute has we well documentated library with over 13,000 volumes in related fields and facilities for micro-filming and photography. Exchange arrangements have been established with several institutes and universities in India and abroad, and journals and reports are received from them. Abstracts for information retrieval, project oriented bibliographies, indexes etc. are also prepared.

The Institute publishes a quarterly journal "Environmental Health", and brings out a "Technical Digest" every month covering some aspects of public health engineering research. The Institute also prepares a number of feasibility and technical reports, apart from publishing the proceedings of symposia conducted from time to time.



Auditorium and Library Building

8. CO-OPERATION WITH OTHER INSTITUTES IN INDIA AND OTHER COUNTRIES

The Institute co-operates with the following national and international agencies in resolving problems arising in the field of public health engineering:

National:

Ministry of Health, Government of India
Indian Standards Institution
Indian Council of Medical Research
Institution of Engineers (India)
Indian Water Works Association
Indian Association for Water Pollution Control
Other CSIR Laboratories
Defence Medical Research
State Chief Engineers (Public Health Engineering Departments)
Maharashtra Prevention of Water Pollution Board
Universities
Committee on Water Resources, Regional Developing Plan for South-East Resources Region, Ministry of Health

International:

World Health Organization
International Water Supply Association
International Association on Water Pollution Research
UNESCO

Staff members are nominated to work on these committees set up for the specific purpose of the above cited agencies.

9. CONCLUSION

In the 12 years since its official establishment, C-PHERI has come to occupy a major position both at the national and international level in respect of investigation, counsel, and planning for water supplies and for waste treatment and disposal. Although there was some research in India in these areas prior to the inception of C-PHERI, it was not extensive and was mostly carried out academically on an unco-ordinated basis. Consequently, the advent of C-PHERI filled a gap in national activity and the Institute has been a resource much relied upon as problems in public health engineering have become apparent.

The Institute has today put up considerable work yielding results of significance and worked upon immediate solutions on specific problems in water and waste water treatment and other areas of public health engineering, both within India and in adjoining countries. Since the results of research developed by C-PHERI may have applicability in other countries with conditions similar to those prevailing in India, the Institute can offer useful service to ameliorate environmental pollution problems in these countries as well. Besides, C-PHERI is now able and ready to serve as a training centre for candidates from developing countries.

oOo