CENTRAL PUBLIC HEALTH ENGINEERING RESEARCH INSTITUTE

NAGPUR

First Annual Report 1958 - 59

I. Origin of the Institute

A proposal for the establishment of this Institute was approved by the *Board of Scientific and Industrial Research* and the *Governing Body* of the C.S.I.R. in September 1957, on the recommendation of the *Public Health Engineering Research Committee*, made at their meeting held on August 21, 1957. Accordingly, a provision of Rs. 60 lakhs for the establishment of this Institute was included in the Second Five Year Plan.

II. Draft Plan of the Institute—Scope of Work to be Undertaken

The Draft Plan of the Institute prepared by Shri N. V. Modak (who was appointed Director of the Institute in April 1958), was approved by the *Governing Body* of the C.S.I.R. in October 1958. According to the Draft Plan, the projects envisaged to be undertaken for investigation and research, *inter alia* included the following :

(i) Treatment of water, sewage and industrial wastes ;

(ii) Environmental Hygiene (including Rural Water Supply and Sanitation, Atmospheric Pollution, etc.) ;

(iii) Industrial Hygiene ;

(iv) Radiological Health ;

(v) Study of materials used in Public Health Engineering Works ;

(vi) Instrumentation from indigenous materials required for laboratory work as well as for Public Health Engineering installations ;

(vii) River and Stream Pollution ;

(viii) Control of Vectors ;

(ix) Sanitation of swimming pools, eating establishments, milk, food and public buildings ;

(x) Dissemination of knowledge pertaining to Public Health Engineering problems and research through publication of bulletins and holding of Seminars, Symposia, Conferences etc. ; and

(xi) Co-ordination of the work in the field of Public Health Engineering Research of all the interested agencies in the country by maintaining liaison with the local, national and international organisations.

It was also stressed in the Draft Plan that in the initial stages of the Institute, greater emphasis would be laid on "Applied Research" as there was an immediate

and urgent need for the same, as no research activity worth mentioning had so far been undertaken in the field.

III. Location of the Institute

After a great deal of pioneer work and deliberations, Nagpur (in Bombay State and now in Maharashtra) was selected for the venue of the Institute. The State Government took keen interest in the establishment of the Institute at Nagpur and made a gift of about 109 acres of land on Wardha Road (now called Jawahar Marg), opposite the Central Jail for the accommodation of the Institute in its own permanent buildings, including staff quarters, and for the installation of working models of important public health engineering works.

As it would have taken considerable time to construct the Institute buildings, the State Government was also approached to place at the disposal of the Director, a suitable building where research operations could be started forthwith. The State Government was good enough to hand over to the Institute a spacious bungalow at 70/1 Civil Lines, Nagpur, having a built-up area of about 16,000 sq. ft. (including out-houses), with sufficient open land around. The total area covered by these premises admeasures about 9 acres.

IV. Planning Committee

The work of the Institute is being done under the guidance of a "Planning Committee" which is composed of the following :

1.	Prof. M. S. Thacker, Director General, Scientific and Industrial Research.	Chairman
2.	Dr. V. Subramaniam, Director, Central Food Technological Research Institute, Mysore.	Member
3.	Col. Barkat Narayan, (Representative of the Community Development Ministry).	,,
4.	Shri K. S. Krishnaswami, (Representative of the Health Ministry).	,,
5.	Dr. B. V. Bhoota, Director, Dorr-Oliver (India) Ltd.	,,
6.	Shri P. C. Bose, Chief Engineer, P.H.E., Government of West Bengal, Calcutta.	,,
7.	Shri K. G. Krishnamurthy Technical Secy. to D.G., S. & I.R.	,,
8.	Shri N. V. Modak (Director).	,,
9.	Prof. M. V. Bopardikar (Assistant Director).	Member Secretary

V. Plans and Estimates for the Permanent Buildings and Staff Quarters—Master Plan for Future Expansion

Steps were simultaneously taken to appoint an architect for the preparation of plans and estimates for the permanent buildings and the staff quarters. Messrs. L. M. Chitale & Son who were entrusted with this work, have completed the plans and estimates for both the projects in consultation with the C.S.I.R. together with a Master Plan for the whole area indicating future expansions of the main buildings and staff quarters when the necessity for the same arises.

The main building will consist of a basement, ground floor and one upper floor having a total built-up area of about 51,000 sq. ft. It is estimated to cost about Rs. 10 lakhs. It is expected that this area would be adequate to meet the requirements of the Institute till the end of the Second Five Year Plan. It does not provide accommodation for a Museum, Assembly Hall and such other amenities at the present stage.

It is intended to provide housing accommodation for about 60 per cent of the staff working in the Institute. The present plans and estimates for the staff quarters provide for constructing 74 units of different type at a total estimated cost of Rs. 5.29 lakhs (C type, 2; D type, 4; E type, 8; F type, 12; G type, 28; & H type, 4).

Tenders for the staff quarters have been received and those for the main building have been invited.

The ceremony of laying the "Foundation Stone" of the staff quarters was perfomed on August 30, 1959 at the hands of Shri Y. B. Chavan, Chief Minister, Bombay State. This colony is to be named "Yashwant Nagar" after the name of the Chief Minister.

VI. Plans and Estimates for the Development of the Land

Plans and estimates amounting to about Rs. 8 lakhs for the proper development of the land with all amenities such as water mains, sewers and sewage disposal, storm water drains, main and approach roads, electric supply and fittings, compound wall, etc. were completed and submitted to the C.S.I.R. for approval. When they are approved, tenders for the same will be invited.

Nucleus Staff, Furniture, Equipment, Chemicals, etc. for starting the Research Operation

As soon as the possession of the State Building at 70/1 Civil Lines, Nagpur, was taken, steps were taken to recruit the nucleus staff and to procure sufficient equipment, furniture, chemicals, etc. to enable actual research work being started without delay.

The laboratories started functioning on April 8, 1959 with the blessings of Prof. M. S. Thacker, Director General, C.S.I.R., who specially visited Nagpur on this occasion at the request of the Director, along with Shri P. M. Sundaram, Secretary,

C.S.I.R. The total strength of the staff on the role of the Institute on this day was 34 (Technical, 12 ; Non-technical, 22) which has increased to 124 (Technical, 80 ; Non-technical, 44) on March 31, 1960. (For details *See* Appendix 'A').

The total expenditure incurred on furniture, equipment, apparatus and chemicals during the year under review amounted to Rs. 6.577 lakhs.

VIII. Library and Periodicals

A library has also been started. It has about 2,000 technical and scientific books. The periodicals and journals received in the library numbered 125 on March 31, 1960. The expenditure incurred on the library during the year amounted to Rs. 76,900.

IX. Symposia held in Bombay and Culcutta

Two symposia, each lasting for two days, were held under the auspices of the Institute during the year under report. The venue of the first symposium was Bombay. It was inaugurated on July 30, 1959, by Dr. Jivraj Mehta, Finance Minister, Bombay State. The subjects discussed were as follows :

1. Sewage disposal from individual houses and small communities ;
2. Modern plumbing with special reference to One-Pipe system of plumbing ; and
3. Digestion of Sewage Sludge.

The second symposium was held in Calcutta on 18th and 19th January 1960. It was inaugurated by Dr. Anath Bandhu Roy, Health Minister, West Bengal. The subjects discussed were "Water Supply from the Tubewells" and "Protected Water Supplies to Communities".

Both the symposia were attended in large numbers by Public Health Engineers from the different parts of the country and they were a great success.

X. Sub-Committee for the Evolution of Economic Design for Septic tanks of different categories

At the symposium held in Bombay it was suggested that a Sub-Committee be appointed to evolve a suitable design for septic tanks of different categories after collecting scientific data in regard to the performance of typical existing septic tanks in the country. The Sub-Committee formed for this purpose consists of :

1. Shri N. V. Modak — *Convener*
2. Shri S. V. Desai, City Engineer, Bombay Municipal Corporation.
3. Shri J. P. Naigawalla, Director, Central Engineering Research Institute, Bombay State, Nasik.
4. Prof. S. J. Arceivala, V.J.T.I., Bombay.
5. Lt. Col. D. K. Ghosh, C.R.E.M.E.S.

Two meetings of the Sub-Committee were held in Bombay. A proforma prepared by the Sub-Committee has been circulated to all the Public Health Engineers in the country, requesting them to return it duly filled in.

This work has been started at Poona and Borivli Field Centres.

XI. Committee on "Tubewells"

Similarly, at the Calcutta Symposium, it was agreed to appoint a Committee of all interests to study the various aspects of water supply from tubewells. teps are being taken to give effect to this suggestion.

XII. Bulletin

The Institute has to its credit the publication of a quarterly bulletin covering over 100 pages. During the year under report, four issues of bulletin were published. One thousand copies of each were distributed free of cost to all the Public Health, Municipal and Local Board Engineers as well as to organisations interested in Public Health Engineering in the country. The response to the bulletin is very encouraging and more and more demands for its supply are being received. It may be necessary next year to increase the number of copies from 1,000 to 1,500.

XIII. Integration of the Institute with Public Health Engineering Research Unit of the I.C.M.R.

Having been satisfied that the research in Public Health Engineering should be carried out under one unitary control, a suggestion was made to the I.C.M.R. to amalgamate their "Public Health Engineering Research Unit" with this Institute. This unit is collecting data on the pollution of streams caused by the discharge of sewage and trade effluents in Bihar, West Bengal and U.P. with a view to suggesting suitable remedies to prevent pollution wherever it occurs. This request is being considered very favourably by the I.C.M.R. It is likely that the amalgamation would take place early next year.

XIV. Budget Allotment and Expenditure incurred

Provisions in the budget and expenditure incurred during the year are detailed below :

	Allotment	*Expenditure*
Capital	5.416	4.941
Recurring (including pay & allowances)	7.804	7.360
Pilot Plants	0.704	.107

XV. Starting of Field Centres at Delhi, Bombay including Borivli, Poona and Hyderabad

As envisaged in the Draft Plan, Field Centres were started at Delhi, Bombay including Borivli, Poona and Hyderabad. It is proposed to establish at

least three more centres during the next year at suitable places where facilities for research exist. The additional field centres will only be started after final decision regarding the amalgamation of the I.C.M.R. unit with the Institute is taken.

XVI. Work done at Delhi Field Centre

This centre has been functioning in the buildings of the Chandrawal Water Works at Delhi belonging to the Delhi Municipal Corporation, for over two years. During the first eighteen months, it undertook *inter-alia* study of the existing water treatment plants of different designs belonging to the Delhi Municipal Corporation as a sponsored research scheme and during the remaining period, the same work was continued under the direct control of this Institute.

As the accommodation available at Chandrawal was found to be insufficient, a new laboratory building costing about Rs. 1.1 lakhs (including furniture, apparatus, equipment, electrical installations, etc.) is under construction. It should be possible to locate the Delhi Field Centre in this building in the early part of the next financial year (1960-61).

As a result of the study of the different water treatment plants at Chandrawal Water Works, an economical and effective design for a clariflocculator was evolved and translated into a small demonstration plant. As this plant gave very encouraging results, additional demonstration units having a clariflocculator capacity of 25,000 g.p.d., are under construction for further studies. It is expected that they would be put into commission early next year.

The results so far obtained, indicate that it should be possible to reduce the turbidity of water from 5,000 to 10 p.p.m. by this clariflocculator with a retention period of about 1½ hours against the conventional retention period of 3 to 4 hours. This will help in reducing substantially the cost of such plants. At the present moment, these plants have been a monopoly of a few firms specialising in treatment of water and sewage.

Different types of Coagulants are proposed to be tried in the new demonstration plant with a view to economy and to avoid import of foreign materials.

Proposals have been made to instal a full-scale Clariflocculator of "Pheri" design to treat four lakh gallons of water per day at Poona at the Corporation Water Works at Swar Gate. Similarly, proposals to construct similar clariflocculators at Sholapur, Sirsa (Punjab) and Hyderabad (Regional Research Laboratory premises) are under consideration.

It is very likely that as the effluent from the "Pheri" flocculators will have a turbidity of less than 10 p.p.m. which is the prescribed standard for drinking water, it may not be necessary in some cases to instal filters for further treatment of water. This will again help considerably in reducing the cost of water treatment plants.

Investigations regarding the rates of filtration were undertaken at this centre. It is found that the conventional rate of filtration of 80 gallon sq. ft. per hour could

be increased to 120 or even to 150 gallon sq. ft. per hour without sacrificing efficiency. A small-scale filter, based on these results, is being constructed at Rohtak (Punjab) to obtain further data on the subject.

It is intended to provide four demonstration filter units at Delhi next year for further studies. Thus, this centre will be engaged in research on treatment of water including flocculation coagulation, filtration and chlorination at least for the next three years.

Some fundamental research will also be done regarding media used for the bacteriological analysis of water.

In addition, arrangements are being made to study the digestion of sewage sludge in digestion tanks and treatment of sewage by oxidation ponds at the Sewage Purification works of the Delhi Municipal Corporation at Okhla, during the next financial year.

The staff working at this field centre consisted of :

1 Officer-in-Charge — S.S.O. Gr. I ;

2 Junior Scientific Officers ; and

3 Senior Laboratory Assistants.

XVII. Sponsored Schemes at Delhi

In addition to the study of water treatment plants, following sponsored schemes were under investigation at Delhi :

1. Definite comparative investigation of the British Ministry of Health and American Public Health Association techniques for quantitative detection of coliform group of bacteria (Dr. S. V. Ganapati and Shri R. S. Mehta).
2. Rheological survey of the Yamuna river (which is a source of Delhi's water supply between Wazirabad—point of water intake—and Okhla (Dr. S. V. Ganapati).
3. Investigation of the significance and value of various biological indices of pollution of water (Shri H. L. Sarkar).
4. Investigation of the quantitative significance of growth of plankton in relation to water quality (Shri H. L. Sarkar).

XVIII. Work undertaken at Borivli (Bombay) Centre

Khadi Commission was pleased to allot accommodation at Kora Kendra, Borivli, for the location of this centre for environmental sanitation work. This place was selected to tackle problems in rural areas created by the expansion of cottage industries. The necessary equipment and apparatus for the working of this field unit has just been received. It also took considerable time to get water and electric connections for the laboratory.

Investigation work on the hazards involved in the conventional rural types of latrines, due to inherent faults, is taken up. In addition, study of ground pollution due to effluents from tannery and other cottage industries is also being tackled.

A comparative study of infection load in community with and without sanitary amenities like supervised water supply, excreta disposal, sanitary housing and vector control is being conducted. For this purpose, part-time services of a local pathologist have been procured.

Analysis of water from wells numbering over 100 have been made to assess the potability of water for drinking purposes and hazards arising therefrom.

It is proposed at this centre to perfect the technique of *gobar* gas plant construction with a view to reducing its cost.

As pointed our before, the effluents from some of the septic tanks are being analysed to provide data to the Sub-Committee appointed for the evolution of an economical and satisfactory design for septic tanks of different categories.

Work on the removal of H_2S from sludge gas has been started at Dadar and Dharavi plants of the Bombay Municipal Corporation, with their co-operation. The presence of excess H_2S in the sludge gas obtained from the digestion of sewage sludge is due to the excess of sulphates in the sludge on account of the infiltration of sea water either into the sewer or the sewage treatment plant. This is a joint scheme of the Bombay Municipal Corporation and this Institute.

Some experiments on high rate filters for water purification were also carried out at Powai (Bombay) in collaboration with the staff of the Bombay Municipal Corporation. As a result thereof a design for a complete water treatment plant including "Pheri" clariflocculator and a modified filter has been prepared for treating 4 m.g.p.d. It is likely that the Bombay Municipal Corporation may construct this plant at their cost as a pilot plant as they have to ultimately treat over 200 m.g.p.d.

Investigations on the performance of the newly constructed sewage treatment plant of the Bombay Manicipal Corporation at Love Grove are expected to be started early next year in regard to (i) utilisation of sludge gas for the manufacture of chemicals; (ii) effect of consolidating sludge on the capacity of digestion tanks; (iii) effect of aeration on the sweetening of the septic sewage; (iv) advantages of deep *versus* shallow digestion tanks; (v) study of the flora and fauna of the trickling filters; and (vi) treatment of supernatent liquor from digestion tanks.

The staff employed at this centre including that at Borivli consisted of :

1 Junior Scientific Officer ;

1 Senior Scientific Assistant ;

1 Senior Laboratory Assistant (Engineer) ; and

1 Senior Laboratory Assistant (Chemist).

It is felt that a number of problems of various types are likely to come up for investigation in the western zone for which a central field laboratory like the one at

Delhi may be required in the near future at Bombay. Some action in this regard may have to be taken next year.

XIX Poona Field Centre

The work at this centre is being carried out in the accommodation provided for this purpose by the National Chemical Laboratory. Actual work was started in October 1959. It has not been possible to develop this centre due to the difficulty experienced in recruiting the right type of personnel. Only one Senior Laboratory Assistant is working at this centre with the help of one Mistry.

The work undertaken pertains to the analysis of septic tank effluents around Poona and that of trade effluents from the industries in Greater Poona area, for the purpose of finding out how they could be treated before discharge to prevent public health hazards. So far trade effluents from eight major industries have been analysed. It is found that there is no gross pollution of the river into which these effluents are discharged. Some treatment at the premises itself is considered necessary in the case of a few industries to safeguard public health. Work in this behalf would be started next year.

It is expected to develop this centre next year when additional staff required for manning the same is sanctioned and recruited. It will also have to collect data for the demonstration clariflocculator unit which is to be installed at Swar Gate to advise the Poona Municipal Corporation regarding the most economical and efficient method of water treatment for their ultimate plant of 50 m.g.p.d.

Work on the utilisation of sludge gas will be started in earnest in collaboration with N.C.L. next year, when the two clarigesters which are under construction for generating and collecting the gas from the housing colony of the N.C.L. are completed. The cost of the mechanical equipment of the clarigesters is being borne by the Institute, while that of civil engineering works by the N.C.L.

When the activities of this centre expand, the space allotted by the N.C.L. will be inadequate and steps will have to be taken either to construct an independent laboratory in the compound of the N.C.L. or to rent a suitable building in Poona for this purpose.

XX. Work undertaken at Hyderabad Field Centre

This centre has for the present been located in a room of the Institute of Preventive Medicine, Hyderabad, with the kind permission of the Director of the Institute and Hyderabad State Government. A Senior Scientific Officer was sent to Hyderabad for the organisation of this centre in the month of November 1959. The following problems were under study :

1. Disposal of paper mill waste from Rajhmundry Paper Mills.
2. Utilisation of the trade waste from Bodhan Sugar Factory.
3. Performance of the existing sewage and water treatment plants of Hyderabad City.

Advice was also given regarding the water supply problem for the Regional Research Laboratory, Hyderabad.

Discussions were also held with the State Officials and Russian experts regarding the treatment and final disposal of wastes from the proposed Synthetic Drug Factory at Hyderabad, to be started under the guidance of the Russian experts. Proposals made by the Institute seemed to be acceptable to the Russian experts. Further investigation work, in this behalf, will be undertaken, after the proposal of locating the factory at Hyderabad has been finalised by the State Authorities.

The staff employed at this centre at the end of the year under report consisted of one Senior Scientific Officer, Gr. I, and three Junior Scientific Assistants who were posted at the fag end of the financial year.

When the work of the centre increases, it will be necessary to provide additional accommodation either at the present place or somewhere else. This centre is expected to tackle problems from the States of Madras, Kerala and Mysore in addition to Andhra Pradesh and as such it will have to be developed on a zonal basis. This will require additional staff and equipment.

XXI. Work done at the Main Laboratory

It will be observed from the foregoing that the research projects taken up for investigation at the field centres pertain to the treatment of water, sewage and industrial wastes and environmental sanitation as they are the major and urgent problems of the nation, requiring immediate solution. The same problems were also taken up for investigation and solution at the Main Laboratory, Nagpur.

It is generally agreed that the present methods of treatment of water, sewage and industrial wastes adopted in the country are wasteful, costly, highly mechanised and require very skilled supervision. Local bodies in industrial concerns responsible for the maintenance cannot afford to spend the money required for their up-to-date up-keep and this results in the deterioration of the effluents produced by these plants. There is, therefore, ample scope for research in this field for the purpose of effecting considerable savings, in order to make them acceptable to the Local Bodies and Industries. Similarly, the present state of Rural Sanitation is far from satisfactory, and it cannot be improved until more economical methods within the means of rural population are evolved. Ways and means have to be found to dispose of human and animal wastes in a manner acceptable to the villages and safer from the point of public health. This will indirectly help considerably in reducing the morbidity and mortality caused by water-borne diseases and unhygienic disposal of excreta.

Field Laboratory at Bhandewadi for Research in Sewage and Sludge

To enable research in Sewage Sludge treatment being done on a large scale, large quantities of sewage—both raw and settled—must be available. As such facilities do not exist at 70/1 Civil Lines or at the permanent site of the Institute on Jawahar Marg, it was considered necessary to construct a field laboratory at Bhandewadi

where sewage from Nagpur City is being collected for treatment. Sanction of C.S.I.R. was obtained to construct a laboratory at this place similar to the one under construction at Chandrawal Water Works No. 2, Delhi. The Laboratory building is nearing completion and the estimated cost of the same is Rs. 54,000 exclusive of services and ancillaries.

Chlorination of Rural Wells for the Elimination of Pathogens

In the field of environmental hygiene, the main loboratory examined a large number of samples of drinking water from wells, tanks and streams within and around Nagpur. Most of them were found to be satisfactory from the chemical standpoint. However, a large number of them were found unsuitable for drinking purpose from the bacteriological point of view. Investigations for elimination of the pathogens are in hand. They include a study of the interval factor between two consecutive chlorination doses, the quantity of chlorine required for effective chlorination and a suitable simple chlorinating apparatus.

Comparative Studies on the Disinfecting Properties of Bleaching Powder and Potassium Permanganate

It has been found that bleaching powder is more effective than potassium permanganate, as its dose is less, its effects last longer and it is also cheaper.

A country-wide survey is being made to collect data on (i) type of disinfectants used ; (ii) their dose ; and (iii) intervals at which wells are disinfected.

Work was also done on the following items

1. *Preparation of a suitable synthetic medium from indigenous material for examination of coliform organisms present in water and sewage*

A new synthetic medium is being developed in this Institute, in order to replace lactose and MacConkey broth. All the ingredients of the new synthetic medium are freely available in India and no foreign exchange is involved. The laboratory experiments indicate that it is not only cheaper, chemically defined, but also it gives better detection of *E. coli*. This work will be continued next year.

2. *Suitability of synthetic polythene tubes in relation to water quality*

Experiments are being conducted to find out whether polythene tubes encourage any bacterial growth during passage of water through them.

3. *Studies on the Microbiology of Jute*

It has been claimed that jute fiber used for jointing pipes carrying drinking water supports bacterial growth. Experiments have been started to find out whether it is necessary to sterilise jute fibers before their use in the jointing of pipes,

4. *Water-borne Virus Contamination*

Literature on water-borne epidemics of Virus Hepatitis was collected and reviewed in order to start the work on the Water Viruses in the near future. A separate building for this purpose will be necessary and the design for the same is in hand.

5. *Comparative study of the advantages and disadvantages of Roller-Tube and Plate Count methods* far the enumeration of bacteria in water and sewage were in progress. The results so far obtained indicate that roller tube method has many advantages over the plate count method. This work will be continued for another year. Steps will also be taken to explore the possibility of fabricating roller tube equipment from indigenous sources.

6. *Fluorosis and Defluoridation*

As incidence of fluorosis was reported among human and cattle population in Chanda disrict (Vidarbha), a rapid screening of over sixty villages covering a human population of 40,000 and a cattle population of 10,000 was undertaken. The study indicated that the incidence of fluorcsis in this area was sporadic and of a mild character. The analysis of drinking well waters showed that the fluoride contents varied from 2 to 5 p.p.m. It is intended to extend the survey to further towns north-east of the region which is known for fluorospar deposits according to the Geological Survey of India. It is also proposed to cover the other parts of Maharashtra, where fluorosis is reported to be endemic in character, in co-operation with the Animal Husbandry Department of Maharashtra State.

Experiments for defluoridating the water were also undertaken on laboratory scale. It is expected that a demonstration plant based on the laboratory study findings may be started early next year.

7. Experimental soak-pits have been constructed in Kohli village of Nagpur district (population 1,000) to demonstrate to villagers the advantages of this type of treatment for the dispcsal of house-hold sullage and waste water in the control of filaria. The pits will be kept under observation during the next rainy season. Along with the soak-pits, latrines constructed by the villagers with the help of the Institute will also be kept under observation. The main idea in taking up this village for experimental purposes is to create an ideal village providing all the amenities necessary for a comfortable and satisfactory community life. The villagers are very co-operative and it is hoped that considerable progress would be made in the improvement of this village in the course of the next year.

8. *Vector Control*

Co-operation of the Director of Public Health is being sought for taking up the work of filaria control in a few selected villages around Nagpur through ecological engineering. It is expected that some work in this line would be started next year on the basis of the experimental work done at Kohli village.

9. *Water Treatment*

The performance of the existing water filtration plant of the Nagpur Municipal Corporation at Kanhan river was studied with a view to find out whether the output of the plant could be increased at reasonable cost by making a few additions and alterations thereto, as the Corporation had advertised for the installation of additional filters to meet their growing demand. The studies showed that it was possible to increase the output of the existing filtration plant by 4.8 million gallons per day (equivalent to the output of the proposed filter plant) with a few additions and alterations. The Municipal Commissioner was accordingly advised. He, having accepted the advice of the Institute has been able to save the funds of the Corporation to the extent of about Rs. 8 lakhs, as the price quoted for the additional filtration plant of 4.8 m.g.p.d. was about Rs. 11 lakhs and the cost of additions and alterations to the existing plant to increase its output is estimated at Rs. 3 lakhs. The work of additions and alterations will be started by the Corporation soon. It will be done by the two firms specialising in water treatment plants who had originally constructed the existing units.

Water from the Ambajhari Reservoir—other source of water supply to Nagpur City—is being studied to determine whether the water could not be treated by micro-strainers instead of by the usual methods of water filtration, with a view to economy. Messrs. Glenfield and Kennedy have kindly agreed to present to this Institute a "Filtrability Test" apparatus for this purpose. They have also agreed to loan to the Institute a demonstration Micro-strainer Unit for further studies.

10. *Sewage Treatment*

The new method of treating sewage by Stabilisation or Oxidation Ponds is being studied. This method does not require any mechanical equipment and heavy civil engineering works and is therefore cheaper not only in initial cost but also in maintenance. It is being used on a large scale in U.S.A. and Australia for medium size communities.

mass scale for being introduced into the experimental Oxidation Ponds. The laboratory has succeeded in culturing *Chlorella* for mass innoculation.

The oxidation ponds will be worked both for primary and secondary treatment to test their performance as methods of sewage treatment.

Two more algae have also been isolated, *viz.*, *Scenedesmus* and *Selenastrum* which are found to be suitable for introduction in oxidation ponds.

After the Chlorella was isolated, it was grown in mass culture for finding out its nutritive value using sewage as culturing media. Experiments indicated that *Chlorella* contains about 45 per cent proteins. Work on the estimation of Carbohydrates and fat contents was in progress and will be continued next year.

11. *Sewage Farming*

As the final disposal of sewage in most of inland towns in the country will be by application on land, the study of existing sewage farms was undertaken. Sewage farms at Poona and Ahmedabad were studied. The object of the study is to find out:

1) the dose of effluent per acre ;
2) the degree of dilution with water, if any ;
3) the nature of crops suitable for the soil and the effluent ;
4) interval between watering ;
5) means necessary for the prevention of hazards to persons working on the farm ;
6) effect of soil texture on the efficiency of sewage purification ;
7) existence of *B. Coli* group organisms in soils and crops grown on sewage farms ;
8) effect of preliminary treatment of sewage on the soil from the point of plant growth ; and
9) utilisation of sludge as fertiliser.

About a dozen important sewage farms in the country will be studied next year and the findings published in a brochure form. A symposium on the subject will then be held to discuss the various aspects of 'Sewage Farming'

12. *Stream Pollution*

Survey of Nag nala (a local stream) was undertaken with a view to finding out the extent to which it has been polluted, the effect of the pollutants on the aquatic life in it, and its ability to purify sewage.

Thirteen sampling stations were set up along the 12-mile length of the stream. Weekly samples were taken and Biological, Chemical and Becteriological analysis done.

The studies so far reveal that :

1. the load of the domestic sewage and trade wastes discharged into the stream is much more than it can carry without impairing its sanitary conditions ;
2. the dissolved oxygen is practically zero in the lower reaches of the stream ;
3. B.O.D. is as high as 400 p.p.m. ;
4. except in upper reaches, fish life is non-existent ;
5. biological organisms found in the stream are indicative of gross pollution ; and
6. salinity values correspond with those found in the streams receiving medium sewage.

13. *Fish Farming in Sewage Effluent Waters*

The aim of these experiments was to determine viability, growth rate, nutritive value and pathogenicity, if any, of Carp reared in sewage effluent.

First series of experiments were completed. The study revealed that Carp can survive without adverse effects, in domestic sewage with a B.O.D. of 50 p.p.m. Second series will be carried out at Bezonbagh in an artificial pond to determine the growth rate of Carp in sewage effluent, and this will be compared with the growth rate of the same species in its natural habitat.

14. *Trickling Filters*

Experiments on Trickling Filters to determine the most economical depth, kind and grading of materials used, re-circulation rate and fauna and flora responsible for purification are being undertaken.

A trickling filter to treat 5,000 gallons of domestic sewage per day has been designed and will start functioning early next year.

15. *Eradication of Chironomus Larvae from Domestic Water Supply System*

Larvae have been collected from the local streams and reservoirs. Their life history and ecological factors are under study. Following methods of control are being tried :

1) *Chemical :* Alum and Chlorine ;
2) *Biological :* Introduction of Larvicidal Fish in the reservoirs ;
3) *Mechanical :* Periodic flushing out of the sludge from storage reservoirs and covering the reservoirs with fine mesh screen to prevent the adult fly from laying eggs on the surface of the water.

Indore Water Works were visited and some measures for immediate eradication were suggested.

16. *Reduction of turbidity by Ciliate Carchesium*

The Ciliate was isolated, cultured and introduced in large numbers in suspension of carmine stain of known turbidity. No significant reduction in turbidity was recorded. Further experiments will be carried out. Probably Rotifers are capable of reducing turbidity.

17. *Identification, Isolation and Culture of Planktonic Organisms*

Protozoa, Rotifers and Crustacea which are representatives of potable and polluted conditions were collected, cultured and identified. In this connection, detailed experimental study on Rotifers has been undertaken.

18. *Alcoholic fermentation of Sulfite Waste Liquor*

This work was undertaken with a view to exploring the possibility of utilizing sugars in straw-board factory wastes in the production of Ethyl Alcohol. Two sets of samples from Bhopal Straw-board wastes were analysed. There is complete absence of sugar. Alternative methods like digestion etc. will be studied next year.

19. *Removal of Brackishness in Drinking Water*

Laboratory experiments for the removal of brackishness in drinking water were carried out by using Cation Exchange Resins developed by the National Chemical Laboratory. As the results were encouraging a pilot plant is proposed to be put up in Manji Dana Colony, Nagpur, where brackish water from local wells is used for drinking purposes. The population served will be about 500. The hardness of water is 600 p.p.m. as $CaCO_3$.

This method of removal of brackishness is also proposed to be used at the Khaperkheda Power Station of the State Electricity Board for softening boiler feed water where the hardness of water is 150 p.p.m. as $CaCO_3$.

In addition to the problem of water softening the following additional items pertaining to the boiler feed water of Khaperkheda Power Station were under investigation :

(i) *Removal of Algae from the Cooling Water Tower :* Investigation was started and will be continued next year. The growth of Algae in the cooling tower affects its thermal efficiency and as such, steps are necessary to get rid of the same by suitable means ;

(ii) Reduction of silica by distillation ; and

(iii) *Substitute for Anthracite used in pressure filter :* At present, anthracite used in pressure filters is required to be imported. An indigenous substitute for the same has to be found. The work on this scheme was started and will be continued next year.

It is proposed to put up a pilot pressure filter at Khaperkheda to investigate the suitability of various indigenous filtering media including the activated, carbon developed by the Regional Laboratory, Hyderabad.

20. *Suppression of Evaporation losses by Cetyl Alcohol or Hexadecanol*

Laboratory studies were conducted for developing a suitable technique in the use of this chemical. The studies will have to be continued next year on a much wider scale. It is proposed to utilise the abandoned swimming pool at Gorewada Tank, Nagpur, for trying out the developed technique on a large scale and thereafter in the Gorewada Tank itself, which is one of the sources of water supply for Nagpur City.

T.C.M. has been pleased to give the Institute about 1,000 lb. of hexadecanol free of cost for experimental purposes.

21. *Search for indigenous materials for use as coagulants in water treatment plants*

This work was in a preliminary stage. Gelatin, a waste product of a paper factory, was suggested in this connection. The experiments revealed that it was unsuitable as it contained large quantities of organic materials. This work will have to be continued next year using other indigenous coagulants.

XXII. Advice given

The Director was invited by many local bodies and industries to give advice in the solution of their problems relating to water supply, sewage purification and treatment of trade wastes. Some important work done is detailed below :

Heavy Electricals Ltd., Bhopal : Tenders received for the purification of plating mill wastes of the Bhopal Heavy Eletrical Works were referred to the Director for advice. Their Consultirg Engineer had recommended the acceptance of a tender costing Rs. 11 lakhs which *inter alia* included re-use of the trade effluent after demineralisation. It was considered unnecessary to recover the trade effluent for re-use after demineralisation as filtered and chlorinated water from Bhopal Water Works was available in sufficient quantity and at a cheap rate. An expert committee was appointed by the Management to give expert opinion with the Director as Convenor. The Committee agreed that the city water supply should be used after demineralisation if necessary and the trade wastes should be purified by the conventional methods. It is likely that due to this recommendation substantial saving will accrue both in capital and maintenance cost of the Plant.

Dhrangadhra Chemical Works : There is a dispute between the Dhragandhra Municipality and the Dhrangdhra Chemical Works regarding the disposal of trade effluent from their factory. It is alleged by the Municipality that drinking water wells in the town have gone brackish due to the pollution caused by the trade wastes. It is suggested that the trade wastes should be conveyed to the sea in a conduit 10 miles long to prevent the pollution. The Institute was requested by both the parties to investigate this problem and suggest economical ways and means for the treatment of the wastes to make them safer from all aspects. The actual investigation work was started in March 1960 only and will be continued next year.

XXIII. Necessity of close liaison with Public Health Engineering Organisation and the Institute

In order that the research carried out by the Institute is put into practice, it is essential that there should be a very close liaison between the Central Public Health Engineering Organisation working under the Ministry of Health, the State Public Health Engineers and various local bodies and industries, since it is they who would be benefitted by the results of research. A common platform must therefore be created where all of them can meet and discuss their problems. One of the methods of bringing all interests on a common platform would be to hold every year a "Conference" of all the Public Health Engineers and Industries in the country. The Central Public Health Engineering Organisation are having such a Conference but they do not invite Industrialists to participate in the deliberations.

Another way would be to secure very close liaison with the Central Public Health Engineering Organisation, as they would be in a better position to advise the local bodies to adopt the methods developed by the Institute when they are scrutinising the Plans and Estimates submitted to them either for loan or subsidy from the Planning Commission by the State Public Health Engineers and Municipal Corporations.

It is suggested that to accomplish this objective, a Joint Meeting of the Ministries concerned and the Planning Commission be arranged.

XXIV. Method of Recruitment

The Institute had great difficulty in securing the technical staff. Public Health Engineering Research is a team work requiring the co-operation of disciplines like Social Medicine, Botany, Zoology, Bacteriology, Chemistry, Physics and so forth. The staff from such disciplines not having a bias towards Public Health Engineering, a good deal of time in the initial stages has to be devoted to train them for the work they are expected to do at the Institute. This is due to the fact that most of the problems taken up for the post-graduate research work in various disciplines are of an academic nature—having little bearing on practical application. It is therefore suggested that the Institute should approach various Universities in the country and request the teachers therein, to take up such problems which would have direct bearing on Public Health Engineering Research. Fellowships to attract the right type of personnel will have to be established in the University by the Institute for this purpose. This will have the advantage of manning the Institute with proper personnel with a bias towards Public Health Engineering.

XXV. General

It will be seen from the foregoing that the work done by the Institute in the first year of its life is substantial in spite of the initial difficulties encountered in getting staff, equipment, buildings, etc. The Institute feels that by their efforts it has been possible during the year under report to save substantial amount of capital cost of water, sewage and trade treatment plants to the Community.

APPENDIX A

Statement of Permanent and Temporary Establishment of the Central Public Health Engineering Research Institute, as on 31st March, 1960.

Category of Post		Sanctioned strength	Actual Strength	Vacant Posts
Gazetted				
Scientific	(P)	28	11	17
	(T)	13	—	13
	Total	41	11	30
Auxiliary	(P)	—	—	—
Technical	(T)	1	—	1
	Total	1	—	1
Non-Technical	(P)	4	2	2
	(T)	—	—	—
	Total	4	2	2
Non-Gazetted				
Scientific	(P)	15	14	1
	(T)	33	20	13
	Total	48	34	14
Auxiliary	(P)	23	13	10
Technical	(T)	5	2	3
	Total	28	15	13
Non-Technical	(P)	22	20	2
	(T)	11	8	3
	Total	33	28	5
Class IV Staff				
Technical	(P)	19	15	4
	(T)	13	6	7
	Total	32	21	11
Non-Technical	(P)	17	11	6
	(T)	3	3	—
	Total	20	14	6
GRAND TOTAL				
Gazetted	(P)	32	13	19
	(T)	14	—	14
Non-Gazetted & Class IV	(P)	96	73	23
	(T)	65	39	26
	Total	207	125	82

P = Permanent
T = Temporary