

IRRIGATION

RESEARCH

IN

INDIA

CENTRAL BOARD OF IRRIGATION

Popular Series

Leaflet No. 2

FOREWORD

In this leaflet, an attempt has been made to acquaint the reader with what is being done in connection with Irrigation Research in India. Details of the highly technical work may not interest all, but a general knowledge of what has been achieved in the country and what is being done for the optimum utilisation and conservation of the water resources of the country should no doubt, be available to every citizen.

Details about individual experiments or of work done on different subjects are available in the office of the Secretary, Central Board of Irrigation and the undersigned will be only too glad to furnish further information to those who feel interested.

KENNEDY HOUSE,

SIMLA.

5th January, 1947.

N. D. GULHATI.

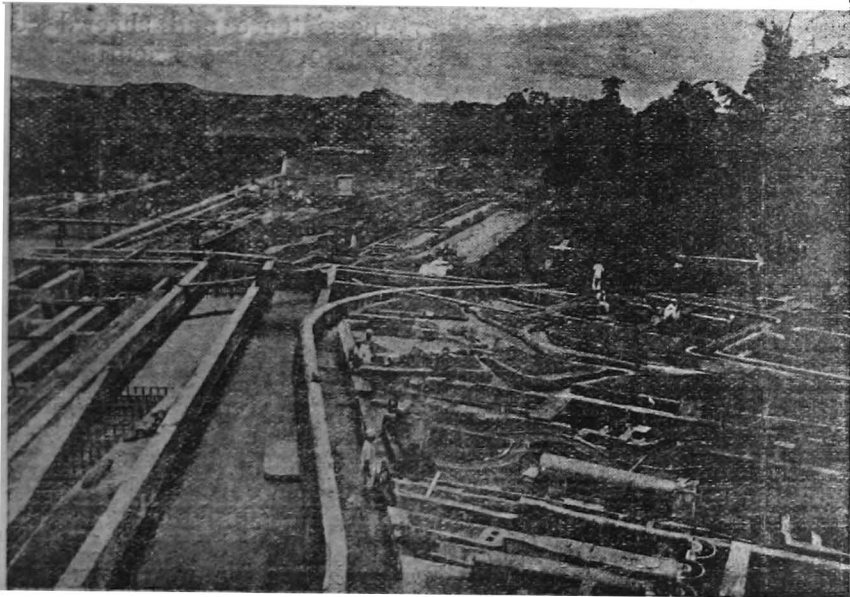
Secretary.

IRRIGATION RESEARCH IN INDIA

THE NEED FOR RESEARCH

“ Nature to be commanded must be obeyed ”

TO construct works, “ all that man can do is to put together or put asunder natural bodies. The rest is done by nature working within ”. “ Human knowledge and human power meet in one ; for where the cause is not known the effect cannot be produced. Nature to be commanded must be obeyed ; and that which in contemplation is as the cause is in operation as the rule ”. These are the words of Francis Bacon who “ elaborated the



A part view of the Indian Waterways
Experiment Station at Poona.

basic philosophy of modern science ; test everything by experiment, accept nothing that cannot be corroborated by experience ”.

To harness the forces of nature for the benefit of mankind, it is evidently essential that the manifestations of nature must be studied and examined in all their implications. Research is the modern method of these elaborate studies. To build weirs, dams, embankments, bridges, falls and other hydraulic structures, strong enough to withstand damage and deterioration by elements, the engineer is increasingly dependent upon the conclusions drawn from experimental investigations. In fact research of this nature has become almost a branch of engineering in itself.

THE GROWTH OF RESEARCH

The great irrigation works that were constructed in India in the 19th century were designed when the Science of Hydraulics and Irrigation Engineering was in its infancy. Mistakes were made and had to be corrected over a long period of trial and error. Works as designed could not withstand the destructive action of flowing waters. But the damage done was repaired, year after year, on improved lines. Problems as they arose were overcome by dogged persistence and shrewd commonsense which had to be substituted for correct scientific knowledge.

Irrigation Research in India had humble beginnings. Individual officers interested in the development of the subject and anxious to solve correctly the problems with which they were faced **THOUGHT, OBSERVED AND CONCLUDED**. The records of the engineering associations in the country give sufficient evidence of the keen interest taken by some engineer officers in developing, as best as could be done without the aid of modern research technique, the theory of flow of water in artificial earthen channels, measures for the improved distribution of water and the design of hydraulic structures.

Experimental research in India, in connection with irrigation, is of recent origin and the first in the field was Bombay, where a Hydrodynamic Research Station was opened on a small distributary near Poona in 1920. As the supply of water available for experiments was limited at this place, in 1925 the Khadakvasla Hydrodynamic Research Station was opened.

The next in the field was the Punjab, where, like Bombay it was found that something must be done to combat the growing evil of waterlogging and deterioration of land by salts ; both

the problems appeared to have been directly or indirectly the result of the development of canal irrigation. Investigations were started in 1925 and gradually a hydraulic laboratory was established in Lahore which has gradually grown into the present Punjab Irrigation Research Institute at Lahore with a large field station at Malikpore near Pathankote.

A small Hydraulic Research Station was established in Karachi in 1930 and about the same time an officer of the Irrigation Department in the U.P. was entrusted with research work in addition to his other duties.

In 1931, the Central Board of Irrigation was formed and an impetus was given to irrigation research in the country by the annual meetings of research officers and chief engineers in which the research carried out during the year was discussed, information pooled, and further programme chalked out.

The Research Station at Khadakvasla near Poona was taken over by the Government of India in 1937 as the Central Hydrodynamic Research Station, since named the Indian Waterways Experiment Station. Bombay however continued to maintain a separate research station where *inter alia* the problem of the disposal of untreated sewage of Poona by irrigation methods continues to be examined and developed.

More recently a Research Station was established in Mysore and others in Bengal (1943) and Madras (1944). The United Provinces has developed its activities and has recently opened a research station near Hardwar. The Hyderabad State is now constructing a large engineering research station with a comprehensive programme, and the Government of India has sanctioned the construction of a new Central Waterways, Irrigation and Navigation research station at Delhi, which will embrace all branches of research dealing with the control and conservation of water.

Ceylon established a research station in 1938 and at present there are 10 research stations in India and Ceylon. The activities of all these stations are co-ordinated by the Central Board of Irrigation.

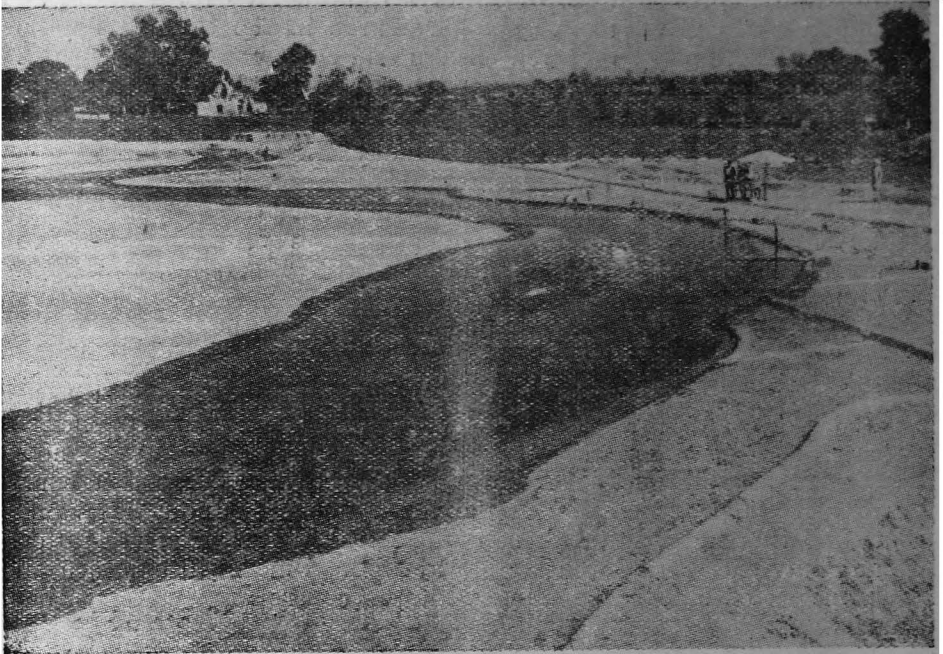
PRESENT ACTIVITIES

Among the numerous problems which are referred to the Irrigation Research Institutes in the country, the following may be mentioned :

Model Experiments.—Hydraulics is an elusive science. Its laws are limited in their application to definite sets of conditions, and when one of those conditions is altered, a law perfectly good

otherwise, is no longer applicable. It is difficult to avoid the tendency to apply a rule or formula to a situation where it does not apply. To overcome the consequences of such tendencies, large hydraulic structures are first examined on models where an attempt is made, as best as possible, to simulate conditions that exist in the original or prototype.

Model experiments are thus employed to verify the design of large structures and these experiments give such useful indications that considerable sums of money have been saved in the past by spending small sums on model experiments.

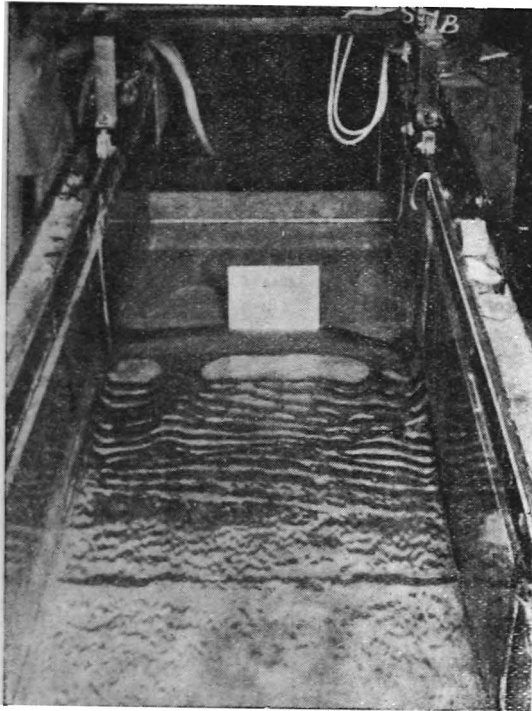


A view of the complete model of the river Beas looking upstream
Experiments were carried out to devise measures to prevent the river from leaving its original course.

Model experiments are particularly useful for river protection works. The laws relating to the behaviour of rivers under different conditions are so little known, that the only possible method of tackling river problems is by recourse to these experiments, and even their application is limited by the extent to which it is possible to simulate the natural conditions on the models.

Silt Investigations.—Silt or detritus in flowing water is at once the bane and blessing of the canal engineer and plays a very

important part in his every day work. Silting and scouring of irrigation channels, silting of reservoirs, and meandering of rivers are some of the manifestations of the silt problem with which the irrigation engineer is directly concerned and a considerable amount of research is carried out on the analysis of silt, the capacity of different kinds of channels to carry varying silt loads and the effect of silt on the behaviour of rivers.

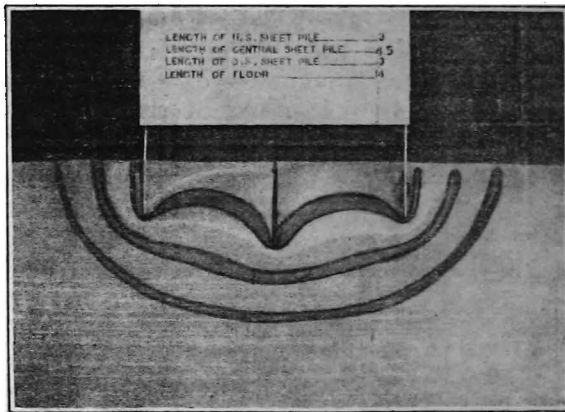


Model experiments on silt exclusion

Design of channels.—The determination of the most economical size and shape of earthen channel for carrying irrigation supplies charged with different silt loads is another problem that constantly engages the attention of the research stations.

Works on sandy foundations.—Good rock and strong foundations are not always available for all massive structures. Many of the large irrigation structures particularly in the plains of Northern India have to be built on sandy foundations liable to scour and permeable to the flow of water. Not an inconsiderable time of the research stations is devoted to basic research in connection with the design of such structures and to the study by

model experiments of measures proposed for the safety of existing works on rivers and canals.



Lines of subsoil flow under a weir on account of hydraulic head as seen in a model

Soil Science.—Soil science is now engaging close attention of irrigation research stations, from the agricultural aspect, for the reclamation of salt lands, in connection with the rise of water table, for determining the bearing capacity in connection with foundation loads and for the consolidation of earth dams and embankments.

There are many other activities of the research stations, including various aspects of hydraulics, hydraulic machinery, hydraulic structures, river training, soils, cements, materials of construction, applied physics, physical chemistry, higher mathematics, statistics and agriculture.

SOME ACHIEVEMENTS

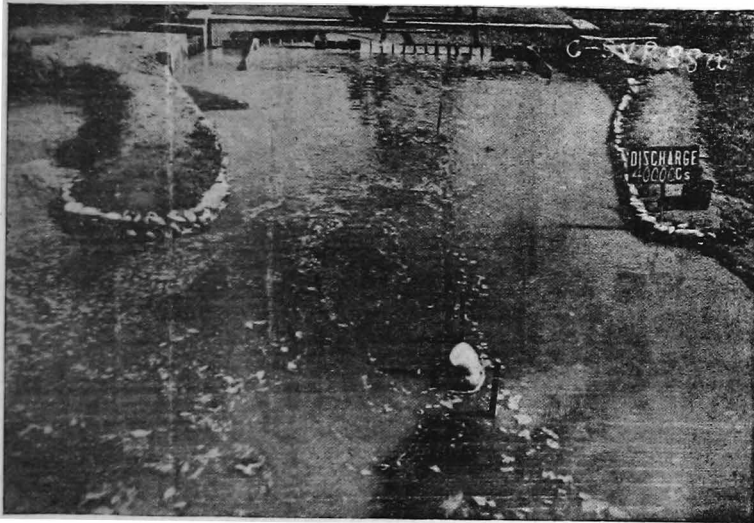
The reader would, no doubt, like to know some of the outstanding achievements of irrigation research carried out in India whether as a result of experimental investigation in the research institutes or by individual officers who have made special observations and investigations on specific problems.

One of the first problems on which a solution was furnished, was the design of earthen irrigation channels. This was as early as the beginning of the 20th century and it made possible the large development that has since taken place in irrigation works in the country. Some of these conclusions have had to be revised as further knowledge and experience was gained and more recent methods of research have been brought to bear on the problem

and the work done in India in this respect is not unworthy of her.

Another problem on which India has made a very valuable contribution is the design of hydraulic structures on sandy or permeable foundations. India gave the world the initial and later the final theory of design of such structures ; the last is contained in one of the world renowned publications of the Central Board of Irrigation.

Outstanding contributions have been made by India to the design of canal structures of all kinds, for devices for the exclusion of silt, for methods of dealing with scour caused by falling waters and, what is perhaps the most important, for the automatic (without manual control) and equitable distribution of water on a scale not known elsewhere in the world.

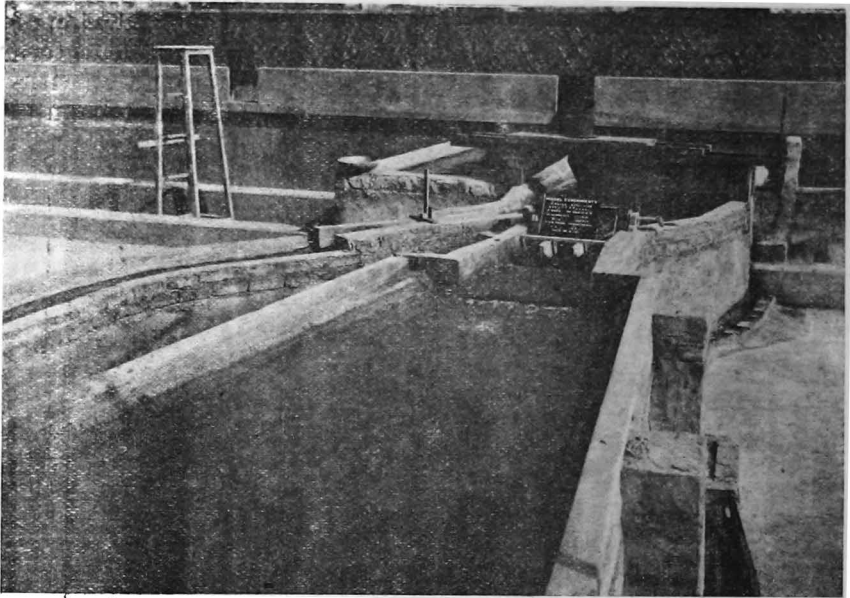


**Model tests of a new device for the control of rivers
A Pitched Island to improve the approach of the river to the Suleimanke
Headworks on the river Sutlej**

New methods, new apparatus and new equipments have been devised for use in experimental research and in the field. It would make this leaflet very long if details are given of all these inventions. The following extracts, from a recent issue of "Engineering", a weekly journal issued in London, will however interest the reader :

"The irrigation engineers of India are making a strong bid for pre-eminence in the field of river and canal engineering,

and it seems that Vicksburg, Delft and Manchester will have to look to their laurels ; the latest (tenth) annual technical report of the Central Irrigation Board, covering the year 1944 and published in Simla in August 1945 (though it has reached us only within the past month), displays a picture of organised research which is almost as admirable as the joint work of the American, British and Canadian men of science in their successful production of the atomic bomb.



Model of a Fall over the Dadu Canal in Sind

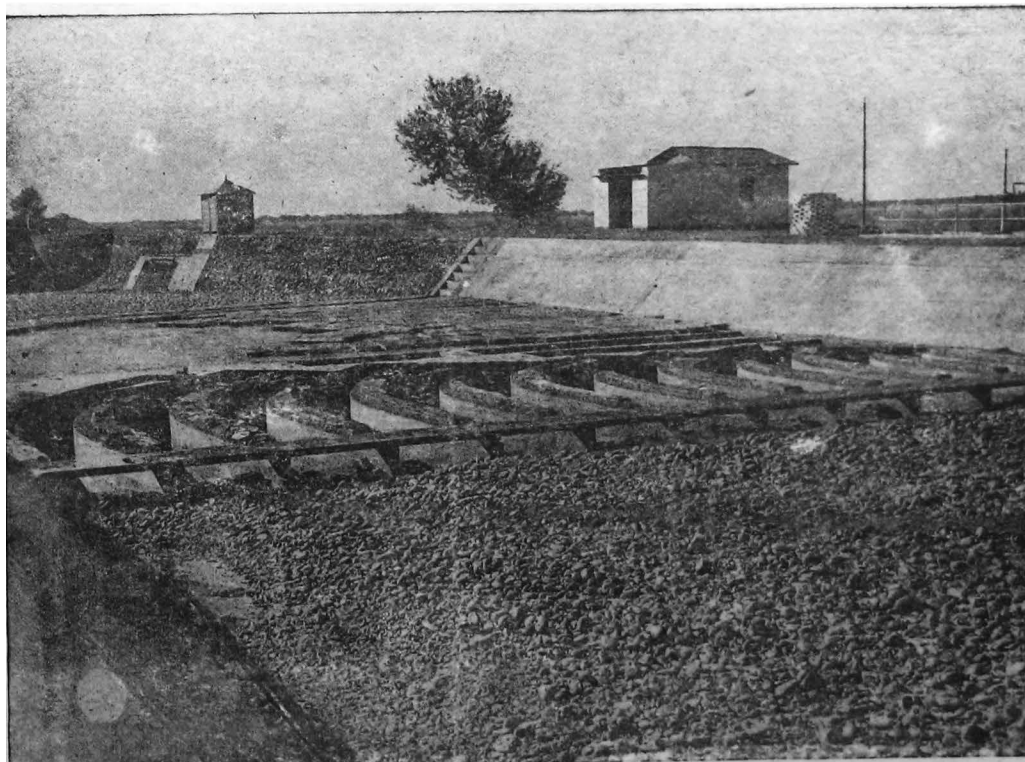
The model is working under full supply conditions after final modifications. Shows smooth flow indicative of no scour-holes

"Great emphasis is placed on the use of models and the comparison of these models with their natural prototypes, but much attention is given also to the comparison of rivers of various sizes, the accumulation of hydraulic data of all kinds, and the diligent pursuit of valid generalisations.

* * * * *

The wide meteorological variations in India, the enormous falls of the major rivers, the extensive demands of irrigation, the extent to which large streams can meander and even change course, and the geological diversity make that country a perfect site for hydraulic investigation. It is highly gratifying to see that every advantage is being taken of the opportunities afforded."

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**Silt ejector in the Salampur Feeder of the Upper Bari Doab Canal
Top removed**