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CYPRUS

DEPARTMENT OF WATER DEVELOPMENT

ABRIDGED ANNUAL REPORT FOR 1956

NICOSIA

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The engineering and geological side of all Government water development work is in the hands of the Department of Water Development whose duties include the search for new sources, the conservation and development of supplies for irrigation, domestic and industrial use, and the problems connected with river training, flood protection and land drainage. The administration of Village Irrigation Divisions and Associations and domestic Water Commissions is supervised by the District Commissioners. Disputes over water rights are handled chiefly by the Commissioners in consultation with the Law Officers, the Department of Lands and Surveys and the Department of Water Development. Soil conservation and the agricultural problems involved in the economic use of water are responsibilities of the Department of Agriculture.

2. In 1956 the main features of the work of the Department of Water Development were the start of the £950,000 Greater Nicosia water supply scheme, the execution of a regional domestic water scheme for the thirteen "dry villages" of the Eastern Messaoria following the acquisition of a small part of the Kythrea Spring, and the completion of the first stage of construction of a 105 foot high dam at Trimiklini. A degree of mechanisation in the work of the department has been achieved by the purchase of new plant and by extending the workshops. On the debit side the disturbed political atmosphere has prevented the investigation of a number of proposed major irrigation projects and has caused the postponement of a seismic geophysical survey of the gravel river beds along the south coast of the island.

3. The activities of the department are divided into five chief services dealing respectively with (*a*) Irrigation and Drainage, (*b*) Town Water Supplies, (*c*) Village Domestic Water Supplies, (*d*) Geology and Drilling and (*e*) Hydrology. There is continuous liaison between these services so that their work is co-ordinated in the best interests of the overall water supply problems of the island. Thus a source of water may be developed for domestic water supplies in excess of the requirements of a particular village and the surplus may be utilised for irrigation ; where gravity water supplies are not available, geological investigations may locate underground sources from which water can be pumped for irrigation or domestic use. A sixth branch of the department, the workshop, serves all the other branches and is growing in importance as mechanisation increases.

Irrigation and Drainage.

4. The total number of gravity irrigation and drainage schemes completed during the year was 63 providing sufficient water to irrigate 11,000 donums, of which 2,000 donums can be irrigated perennially. Seven more schemes were in progress at the end of the year and a further 83 have been planned in detail and are ready to be carried out as opportunity occurs.

5. The rate of progress in irrigation since the commencement of the Ten-Year Programme of Development in 1946 is shown in the following table :—

	Gravity Irrigation		Mechanical Irrigation (i.e. Pumped)	Total
	Perennial	Seasonal		
	Donums	*Donums*	*Donums*	*Donums*
1946 Census..	59,409 say 59,500	284,977 say 285,000	53,131 say 53,000	397,517 say 397,000
Estimated at end of 1955 ..	86,500	345,000	113,500	545,000
New Irrigation, 1955 (say).. ..	2,000	9,000	9,500*	20,500
Estimated totals at end of 1956	88,500	354,000	123,000†	565,500
Percentage increase since 1946 census and commencement of Ten-Year Programme of Development	49%	24%	132%	42%.

* Includes 1,000 donums resulting from private drilling.
† Includes 2,500 donums resulting from private drilling.

6. The total area of arable land in Cyprus amounts to about 3,900,000 donums of which 80% to 85% is cultivated ; 14% is now irrigated in an average winter and 5.4% in an average summer. It is estimated that the irrigation works carried out under the irrigation development programme are causing the value of agricultural production in Cyprus to increase by about £750,000 each year.

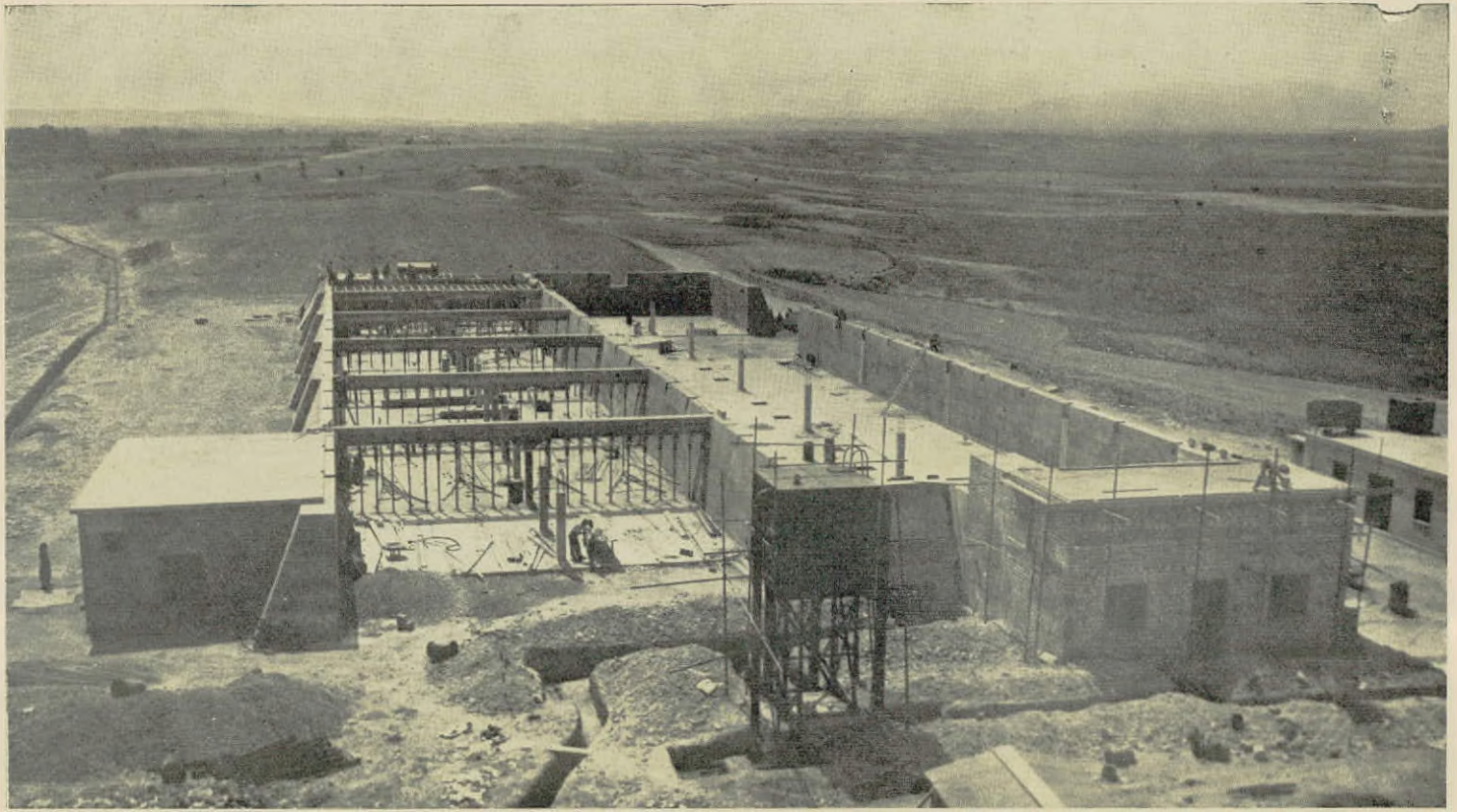
7. Schemes under construction include a 105 foot dam at Trimiklini and 4 miles of tunnels at Famagusta for re-charging the aquifers. Plans have been prepared for a 60 foot concrete dam for Pyrgos (Tylliria), a 50 foot concrete dam for Argaka and Magounda, 18 miles of concrete channels for Kythrea costing £60,000, a drainage scheme for the Syrianokhori marshes, and many other works. Preliminary investigations have been made for many schemes including dams at Ayia Marina (Paphos), Pomos, Palekhori, Ayios Georghios (Akhna), Meniko and lined channels at Polis and Kandou.

Town Water Supplies.

8. To relieve the very acute position in the central part of Nicosia and to provide new supplies for the suburban villages which now have practically no piped water a £950,000 scheme is being implemented by the Department. This Greater Nicosia scheme was prepared in June, 1954, but its execution was delayed for financial and other reasons until May, 1956, when it was finally approved following examination by consulting engineers. This scheme will make available an additional million gallons per day from boreholes at Dhikomo, Kokkini Trimithia, and Dhali and from an old adit at Sykhari. Three covered service reservoirs of 1.70, 0.85 and 0.85 million gallons respectively are included as well as new pipe distribution systems for the suburban villages of Strovolos, Engomi, Ayios Dhometios, Orta Keuy, Trakhonas, and Eylenja.

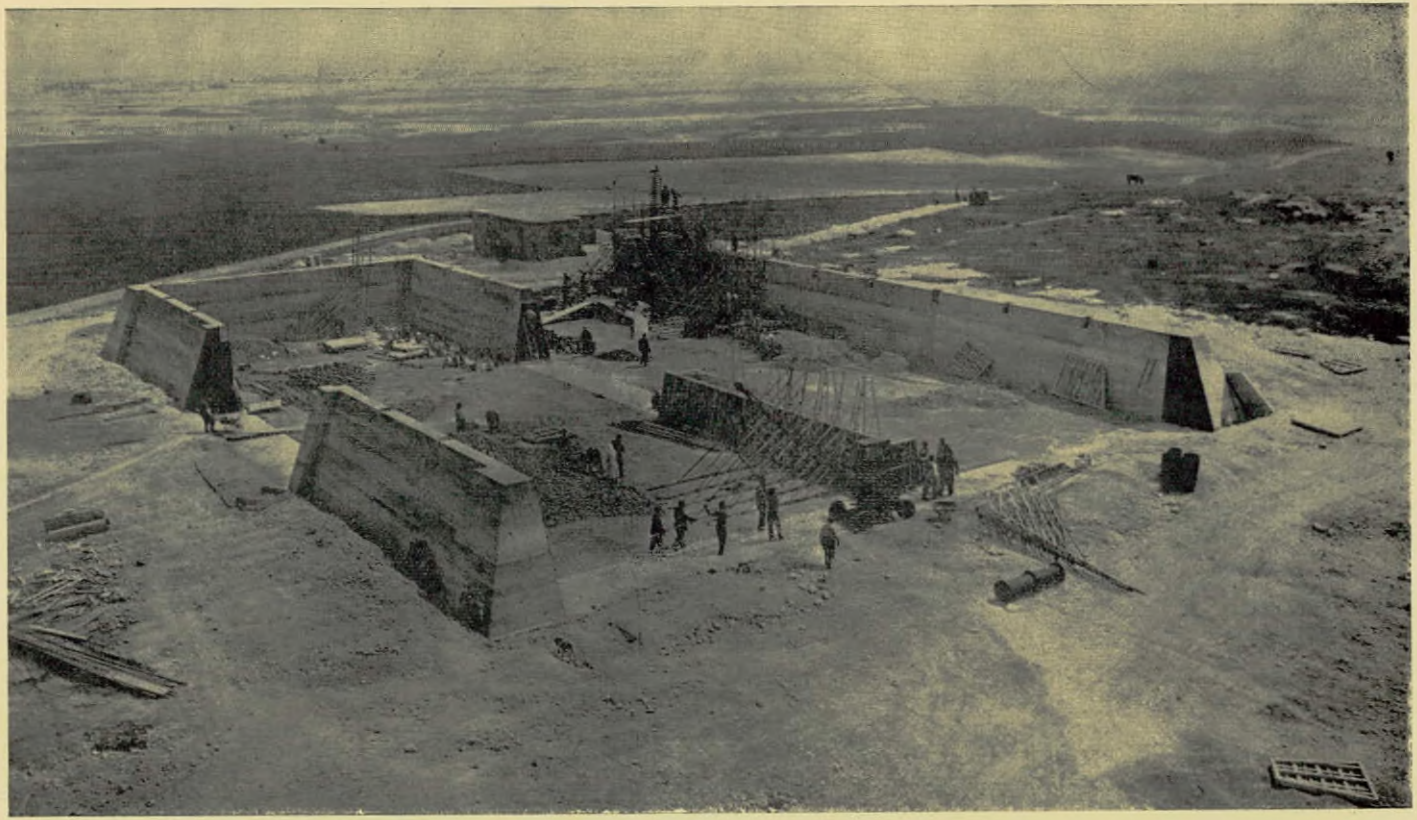
BOREHOLES UNDER TEST.

Boreholes near Dhikomo are being tested by pumping continuously at the rate of 16,000 gallons per hour for 40 days with electro-submersible pumps. This group of three boreholes has been drilled to a depth of 325 feet in the hard limestone of the Kyrenia hills and will form one of the chief sources of the new Greater Nicosia Water Supply Scheme, now under construction.



ENGOMI RESERVOIR UNDER CONSTRUCTION.

This reservoir, of 1,700,000 gallons capacity, will be the chief service reservoir for Nicosia. Provision is made for future extension.



LAKATAMIA RESERVOIR UNDER CONSTRUCTION.

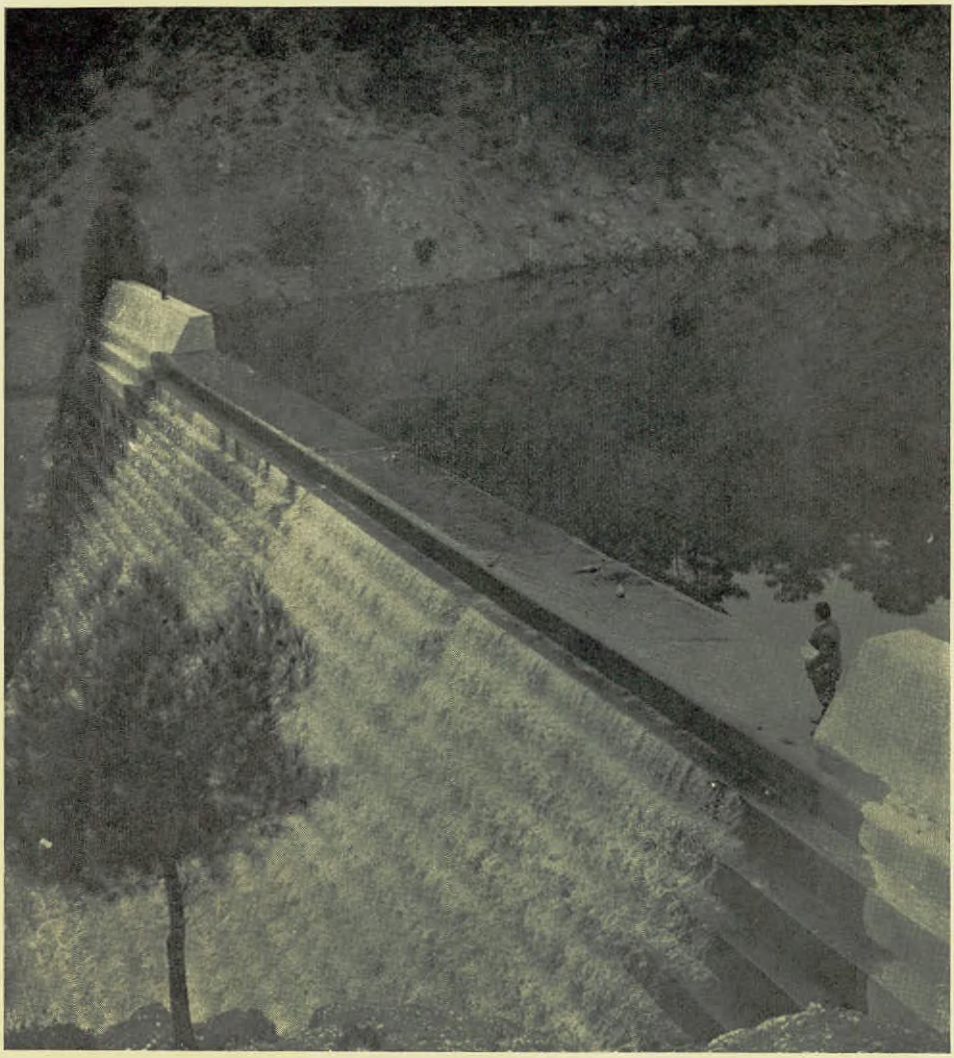
This reservoir, of 850,000 gallons capacity, will serve the higher parts of Nicosia. Another similar reservoir, of the same size, is under construction at Hamid Mandres, for the north-eastern quarters of the town.

TYPICAL VILLAGE WATER FOUNTAIN.

Many street fountains such as this are built every year. A village scheme usually includes one fountain to each ten or twelve houses.

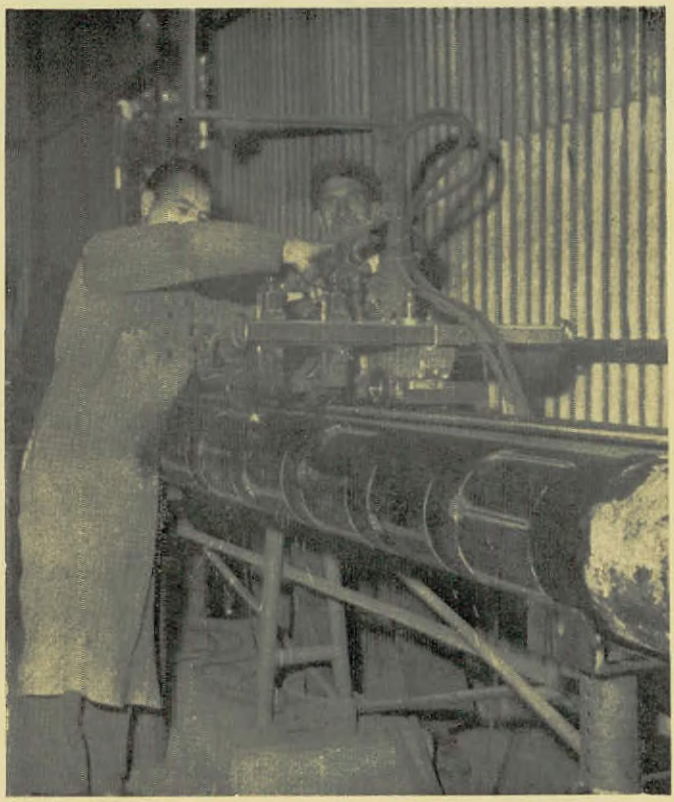
ELEVATED STORAGE TANK AND PUMPHOUSE.

Elevated tanks of this type are built on the plains for the purpose of storing water at sufficient height to provide pressure in the distribution pipes of a village water supply system. This tank and pumphouse is at Syrianokhori village, near Morphou.



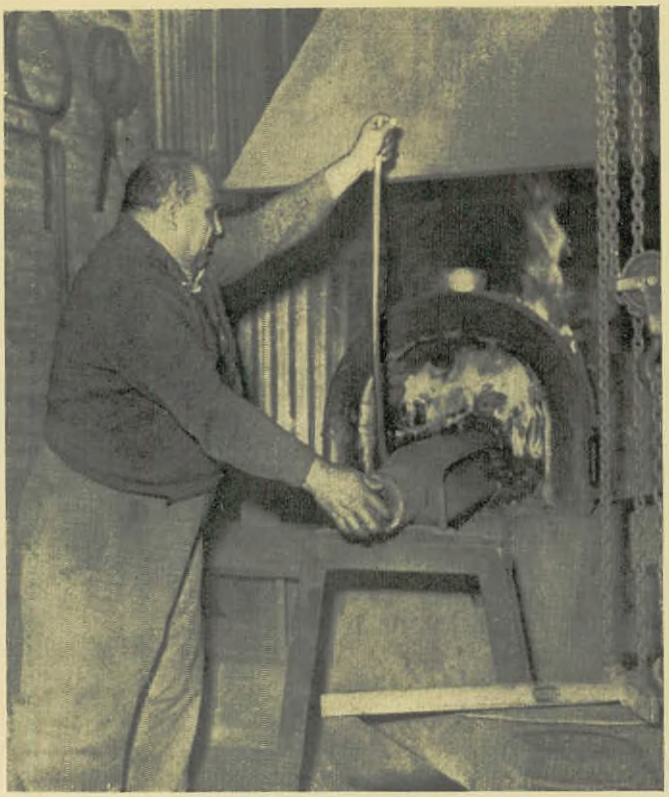
PERAPEDHI DAM.

This is a typical example of an irrigation dam built in a hill valley for storing irrigation water. It is 65 *feet high and holds ten million gallons. A similar dam of the same size is about to be started at Pyrgos and a larger one, of height* 105 *feet, is under construction at Trimiklini. When these are finished there will be twelve dams of this type in Cyprus.*



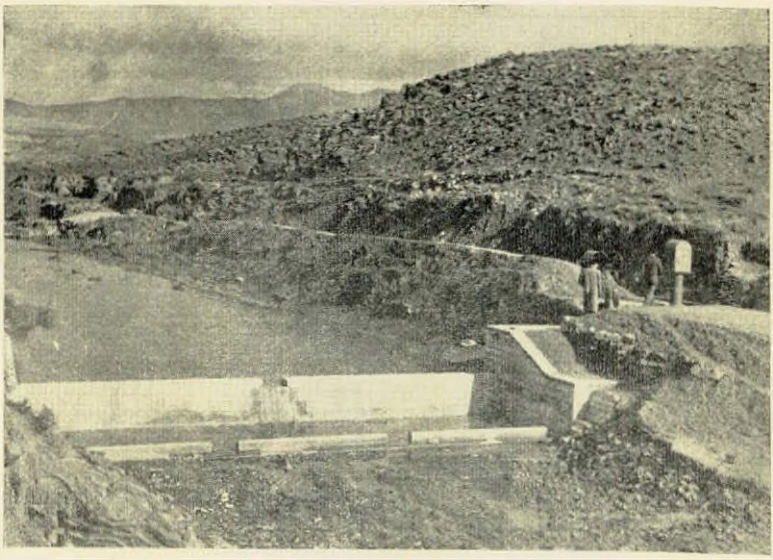
PERFORATING PIPES.

Pipes for borehole casings are perforated in the departmental workshops by means of a special oxy-acetylene cutting machine.



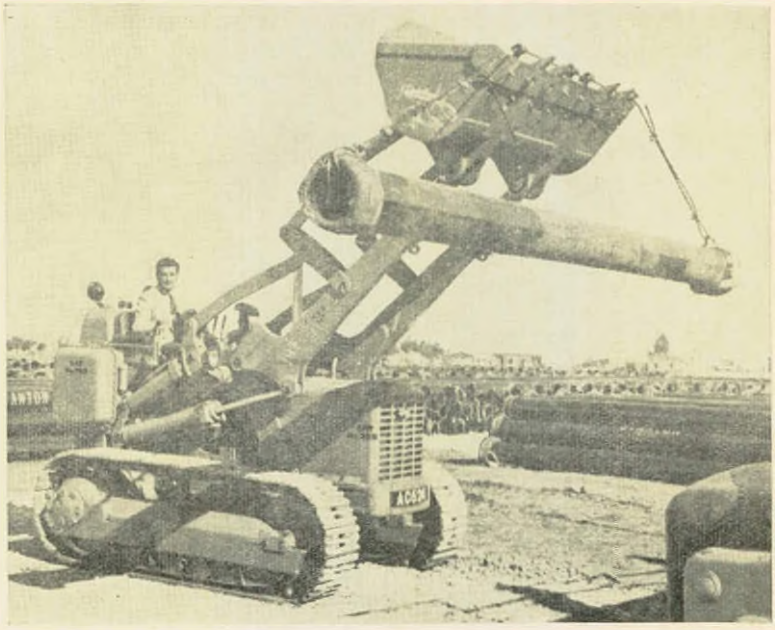
RE-FORGING DRILL BITS.

Borehole drilling plant requires constant maintenance. A team of men is kept continuously busy repairing drilling bits.



HYDROLOGICAL MEASURING WEIR.

The department operates 31 measuring weirs equipped with automatic water level recorders. These record the quantity of water flowing in rivers and streams.



TRAXCAVATOR HANDLING PIPES.

Mechanical plant, of this type is in great demand. This particular machine, although used mostly for excavation is also useful for handling pipes and lowering them into trenches.

9. The above scheme will not, of itself, satisfy the needs of Nicosia and a long-term project to pump 4 million gallons daily from boreholes near Morphou Bay is under examination. Fifteen prospecting boreholes have been drilled for this scheme and at the end of the year 11 of these had been tested each at rates exceeding 25,000 gallons per hour. The water will be pumped through twin 23-mile pipe lines against a gravity head of more than 600 feet. It is probable that only one of the two pipe lines will be laid in the first instance, to give a supply of two million gallons per day. A preliminary estimate of cost is £700,000 for the first stage, with a single pipe line and £1,300,000 for the completed scheme. The Westminster firm of Messrs. Howard Humphrey & Sons has been engaged as consulting engineers for the collecting tank, pumping station, and main pipe lines.

10. More water is needed at Famagusta. The water level in the Phrenaros boreholes, from which practically all the water is drawn, is declining from year to year with very little recovery after the winter rains and it is unlikely that the present output will be maintained for many more years. The position will be aggravated by the increased demand that is likely to follow the construction of the new port. A preliminary scheme has been prepared for supplying an additional one million gallons per day in the first instance, from near Xylophagou through a main pipe line designed for a future flow of 2.2 million gallons a day. The sources are ten boreholes that have been tested at various rates from 9,000 to 16,000 gallons per hour per borehole. The proposed main pipe line will be of asbestos cement, 15 inches diameter and 10 miles long ; a one million gallons covered service reservoir that can be enlarged in future is included in the scheme.

11. Investigations and studies have been continuing for improvements and extensions to the water supplies of all the other chief towns in the island in particular for Paphos and Limassol.

Village Domestic Water Supplies.

12. During the year 57 village water supply works were completed and the length of pipes laid, 180 miles, is roughly equivalent to the distance by road from Paphos to the Cape Andreas monastery. Fourteen of these schemes are entirely new, 40 are improvements to existing supplies that were formerly unsatisfactory or inadequate, and the remaining 3 are for schools or police stations. It is now estimated that of the total of 627 villages named in the census of 1946, the number with piped supplies is 502 or 80%. Of these 415 (66%) may be considered satisfactory and 87 (14%) need fundamental repairs or replacements. The 125 villages still without piped supplies are on the whole situated far from reliable sources, and the cost and difficulty of supplying them with piped water will in most cases be greater than in past schemes.

13. In addition to the 57 schemes completed in 1956 a further 16 schemes were under construction but incomplete at the end of the year. The number of schemes prepared and awaiting execution in due course after revision as necessary and as staff and money become available is 200.

14. The problem of the water supply of the dry villages of the Eastern Mesaoria has at least been settled after many years of unfruitful effort. Under the Water (Development and Distribution) Law 5% of the water of the Kythrea spring was acquired for the domestic use of the villages in the plain and the water has now been piped to 13 of the villages, namely Petra tou Dhiyeni, Chatos, Knodhara Kourou Monastir, Mora, Angastina, Marathovouno, Mousoulita, Yenagra, Pyrga, Ornithi, Aphania and Asha. The total length of pipe in this scheme amounts to 63 miles. The first 2½ miles, through the Kythrea village, was laid by the Army (Royal Engineers). The volume of water available will vary between about 100,000 and 250,000 gallons per day according to the discharge of the Kythrea spring and will be used for supplying a population which at the time of the 1946 census was 8,961 and is now probably about 11,000. The average consumption will therefore be about 17 gallons per person

per day. At the end of the year the new pipelines had reached all thirteen villages but some of the distribution works were still incomplete. The domestic water scheme is expected to cost approximately £90,000. It has not yet been decided how the Kythrea irrigators will be compensated for the loss of their water but Government has offered to line in concrete 18 miles of irrigation channels at an estimated cost of £60,000 without asking for a village contribution which would normally be one-third of the total cost or £20,000. When this is done there is no doubt that the water saved by the elimination of waste will more than compensate for the water piped to the dry villages.

Drilling for Water.

15. The activities of the Drilling Section in finding and developing new sources of underground water may be assessed by the fact that during the period 1946-1956 a total of 2,140 new boreholes has been sunk with an aggregate of over 400,000 feet of drilling. Two-thirds of these boreholes were successful and the tested total quantity of water pumped therefrom was 8.7 million gallons per hour. It is estimated that, as a result of the drillings, the total additional volume of water now available for irrigation, domestic, and industrial purposes is of the order of one hundred million gallons per day. The agricultural development which has taken place as a result of the perennial irrigation from borehole pumping is clearly visible in many areas throughout the island, such as in the Western Mesaoria, the Akrotiri Peninsular and around Xylophagou and Liopetri. Where previously the summer landscape was bare and arid, citrus groves and vegetable gardens are being extended year by year and the agricultural economy of these districts is greatly enhanced.

16. The number of boreholes sunk by the department during the year was 213. Of these 116 were for irrigation, 30 for domestic water, 35 were for prospecting for water and 8 for industrial water supplies. In addition 7 observation boreholes were drilled and a further 17 for technical and engineering purposes. Of the 189 boreholes for water, 73% produced more than 1,000 gallons per hour on test and are classified as successful. The tested outputs show that, if pumped together, these boreholes are capable of a total output rate of 1,315,000 gallons per hour. This is a new high borehole water production record for Cyprus.

17. The widespread and intensive drilling operations which have been carried out in recent years have undoubtedly discovered and demarcated most of the island's aquifers so that it is unlikely that any extensive new areas of underground water remain untapped. During 1956 Government prospecting drilling was devoted mainly to the finding and testing of new sources of supplying the urgent additional water requirements of Nicosia and Famagusta. Some 20 successful and high yielding boreholes were sunk for this purpose. For Nicosia the boreholes have been located along the landward edge of the Syrianokhori Marsh and on the southern slope of the Kyrenia hills near Dhikomo. For Famagusta the borehole sources are near Xylophagou and Liopetri. Prospecting drillings near Elea (Morphou) have proved that there is a considerable extension inland of the free yielding coastal gravel aquifers which may be developed to good purpose.

Hydrology.

18. The hydrological service continued and increased its work of collecting and recording information on the following subjects :—

(*a*) Changes in ground water levels.
(*b*) Quantity of water pumped from wells and boreholes.
(*c*) Annual re-charge of aquifers.
(*d*) Flood run-off in rivers.
(*e*) Summer discharges of streams.
(*f*) Discharges of springs.
(*g*) Run-off from different types of catchments.
(*h*) Chemical and bacteriological analyses of water.

Special intensive studies are being made of groundwater conditions in the Phrenaros and Kokkini Trimithia areas, which are respectively of special importance to the Famagusta and Nicosia town water supplies.

19. Among the results obtained from research on the above subjects one of the most useful is the information concerning the effect of the recent expansion of borehole pumping upon the underground water resources of the island. The increased agricultural production resulting from irrigation with pumped groundwater is of great economic value to the island and it is very important that the present pumping output should not only be maintained but that it should be increased from year to year where possible. The reservoirs of underground water, however, are not unlimited and so in developing irrigation from wells and boreholes, one must take care not to exhaust the aquifers by drawing off more water than can be replaced naturally from the rainfall or in some cases artificially by re-charge works.

20. In order to study the effect of the recent developments it is necessary to keep a careful watch upon changes of ground water level in pumped areas. For this purpose a total of 45 special observation or control boreholes has been drilled at key points and the level of the water in each is measured regularly each month. The chemical quality of the water is also checked periodically so that any increase in salinity can be detected at an early stage. The information obtained from these observation boreholes is showing beyond doubt that in certain areas such as Phrenaros, Famagusta, Kokkini Trimithia, Laxia and elsewhere new drilling must be rigidly controlled if existing public and private interests are to be protected and if further groundwater development is to proceed on sound lines.

21. Regular flood measurements were made in the winter of 1955-56 at 20 automatic recorder gauging sites and during the year more sites were prepared to bring the total number up to 31 in 1956-57. Measurements of the flow of 320 springs were recorded regularly and 1,473 water samples were taken for chemical analysis and 395 for bacteriological analysis.

Finance.

22. The following is a summarised statement of the expenditure of the Department of Water Development in 1956 :—

Nature of Work.	Government Funds.	Contributions from Beneficiaries.	Total
	£	£	£
1. Irrigation and Drainage.. ..	89,026	36,250	125,276
2. Village Water Supplies	136,955	144,000	280,955
3. Subsidised Drilling	9,797	2,275	12,072
4. Prospecting for Water	28,528	—	28,528
5. Drilling upon Repayment ..	—	16,540	16,540
6. Greater Nicosia Water Supply Scheme	133,889	—	133,889
7. Town Water Supplies upon repayment	—	18,587	18,587
8. Hydrological Research	19,626	—	19,626
9. Purchase of Plant	91,987	—	91,987
10. Miscellaneous works upon repayment	—	25,824	25,824
11. Departmental and Maintenance ..	98,888	—	98,888
Totals	608,696	243,476	852,172

23. Water development works are usually assisted by Government grants or loans, or by both grants and loans. Towards the cost of gravity irrigation works the village contribution varies from 20% to 60% according to the type of work and the nature of the ownership of the water. Where the water is owned collectively as by the members of an Irrigation Division, the usual rate is 20% for spate irrigation and 33.3% for perennial irrigation. In Irrigation Associations there is private ownership of water and the village share is usually higher than for a division. Each case is considered on its merits with the result that the average village contribution over the past year was about 42%. The village share of the cost of a scheme is usually raised by a loan from the Government Loan Commissioners at a low rate of interest. Occasionally it is paid partly or wholly in cash or in free labour. A borehole under the subsidised drilling scheme is carried out for a private person at a fixed price to him of £32.500 mils for the first borehole, and the balance of the cost which, in 1956 has on the average amounted to about £140, is paid by Government. Private individuals requiring a second or third borehole are charged the actual cost in full including departmental charges. Municipal Corporations, companies, etc., also usually pay the full cost and departmental charges. The recently completed town water supply schemes were paid for in full by the respective water boards, which raised the money by special loans from Government and the new Greater Nicosia scheme is, for the time being, financed wholly by Government. Village domestic water schemes are paid for half by Government and half by the village if no house connections are wanted. If there are house connections the extra cost is borne entirely by the village.

I. L. WARD,
Director.

January, 1957.