



GOVERNMENT OF CYPRUS

WATER SUPPLY IN CYPRUS

PROGRESS REPORT FOR 1937

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WATER SUPPLY IN CYPRUS

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STAFF.

THE field staff dealing with the Island's water supply consists of the Water Engineer, two Inspectors of Water Supplies and the necessary drill foremen and foremen artisans. The office staff includes one Fourth Grade Clerk from the General Clerical Staff and two temporary clerks. Labour is recruited from the areas in which works are proceeding and the money so disbursed forms in remote parts of the country a valuable increase to the cash available there.

2. The Water Engineer arrived in Cyprus in mid-March and took over charge of all water supply work in the Island. A re-survey of water supply resources was undertaken and a study of the numerous water supply reports by visiting experts since the Occupation was made. From the reports, it was apparent that many valuable suggestions have been made from time to time but that few of the schemes initiated, mostly on paper, had been investigated thoroughly and pushed forward to a conclusion.

KYRENIA HILLS ADITS.

3. The most notable amongst these schemes was that of the British geologist, Clement Reid who, in 1906, indicated the possibility of water being held in the Trypanian Limestones of the Kyrenia Hills by the clays and clayey sandstones of the Kythrean Series and suggested that this water might be tapped by adits driven through the younger rocks into the limestones. He selected a favourable site at Pileri, near Kythrea, where, from 1908 onwards, inconclusive attempts were made to drive through to the limestone. Finally in 1934, work on the Pileri adit was suspended and an adit was commenced further to the west near the village of Sykhari. Here again, nothing conclusive was done and, towards the end of 1936, the works were temporarily closed. These works consisted of two adits, one at the sixty feet level and the other at the hundred feet level, both circular in section and lined with reinforced concrete and each penetrating about six hundred feet into the hills. Both faces were in clay of the Kythrean Series and it was estimated that about 300 feet had to be made in each case before the coarse basal conglomerate of the Kythrean Series would be reached. It had been recognized that this basal conglomerate, which here dips nearly vertically, would be, if of reasonable thickness, an important water-bearing rock. Experience at Sykhari had already shown that, if the head of water on the hundred feet adit could not be somewhat reduced, some danger both to the miners and to the works might be experienced when the water was tapped. From what was known of the detailed geology, it was expected that the water would not increase gradually as mining proceeded but that it would appear suddenly in considerable volume. This actually proved to be the case. It was therefore decided to complete the sixty feet adit and to reserve any further decision on the course of the works until that had been done. During September, water was tapped and flowed forth from the adit. The initial volume was 1.2 million gallons per day, but, as the season advanced, the flow, in common with that of other springs, diminished until, at the end of the year, it was about half-a-million gallons per day. In the meantime, it had been decided that the flow from this adit would be inadequate for the supply of Nicosia and work was re-started in the hundred feet adit, which by the end of the year had about 200 feet remaining to drive. A headshaft, seven feet square and lined with reinforced concrete, was sunk to the sixty feet level. The water at the sixty feet level is controlled by a valve situated in the adit near the headshaft. It is important to note that the water in the conglomerate comes from cracks and fissures and issues under some pressure.

4. As mentioned above, the Sykhari water has been tentatively earmarked for the supply of Nicosia for which a volume of three-quarters of a million gallons per day will be required. In connection with this, the Land Registry and Survey Department has prepared a series of sections showing the relative levels along the line of the proposed distribution reticulation in Nicosia and its suburbs.

5. The work at Sykhari indicated the possibility of successful exploitation of water in similar geological circumstances along the Kyrenia Hills. In order to arrive at some approximation to the amount of water which might in this way be made available, it became necessary to make a study of rainfall, run-off and of the flow of the various springs issuing along both sides of the range. Further, it was necessary to come to some conclusion about the origin of the spring water, that is, whether it was truly artesian and derived, as many people believe, from the Anatolian mountains or whether it is purely local and dependent on the rainfall on the Kyrenia Hills. Study of the gaugings of Kythrea spring,

which have been taken weekly since 1934, seems to indicate a local origin for the water and that the variations from year to year depend on the volume of the winter rains. Furthermore, analyses of spring waters from the Kyrenia Hills show relatively little mineralization, much less than would be anticipated had the water gone to the great depth (with consequent increase in pressure and temperature) required for its passage through the rocks beneath the sea from Anatolia. Geological desiderata, while not very definite, may indicate a local origin for the water. There is one fact quite definite and that is that the water is not derived from the Troödos Mountains. In any case, whatever may be the source and nature of the water, it is obvious that no works should be initiated of which the total output would exceed the minimum amount estimated to be available. If the spring water is derived from local rainfall, it is estimated that an additional volume of about five million gallons per day may be taken from the Kyrenia Hills by adits similar to that of Sykhari, without prejudice to existing springs. It has been decided that development of this water should be strictly controlled so that this very valuable asset will be economically used. Should it be finally proved that the water is artesian in origin then of course much more will be made available but, for the present, a cautious policy must be followed to avoid damage to these wonderful springs all along the range which have poured out their waters since time immemorial.

6. In connection with the development of this water, towards the end of the year, preliminary prospecting work was undertaken along the Trypanian-Kythrean junction in the hills above Trypimeni and met with encouraging results. Work is proceeding.

MORPHOU BAY AREA.

7. Another area of great water-bearing potentiality, to which attention was attracted when the Island's water resources were examined, was that bordering on Morphou Bay. Here a drilling campaign, operating from 1928-1931, had indicated the existence of very large supplies of sub-artesian water at reasonable depths and, at lower levels towards the sea, hydrostatic pressure has been adequate to give artesian flows. Although much consideration was given to this water, no firm scheme for its utilization had been evolved. It had been suggested, for instance, that it might be pumped to Nicosia for domestic supply there and distributed for irrigation down the eastern Mesaoria. These plans, for financial reasons, did not mature. If it did not pay to pump the water to more distant points, it seemed likely that it might be profitably used for summer crops in the area which it underlies. Tentative offers to farmers to sell boreholes and water for nominal sums produced little response. Further examination of the question showed that the very small holdings and the low value of crops produced prevented any expenditure on installation of pumps. In fact, even where the subsurface water is quite shallow, there are practically no wheel-wells. As an indication of the smallness of holdings, one representative area of 714 donums had 250 owners, each holding averaging 0.94 acre. In these circumstances, it was evident that any scheme to make use of the water would have to be along co-operative lines and investigation was in progress at the end of the year. Any scheme, however, must be able to pay its way. Advance is made difficult by the smallness of holdings, burden of debt, low value of crops and wasteful methods of irrigation. It is hoped, however, that the practical demonstrations of economical use of water as seen in the orange groves at Famagusta, at the Fassouri plantation of the Cyprus Palestine Plantations Co., Ltd., near Limassol, and at the Cyprus Farming Co.'s estate at Kouklia will eventually lead to a change of method by the farmer. It should be noted that installation of pumps in this area where subsurface water is so abundant, is a definite insurance against drought and against failure of rains in spring when water is required to finish off cereal crops. In addition, heavy draught on the aquifers in summer will leave more room for storage of winter water and less will be lost to sea from the rivers.

PREVENTION OF LOSS OF WATER TO SEA.

8. There is a general opinion throughout the Island that very large quantities of water are lost to the sea but, relatively to other countries similarly placed, this is probably incorrect. Floods are often great in intensity but are of no great duration and it seems likely that Cyprus uses a greater proportion of its rainfall than is the case with most dry countries having similar conditions.

9. Nevertheless, the escape of water from rivers in the winter months and the possibility of storing it for summer use has received study. In particular, the question of chains of dams in hill gorges was considered but it was finally concluded that these would yield disappointing results. Grades are so steep that relatively high and therefore expensive dams would be necessary if any appreciable volume of water were to be retained. So great is the volume of water required for irrigation and so small the actual cash return that there is no possibility of such dams being an economic success. The catastrophic downpour nature of Cyprus rainfall is also against the use of dams. During these terrific downpours, great masses of very coarse alluvium are moved along the river-bed in the traction load

and any checking of the velocity of the water by a dam would cause the load to be dropped blocking the dam. No sluices in any dam could deal with such coarse material during downpours which are known to reach eight or nine inches in a few hours.

10. It is clear that the best methods of delaying run-off and thus preventing loss of water are by increase of the vegetative cover, terracing, contour-ploughing even on gentle slopes, upkeep of dry dykes bordering fields and the subdivision of large fields into small plots by raising low banks about nine inches high. Where fields are unsuitably shaped for contour-ploughing and furrows must follow the slope, then the furrow should be broken every few feet. If all these methods are pursued steadily and patiently over a long period, amelioration will come and the flow period of rivers and springs will be increased, but it is doubtful, owing to the geological nature of the southern mountains and to the character of the rainfall, that the ideal of perennial rivers in the eastern Mesaoria will ever be achieved.

11. In the eastern Mesaoria there is, in normal years, practically no loss of water. Loss by surface flow from the very steep slopes on the north side of the Kyrenia Hills is inevitable and little can be done about it. More serious loss occurs in the rivers draining to Morphou Bay, along the Tillyrian coast and from the rivers between Paphos and Limassol. In these cases, the best immediate method of reducing loss is by heavy summer pumping for irrigation from the coastal deposits, thus leaving more subsurface storage space to take the winter flow.

12. There is another source of loss from the rivers, which, as it is invisible, has attracted little notice. That is the loss from the subsurface flow in the gravels of the river-beds. This applies particularly to the rivers detailed in the preceding paragraph. After the actual surface flow in the rivers has ceased, there still persists in the alluvium a steady, unseen percolation seaward and there is no doubt that in some of the larger rivers this is important in volume. This loss, like that from surface flow, may be reduced by pumping during summer from wells in the young coastal deposits, but in certain circumstances it may prove profitable to force the water to the surface by a subsurface dam. A subsurface dam is an impervious septum constructed across the alluvium in a river-bed and keyed at the base and sides into impervious rock. Its advantages over an ordinary dam are that, as it does not project above the surface and is supported by alluvium, it need not be so strongly constructed and is therefore much cheaper to build. It is not vulnerable to heavy flooding nor will it silt up and the water it holds up is little affected by evaporation as the storage is subsurface. The use of coupled drive tubewells, combined with a siphon arrangement, is also being considered for the salvage of water from these gravels. At the end of the year investigation to discover suitable sites for experiment was in hand.

OTHER INVESTIGATIONS.

13. Other important potential water supply sources to be investigated included the Dheftera area where small artesian flows are known to occur from depths of about 600 feet and the Kouklia (Famagusta) area underlying which, at reasonable depths, a considerable quantity of water is known to exist. It is hoped to be able to trace this water by drilling, but owing to the great demands on the drills for both Government and private work it was impossible to commence in 1937.

14. The general question of water supply in the central plain has continued to receive study, but further work is required. Here again matters are complicated by low crop values and wasteful methods of using water. Enquiries are in progress regarding the value of water and the cost of more efficient means of watering. Information is being collected with reference to the volume of water required by different crops. At the present time, the average farmer is interested only in flowing water.

15. In addition to these more important works and investigations, many minor water supply investigations were undertaken such as for a hotel, a winery, the Jubilee Sanatorium, the Leper Farm and Mental Hospital and Morphou Experimental Farm. Some work was done for Famagusta Municipality. At the Government Stock Farm at Athalassa, drilling was undertaken and a new supply located. A well was sunk and a pump and water tower constructed. This installation forms a most valuable addition to the water supply of the Farm. Certain advice, after investigation, was tendered to Government in respect of the Limassol Salt Lake. Some prospecting work, still incomplete, was carried out in connection with the proposed seaside resort at Boghaz, Famagusta. Preliminary work was done for a winter irrigation scheme at Menoyia. Periodical gaugings were undertaken on behalf of the Commissioner at the Lefka irrigation works. Weekly gaugings of Kythrea spring were continued and a commencement was made with the regular recording of the temperature of the spring water.

16. During the year, surveying in connection with the proposed new distribution scheme for Larnaca was completed and the preparation of the necessary plans and estimates was begun.

EASTERN MESAORIA RESERVOIRS.

17. The question of the utilization of water from the eastern Mesaoria reservoirs was reviewed. Medical reasons prevent the retention of the water for summer crops and there is very little demand for water for finishing cereals in spring. It is obvious however that these reservoirs have played an important role in making possible the drainage and cultivation of many thousands of acres of swampland situated below them and that they exercise considerable control over the river system of the eastern Mesaoria. There could therefore be no question of their abandonment as that would entail the swamping out of much farmland and a definite increase of malaria in the district or the building of other control works further to the east. It was therefore recommended that the reservoirs be maintained primarily as a river control, that efforts be made to reduce recurrent charges for maintenance, and that the price of water for cereal irrigation in spring be reduced.

DRILLING.

18. For the greater part of the year four drills were at work. A total footage of 6,352 was drilled of which 478 feet were for ventilation at Sykhari. The total number of drillholes was thirty-four of which eighteen were for Government and sixteen for private persons. Of these, five and thirteen respectively were successful. The discrepancy between the proportion of successes in the two classes is explained by the fact that Government drilling may be undertaken in any part of the country, is largely in the nature of prospecting and that all the more likely areas, geologically, have already been investigated, while private drilling is mainly done along the coast where success is more assured. It is estimated that 2,720,000 gallons of water per day were made available and it is known that most of this volume will come into use for irrigation in 1938.

19. The subsidized drilling service provided by Government does not seem to be generally known. For the sum of fifteen pounds plus five pounds for transport, a well will be drilled and test-pumped in any part of the Island. This represents a very great saving to the farmer, but the small holdings and the fear of the recurring charges which pumping entails, prevent the fullest use being made of this service. Nevertheless, during the year the number of private persons desiring drilling on their property never fell below twelve, and there was consequently some delay in the execution of the Government drilling programme.

VILLAGE WATER SUPPLIES.

20. Water supply schemes for irrigation attract great attention and interest throughout the Island, but little consideration has been given to the excellent work, continued steadily over a long period, of providing villages with potable domestic supplies. The benefit conferred is very great but it is difficult to give it a cash value. There is the great saving in time and labour particularly to the women and the increased efficiency of all, due to reduction of water-borne disease. In many cases, farm animals are released from water carrying and become available for more remunerative work. It is a fact that the provision of a good supply in a village has a definite effect in raising morale. In many cases, the supply is adequate to serve for watering small kitchen gardens, a matter of some importance economically. Much still remains to be done and each year the problem presented becomes more difficult of solution as the schemes for villages, relatively close to ample supplies, are completed and schemes dealing with areas of scantier water come forward for consideration. Recently, there have been indications that the wealthier villages and those that have had supplies for a long period, are no longer content with distribution from street fountains but desire house-to-house distribution. This is a logical advance and every effort will be made to meet the wishes of the people but it must necessarily involve a greater consumpt of water and render the problem of supply more difficult.

21. Many villages are still using water taken from unprotected, contaminated wells in the village square. The bacteriological analyses of water from such wells indicate extreme pollution and it is a matter for congratulation that cases of water-borne typhoid are not more numerous. It is essential that some improvement in conditions should be made at an early date. Such villages are usually poor and unable to do much to help themselves. They are situated mainly in the eastern Mesaoria, but there are examples in Paphos District, along the Karpas and in the Tillyria.

22. During the year, twenty schemes for villages in all parts of the Island were completed, involving an expenditure of about £4,000. In each case, the water was gravitated into the village and distributed by street fountains. The scheme for the large and important village of Evrykhon was completed: in this case a very large number of street fountains were erected but already there is an agitation for house-to-house distribution.

23. In addition to the schemes completed, detailed investigations were undertaken and estimates prepared for supply to thirty-four villages. Further to these, in many villages, preliminary examinations were made with a view to planning more thorough investigation at a later date.

FINANCE.

24. All cost of prospecting and investigational work on water supply and including drilling, is borne by a Colonial Development Fund grant which in the year under review was £6,000. To this the Colonial Government added £500. For village water supplies, there was available from Colonial Development Fund £1,000, from the Colonial Government £1,000, while a further £2,000 was subscribed by the villages benefited, making £4,000 in all. The salaries and other expenses of the Inspectors of Water Supplies were borne by the Colonial Government. For certain of the work, as for instance that at Athalassa, separate provision was made.

GENERAL.

25. Following the abundant rains of the winter of 1936-37, water supplies from rivers, springs and wells during 1937, were good. The prospects for 1938 are fairly good.

26. Close co-operation with other Government departments has been maintained during the year, in particular with the Medical, Agricultural, Land Registry and Survey, and Forestry Departments and with the Registrar of Co-operative Societies, from all of whom valuable information and support have been received.