M.R.O. 1—77,005—8-6-37.

(1) Number of pages 4

(2) Date of repair

(3) Initials of the Referencer

MADRAS RECORD OFFICE.

Government of Madras.

Public Works DEPARTMENT.

G.O. No. 129. Press Mis.-
265-266

Dated 11— 1— 1866.

Not to be folded or roughly handled

No. 265. Read the following Notes by Lieut.-Colonel J. H. DYAS, R. E., Chief Engineer Irrigation Works, North Western Provinces, dated Roorkee, 18th November 1865, No. 131.

Necessity for observations on Evaporation.

1. To the Hydraulic Engineer, and especially to one employed on works of irrigation, above all, of tank irrigation, it is as essential that he should know the laws of average evaporation for every part of his district, as it is that he should be acquainted with those of rain-fall.

2. Little or nothing however is as yet know about evaporation in the North Western Provinces, where we have been irrigating for the last forty years.

3. Observations are, it is true, taken with the Dry and Wet bulb Hygrometer, but these do not give directly what we want, viz., the number of inches of moisture evaporated from a given surface in a given time: and without this information (in addition to knowledge of the rain-fall) it is impossible to mature properly any scheme for tank irrigation in a country where there are no existing works of the same mature. With this information we may do so; and we also gain data for the solution of many problems of great economical value, connected with irrigation in general.

4. For instance, the loss of water in the main channels of an ordinary irrigating canal in Northern India, from evaporation and absorption combined, may be estimated at 20 per cent. of the total supply received into the canal at its head. That is to say, if the Ganges Canal were now running with a full supply of 6,750 cubic feet per second, 1,350 cubic feet of water would be absolutely lost in each second of time. And if, as at present rates, each cubic foot per second received throughout the year into the canal head, is worth 500 Rupees, it follows that the sum of Rupees 6,75,000 would be lost to Government each year by evaporation and absorption from the main channels, and probably half as much more from the Rajbahas and escapes, or Rupees 10,12,500 in all from the Ganges Canal alone.

5. It is worth while therefore to study the matter.

6. Now it is evident that so long as we are unable to separate the loss of evaporation from the loss by absorption, we cannot arrive at any clear knowledge of the subject; and loss by absorption must vary so immensely with the nature of the soil, and the head of pressure of the water, that it would be quite impossible to theoretically estimate its amount, even in any one locality of moderate extent, nor is it easy to contrive means of measuring it by direct observation.

7. Fortunately however, evaporation is less refractory, we *can* measure *it*, and with very little trouble; and having once got it, we can eliminate it from the observed loss due to both causes combined, and thus at last we may arrive at the amount of loss by absorption in any given locality.

8. Having got so far then, we are in a position to say to what cost it will pay to go, in order to reduce or perhaps even to practically annihilate either loss.

9. Thus, for instance, in one place, we may find that it would pay to puddle artificially, if the process of natural puddling were found to be too slow for our wants. In another, it might pay to line banks and bed with brick work or with masonry. In a third, it might even pay to cover over the canal or water course as well.

10. Having thus demonstrated the practical value of observations on evaporation, it remains to devise means for taking them in the best manner possible.

11. For information on this head, we naturally turn, first, to England. Now the latest notice I can find is in Mr. G. J. Symons "British Rain-fall" for 1863, where (preface, p. 12) he says, "For the future I look for improvement in our "means of measuring the evaporation of the earth's surface, as a subject of the "highest importance, affecting many matters besides the primary question of "drainage and water supply, and as adding one more to the branches herein "previously touched upon."

12. I have not yet got his report for 1864, so that I am not in a position to say what, if any, steps have been taken by Mr. Symons, but it is evident from the above, that even in England a belief in the importance of the subject is gaining ground, while it is admitted that it has hitherto been unduly neglected. It is of infinitely greater importance in India.

13. I do not propose to go to any great expense in taking the necessary observations, but merely to add an "Evaporometer" of the best known pattern to the set of Meteorological instruments now at each of the six observing stations of the North Western Province, viz. :—

Nynee Tal, Roorkee, Agra, Beawr, Jhansie, and Benares,

Some comparative experiments, too, will be necessary between Evaporometers of different sizes and designs, and in different situations, but this can be gone into hereafter.

14. What then is the best form of Evaporometer? Turning again to England, I find the only one given in Negretti and Zambra's treatise on Meteorological instruments (p. 139, Edition of 1864) consists of a small open cylindrical brass vessel, with a separate graduated glass cylinder of smaller diameter for measuring the quantity of water. The brass vessel is fitted with a wire screen to keep off birds.

15. This would appear to be a very imperfect instrument, and one that would not give very accurate results, especially in India. The small size of the vessel, in combination with the nature of the material of which it is made, would raise the temperature of the water contained in it, when exposed to an Indian sun, so as to destroy the value of its indications.

16. An ingenious Evaporometer, invented and constructed by the celebrated James Prinsep, is described (under date Benares, 1st January 1823) in the Appendix to Volume XV. of the "Asiatic Researches." It consists of a brass cup screwed into a graduated glass tube of smaller diameter. The water can be temporarily withdrawn, for observation, from the cup into the tube, by means of a piston.

17. This instrument is open to the same objection as Negretti and Zambra's cylinder. Mr. Prinsep indeed notes this; for he says, "by two months' comparison "I find that the evaporation from a large vessel was just one-fourth less than from "my small cup," unfortunately he does not say *how* large the large vessel was.

18. His observations (taken in 1822-23) are very valuable, and he adds some by James Kyd taken at Calcutta in 1821-22; Mr. Kyd used a reservoir of 100 square feet area, and his observations are therefore still more valuable.

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11th January 1866.

19. But the most useful set of observations I have been able to find are by Lieutenant Ludlow of the Madras Engineers, Superintendent Madras Magnetical Observatory, in 1844, as published in the Professional Papers of the Madras Engineers, Volume IV., page 131, *et seq.*

20. Lieutenant Ludlow compares the amount of evaporation in a tank with that on dry land, at some distance from water, in the same neighbourhood. He shows that the average evaporation on the tank is one-fifth less than that on land, or that the evaporation on land is one-fourth more than that on the tank, during the hottest months of the year, a result which may also, in a smaller degree, be expected from a comparison of evaporation from the surface of a large running canal, and from the dry land in its neighbourhood.

21. Lieutenant Ludlow also shows that the tank diminished in depth, so the proportionate amount of evaporation increased, and that this fact is not to be accounted for by an examination of the register of the temperature of the water in both Evaporometers, the temperature of the water at the surface and bottom of the tank, or the temperature of the air as shown by a Thermometer freely exposed to the sun. Neither could it be accounted for by the *general* hygrometric state of the air, nor even by the force of the wind, nor the state of the weather.

22. He suggests that the amount of evaporation increases not only in proportion to the surface exposed, but inversely as the depth of water: and argues the necessity of attending to *depth* in forming reservoirs.

23. Lieutenant Ludlow says he was obliged to reject two months' observations, in consequence of their having been made with an instrument procured from England, which was of defective construction. He then made up two instruments himself. Unfortunately, he describes neither one nor the other.

24. Mr. Parker, Executive Engineer of the Futtehgurh Division, Ganges Canal, has designed and constructed a very ingenious self-acting Evaporometer, sound in principle, and simple in construction. I hope shortly to get a drawing and description of it. I believe Mr. Parker intends to patent his invention. I have recommended him to consult Mr. G. J. Symons during his visit to England. Possibly his Evaporometer may ultimately be found to be the best for our purposes; but before coming to a decision, I am anxious to know what they have arrived at in Madras, both as to mode of experimenting, and description of instrument employed.

No. 380 I.

PUBLIC WORKS DEPARTMENT, IRRIGATION BRANCH.

Roorkee, the 4th December 1865.

ORDER.—Ordered, that a copy of the foregoing, be forwarded to the Secretary to the Government of Madras, Public Works Department, with a request, that this Government may be favored with drawings, or with pattern of the most approved Evaporometer, and with any information on the subject that may be deemed useful.

(Signed) J. H. DYAS, Lieut.-Colonel, R. E.,
Under Secretary to Government, N. W. P.,
P. W. D., Irrigation Branch.

Proceedings of the Madras Government, Public Works Department,
11th January 1866

No. 266. ORDER THEREON, 11th January 1866, No. 129.

ESTABLISHMENT, No. 24.

1. Communicated to the Government Astronomer, with a request that he will state what instruments are in use at the Observatory for measuring evaporation, and that, if practicable, he will furnish a drawing of the Evaporometer which he most approves.

2. The Government will be glad to obtain any information that may be traceable in the records of the Observatory of the instruments employed for determining the amount of evaporation at Madras by Lieutenant (now Major General) Ludlow, in 1844.

(True Extract.)
(Signed) CHARLES A. ORR, Colonel, R. E.,
Secretary to Government.

To the Government Astronomer.

Exd. S. T. Augustin

Public Works Dept

No 129

Proceedings of the Madras Government
January 1866.
(Under date the 11th January 1866
Read the following

From the Under Secretary to
Govt N. W. P. & Ad. D.
Irrigation Branch.
Forwarding copy of an note by the Chief
Engineer Irrigation Works North Western
Provinces on the subject of Sir Proby Cautley's
requesting to be favored with drawings or de-
scriptions of the most approved Evaporometers
and with any useful information on the
above subject.

Secretary 4th December 1865
No 3801

Communicated to the Government
Astronomer with a request that
he will state what instruments
are in use at the Observatory for
measuring evaporation, and that,
if practicable, he will furnish a
drawing of the Evaporometer which
he most approves -
The Government will be
glad to obtain any information
that may be traceable in the
records of the Observatory of the
instruments employed for determining
the amount of evaporation at
Madras by Lieut (now Major Gen)
Ludlow - in 1844 -

To the Govt Astronomer -

Desp 12/1/66

1866 Dec 11th
Dep. of Govt. for Educn.

No 129
Dep. of the Govt.
of N.W. Provs. 66

Instruments for measuring
evaporation.—The Government
Astronomer requested to furnish
certain information relative to
for transmission to the
Government of India.

No. 265. 266.

Dec 7, 1865 Dep. Jany 1866.