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MADRAS RECORD OFFICE.

Government of Madras.

DEPARTMENT.

G.O. No.

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1877

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*Proceedings of the Madras Government, Public Works Department,
27th June 1871.*

No. 458. Read the following Endorsement of the Secretary to the Government of India, No 217-I —

Despatch from the Government of India, Public Works Department, (Irrigation,) to the Right Honourable the Secretary of State for India, dated Simla, 3rd June 1871, No 66, P W.

In continuation of our despatch (Public Works) No 65, dated 2nd instant, we have the honour to transmit, for compliance, copy of a letter received from the Chief Commissioner of British Burmah, applying for one of Colonel Sankey's hydrometers for use in the Irrawaddy surveys. Copies of the notes referred to in paragraph I also accompany.

2. From the objections put forward in these as well as those contained in the reports from Bengal, forwarded with our despatch quoted above, it would seem advisable, before more of the instruments are manufactured, to obtain an opinion from some competent person as to the practicability of satisfactorily overcoming the difficulties mentioned.

3. As Colonel Sankey is at present absent from India on special duty, we have been unable to refer to him previous to forwarding the indents for these instruments to your Grace; but we have communicated the comments which have been received from the different provinces to the Chief Commissioner of Mysore for communication to Colonel Sankey for any remarks which he may wish to offer, and, on their receipt, they shall be duly forwarded for your Grace's information.

COPIES of the notes and of this despatch forwarded to the Governments of Madras, Bombay, Bengal, North-Western Provinces, Punjab, the Chief Commissioner of the Central Provinces, for information; and the Chief Commissioner of Mysore, for the purpose indicated in paragraph 3 of the despatch.

(Signed) C A. DICKENS, Colonel, R. A.,
Secretary to the Government of India.

From Lieutenant-Colonel W S OLIPHANT, R E, Officiating Secretary to the Chief Commissioner of British Burmah, Public Works Department, to the Secretary to the Government of India, Public Works Department, dated Rangoon, 17th May 1871, No 80—5 C—A

I AM desired by the Officiating Chief Commissioner of British Burmah to forward copies of notes by Mr. R Gordon, Executive Engineer, Myanong Division, and the Officiating Chief Engineer, relative to Lieutenant-Colonel Sankey's self-registering hydrometer

If the hydrometer is found to be a practically correct self-registering gauge, the Officiating Chief Commissioner directs me to ask that one may be sent to this province for use in the Irrawaddy surveys

From R. GORDON, Esq, Executive Engineer, Myanong Division, to the Assistant to the Chief Engineer, British Burmah, dated Henzadah, 5th April 1871, No 4

I HAVE the honour to acknowledge the receipt of drawings and memorandum by Lieutenant-Colonel Sankey on a self-registering hydrometer for rivers and tide-ways, forwarded with Circular Proceedings No. 195, requesting a report as to whether the machine is likely to prove useful, and to report as follows.

Secretary to the Govt. of India.

Madras
Department

*Proceedings of the Madras Government, Public Works Department,
27th June 1871.*

The hydrometer described is a self-acting and registering water gauge which is (1) to be perfectly trustworthy and intelligible, and (2) to act continuously day and night for a month at a time, if required

Such a gauge will be a very great boon. In connection with the Delta Survey in this division five water gauges are continually recorded, and, as the operations extend, at least five more will be required. These are at present recorded by the keepers of the staging bungalows, etc., who are checked from time to time by the officers over them. The gauges consist of wooden posts placed slantingly on the river bank and marked in position. They in a great measure serve to check one another, as a rise or fall at any part of the river must, after a suitable interval of time, be followed by a similar change at the others, and any irregularity in the record can be at once seen. When the observations are required for elaborate calculations of slope discharge, etc., as they probably soon will be, extreme accuracy will be required. For instance, a change of surface slope in the river at full flood from $3\frac{1}{2}$ inches to $4\frac{1}{2}$ inches per mile may imply a difference in the discharge of from 100,000 to 200,000 cubic feet of water discharged per second, and an error to that extent in the gauge record may entail very serious consequences in the practical result of the calculations. It is, therefore, necessary that the gauge record be perfectly accurate. We can, by following the method laid down for levelling operations in the Great Trigonometrical Survey of India, report for persons to record the different gauges at regular intervals daily during the time of observations for perfect accuracy, a great deal of trouble and expense will be saved. Will the self-acting gauge as now proposed do this?

They seem at present open to objections on the following grounds —

First — The record for one month is to be on a sheet of paper 8 inches $\times$ 16 inches, the 8 inches to be divided into 30 or 31 parts for the days in the month, and the 16 inches to be divided into 30 or more parts, to show as many feet with further sub-divisions for the inches, that is, a quarter of an inch vertically will record one day's observation, and half an inch horizontal, one foot of rise or fall. Supposing the paper to be ruled with perfect accuracy and to be at first as accurately placed on the cylinder, how will the moisture and dryness of the atmosphere affect it? I have an anemometer working on the same principle, the sheets of which are $8\frac{1}{2}$ inches long. During the dry season there are often dense, moist fogs of a morning, and at noon the thermometer stands at 108° in the shade of the verandah. The consequence is, I find the paper lengthened nearly half an inch with the moisture of a morning and drawn tight up again at mid-day. When the paper is 16 inches long in similar circumstances the stretching must be more; and from this cause alone an error of over one foot in the height may be recorded independent of errors in the time. This might possibly be avoided by using a cylinder of slate or soft stone from which the monthly record might afterwards be traced. An improvement on the recording pencil would be a spiral on a cylinder as used in Robinson's anemometer.

Second — It is necessary that the working band should not wind on to itself. The tendency to error from this source is noted in the drawings, where it is recommended that the paper ruling should have a slight decrement in the scale to remedy it. This, however, should be avoided.

Third — The above difficulties being overcome, there is a more serious one. The float must always be at the same depth in the water, and the band must be perfectly inelastic and must not dilate or contract with moisture or dryness, and should expand with heat exactly the same as the iron column does. To ensure these conditions it must be of iron. It will, therefore, have a moderate weight. Suppose it altogether to weigh 3 lbs. The float is 8 inches high, by 7 inches diameter; and, excluding consideration of the guide wheel, etc., has 11 lbs displacement. Suppose it intended to be 7 lbs in weight, it will then of itself float to about the line $a-b$ in the drawing. How is it ensured to be always at that height? When at the bottom of the column the float plus the chain will weigh 10 lbs. half way up $8\frac{1}{2}$ lbs, and at top the float alone 7 lbs. It may be said the strong

*Proceedings of the Madras Government, Public Works Department,
27th June 1871.*

spring will serve to just lift the band and to put the machinery in motion. If so, it must be strong enough to lift 3 lbs plus overcoming friction of machine. Will it always have a 3 lb upward pull on the float and band? If it has, when at the top, the displacement of the float will be only 4 lbs and an error of nearly 3 inches will result. If the spring could be adjusted to lift only 3 lbs when the float is at the bottom and to diminish in power proportionately to the weight of band unwound, the machine might give a tolerably accurate record and not otherwise.

Even if so adjusted, there may be difficulty in keeping it to a uniform action for a long period, but possibly these difficulties may be overcome.

As at present shown in the drawings, the machine is open to these objections which are serious and practical. They may not be insuperable, but till it can be shown that they have been considered and overcome, the machine cannot be accepted as trustworthy for hydraulic operations of any delicacy. Should they be removed, one machine to record a rise and fall of nearly 40 feet might be sent to this division for trial.

Note by Lieutenant-Colonel W S OLIPHANT, R E, Officiating Chief Engineer, British Burmah, on self registering hydrometer by Lieutenant-Colonel SANKEY, R E, dated 16th May 1871

The three points noted by Mr Gordon are practical and serious objections to the adaptability of Lieutenant-Colonel Sankey's gauge for the accurate registration of hydrometrical changes.

The contraction and expansion of the register paper may be reduced to a considerable degree by enclosing it, as noted in the drawings, in a felt-lined metal case, but I think there would still be some error in record from this cause. I do not consider the error in time would be appreciable, or at any rate of any importance. The errors that would be due to the change in displacement of the float and the diameter of the driving band wheel are of much more importance and must be corrected or compensated for, before an absolutely accurate record could be expected.

This compensation could be roughly provided for by taking the minimum and maximum diameters of the working band wheel and arranging the horizontal divisions on the paper proportionally, but even then some correction would be due for the difference of immersion of the float.

If Colonel Sankey considers there is any practical value in these objections, he will, no doubt, be glad that they have been pointed out, and devise some remedy for their correction. Should he, on the other hand, be able to show that the objections raised are merely theoretical, and that they do not affect to any important extent the hydrometrical register of the gauge, then I should be glad to receive one as soon as possible for experimental working on the Irrawaddy.

ORDER THEREON, 27th June 1871, No 1,713
No 459.

IRRIGATION, No. 22

COMMUNICATED to the Chief Engineer for Irrigation

(True Extract)

Captain, R.E.,

Acting Joint-Secretary to Government.

To the Acting Chief Engineer for Irrigation
Exd. E. C. Shunker.

Colonel, R.E.,
Secretary to the Govt. of India.

No. 66 WORKS.
GOVERNMENT OF INDIA.
PUBLIC WORKS DEPARTMENT.
IRRIGATION

TO HIS GRACE
THE RIGHT HON'BLE THE DUKE OF ARGYLL, K.T.,
Secretary of State for India.

SIMLA, JUNE 3, 1871.

MY LORD DUKE,

IN continuation of our despatch (Public Works) No 65, dated 2nd instant, we have the honor to transmit, for compliance, copy of a letter received from the Chief Commissioner of British Burmah, applying for one of Colonel Sankey's hydrometers for use in the Irrawaddy surveys. Copies of the notes referred to in paragraph 1 also accompany

2 From the objections put forward in these, as well as those contained in the reports from Bengal, forwarded with our despatch quoted above, it would seem advisable, before more of the instruments are manufactured, to obtain an opinion from some competent person as to the practicability of satisfactorily overcoming the difficulties mentioned.

3 As Colonel Sankey is at present absent from India on special duty, we have been unable to refer to him previous to forwarding the indents for these instruments to your Grace, but we have communicated the comments which have been received from the different Provinces to the Chief Commissioner of Mysore for communication to Colonel Sankey for any remarks which he may wish to offer, and, on their receipt, they shall be duly forwarded for your Grace's information

We have the honor to be,

MY LORD DUKE,

Your Grace's most obedient, humble Servants,

MAYO.

NAPIER OF MAGDALA.

JOHN STRACHEY.

R. TEMPLE.

J. F. STEPHEN.

B. H. ELLIS.

H. W. NORMAN.

No 217 I.

Copies of the notes and of this despatch forwarded to the Governments of Madras, Bombay, Bengal, North-Western Provinces, Punjab, the Chief Commissioner of the Central Provinces, for information; and the Chief Commissioner of Mysore, for the purpose indicated in para. 3 of the Despatch.

J. N. N. N. Colonel, R.A.,
Secretary to the Govt. of India.

*To the Govt. of Madras
P. W. Department*

No 80—5 C—A, dated Rangoon, the 17th May 1871

From—LIEUT. COLONEL W S OLIPHANT, F E, *Offg. Secretary to the Chief Commissioner of British Burmah in the P. W. Dept*

To—The Secretary to the Government of India in the P. W. Dept

I AM desired by the Officiating Chief Commissioner, British Burmah, to forward copies of notes by Mr R Gordon, Executive Engineer, Myanung Division, and the Officiating Chief Engineer, relative to Lieutenant-Colonel Sankey's self-registering hydrometer.

If the hydrometer is found to be a practically correct self-registering gauge, the Officiating Chief Commissioner directs me to ask that one may be sent to this Province for use in the Irrawaddy Surveys.

No 4, dated Henzadah, the 5th April 1871

From—R GORDON, Esq, *Executive Engineer, Myanung Division*

To—The Assistant to the Chief Engineer, British Burmah

I HAVE the honor to acknowledge the receipt of drawings and memorandum by Lieutenant-Colonel Sankey on a self-registering hydrometer for rivers and tide-ways, forwarded with Circular Proceedings No 195, requesting a report as to whether the machine is likely to prove useful, and to report as follows

The hydrometer described is a self-acting and registering water gauge which is (1) to be perfectly trustworthy and intelligible, and (2) to act continuously day and night for a month at a time, if required

Such a gauge will be a very great boon. In connection with the Delta Survey in this division five water gauges are continually recorded, and, as the operations extend, at least five more will be required. These are at present recorded by the keepers of the staging bungalows, &c, who are checked from time to time by the officers over them. The gauges consist of wooden posts placed slantingly on the river bank and marked in position. They in a great measure serve to check one another, as a rise or fall at any part of the river must, after a suitable interval of time, be followed by a similar change at the others, and any irregularity in the record can be at once seen. When the observations are required for elaborate calculations of slope discharge, &c, as they probably soon will be, extreme accuracy will be required. For instance, a change of surface slope in the river at full flood from $3\frac{1}{2}$ inches to $4\frac{1}{2}$ inches per mile may imply a difference in the discharge of from 100,000 to 200,000 cubic feet of water discharged per second, and an error to that extent in the gauge record may entail very serious consequences in the practical result of the calculations. It is therefore necessary that the gauge record be perfectly accurate. We can, by following the method laid down for levelling operations in the Great Trigonometrical Survey of India, report for $\frac{1}{100}$ inch, ensure that the gauges can be fixed relatively to each other with an error of less than $1\frac{1}{2}$ inches per 100 miles, and by going to some expense and trouble we can secure trustworthy persons to record the different gauges at regular intervals daily during the time of observations for discharge. But if the self-acting gauges can continuously record the river height, with the same perfect accuracy, a great deal of trouble and expense will be saved. Will the self-acting gauge as now proposed do this?

They seem at present open to objections on the following grounds

First, the record for one month is to be on a sheet of paper 8 inches $\times$ 16 inches, the 8 inches to be divided into 30 or 31 parts for the days in the month, and the 16 inches to be divided into 30 or more parts, to shew as many feet with further sub-divisions for the inches, that is, a quarter of an inch vertically will record one day's observation, and half an inch horizontal, one foot of rise or fall. Supposing the paper to be ruled with perfect accuracy and to be at first as accurately placed on the cylinder, how will the moisture and dryness of the atmosphere affect it? I have an anemometer working on the same principle, the sheets of which are $8\frac{1}{2}$ inches long. During the dry season there are often dense, moist fogs of a morning, and at noon the thermometer stands at 108° in the shade of the verandah. The consequence is, I find the paper lengthened nearly half an inch with the moisture of a morning and drawn tight up again at mid-day. When the paper is 16 inches long in similar circumstances the stretching must be more; and from this cause alone an error of over one foot in the height may be recorded independent of errors in the time. This might possibly be avoided by using a cylinder of slate or soft stone from which the monthly record might afterwards be traced. An improvement on the recording pencil would be a spiral on a cylinder as used in Robinson's anemometer.

Mr 27/1/71

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Note by LIEUT.-COLONEL W S OLIPHANT, R E, *Officiating Chief Engineer, British Burma, on self-registering hydrometer by* LIEUT.-COLONEL SANKEY, R E, *dated 16th May 1871.*

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102761.
GOVERNMENT OF INDIA

PUBLIC WORKS DEPARTMENT.

IRRIGATION.

To

No. 217 I.

Dated Simla, 3rd June 1871

Received 18 June/71

Secy. Secy.

[Signature]

No. 1713.

Communicated to the Chief Engineer for Irrigation.

[Signature]

[Signature]

Forwards, for compliance, copy of a letter received from the Chief Commissioner of British Burmah, applying for one of Lieutenant Colonel Sinkey's hydrometers for use in the Irrigatory Surveys.

No. 1713-27 June/71

With enclosure

East India Company
27 June 1871

to Mr. S. S. S. S.

Recd 27/7/71

102761 P. 192

Govt of (1871) Madras.

PUBLIC WORKS.

To the Chief Engr. for
Irrigation

Dated

Recd

G O 27 June 1871, No 1713

Nos. 458 & 459