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MADRAS RECORD OFFICE.

Government of Madras.

Judicial DEPARTMENT.

G.O. No. 2267 Press Mis.

168 69

Dated 4—10— 1859

Not to be folded or roughly handled

Proceedings of the Madras Government, Public Works Department, from 24th September to 4th October 1859.

No. 168. Read the following letter from Lieutenant-Colonel J. H. BELL, Chief Engineer; to J. D. BOURDILLON, Esq., Secretary to Government, dated 8th September 1859, No. 4741.

I have the honor to acknowledge the receipt of the proceedings of Government, dated 1st August No. 1838, communicating copy of a letter from Major Worster on the subject of aneroids, and calling for any further remarks that I may wish to offer.

2. I observe that Major Worster allows that as a subsidiary instrument to the barometer the aneroid, in careful hands, will no doubt be found very useful from its portability, and being less liable to serious injury, but, he adds, it never should be relied on for independent observations.

3. In so saying, Major Worster grants the whole question, for it was never intended either by myself or by Colonel A. Cotton to put the aneriod on an equality with the standard barometer as a scientific instrument, Colonel Cotton expressly states, that each aneriod is to be compared with the barometer, and a memorandum prepared to accompany it when it is issued, showing its heights corresponding to those of the barometer.

Letter dated 4th June, No. 230.

4. Major Worster suggests that, if it be resolved to meet the wishes of the Commandant of Engineers, it will also be necessary to supply good standard barometers to each District Officer, to afford the means of frequent comparison, and that if these means exist, then, and then only, the instrument may be usefully employed for preliminary observations, as suggested by Colonel A. Cotton.

5. Here I cannot altogether agree with Major Worster, for while granting the desirableness of having standard barometers in as many localities as possible to afford the means of comparison, I do not admit that such frequent comparison is necessary, much less a sine quâ non to the utility of the aneriod.

6. Major Worster admits that the aneriod is less liable to serious injury than the barometer. If then the aneriod is found on comparison with a standard barometer to be a good one of its kind at starting, (and if otherwise of course it should not be issued) there is no more reason why it should get out of order than a barometer; and even supposing that it should alter its zero point, and there be no standard barometer at hand to correct it by, it can nevertheless be set sufficiently correct for all practical purposes by means of the screw at the back of the instrument, and a reference to the table prepared by Captain O'Connell, which gives the monthly mean pressure of the atmosphere at Madras and other places with their heights respectively above the sea level. With aid of the screw and this table, the instrument can be set at any station, the height of which above the sea has been previously ascertained.

7. Major Worster remarks that if we could ensure sufficient stability in the mechanism, with the requisite sensitiveness to change, the same confidence might be placed in its readings as in those of a mountain barometer, which, in like manner, has its zero determined by comparison with a standard instrument. As respects stability of the mechanism, this will depend in a great measure upon the goodness or otherwise of the instrument, as it comes out of the hands of the maker, but supposing it to have been procured from a first-rate maker, and common care to be used in carrying it from place to place, I do not think there is any reason to fear for its stability. And with respect to its sensitiveness to change, it is generally considered to be more sensitive than the mercurial barometer.

8. Mr. J. H. Belville, of the Royal Observatory, Greenwich, in his manual on the mercurial and aneriod barometers, states as follows, "Though for purely scientific purposes the aneroid is at present far removed from competition with the mercurial barometer, it nevertheless has some advantages in its *extreme sensibility* and its portability."

9. As a proof of the portability and at the same time the stability of the aneroid, Mr. J. H. Belville gives at pages 45 to 47 of the same manual, the readings of the instrument he carried with him during an excursion into Wales in the summer of 1848. While on this journey, a

storm occurred exceeding any on record since January 1839. On this occasion the aneroid showed a depression of nearly $\frac{3}{4}$ of an inch within a few hours, after an absence of about a month, Mr. Belville returned to Greenwich on the 8th September, and on the instrument being again suspended in its usual place, it was found that the zero point had remained perfectly steady.

10. Mr. Belville concludes his remarks on the aneriod in these words. "In consulting the above journals, we find that the movements of the aneriod were always consistent. It was a delightful companion, and highly useful, its indications preventing many an excursion which would have ended in disappointment. The tourist should never travel without it, and the seaman will find it a safe guide when the motion of the mercurial column renders the marine barometer almost useless. In all cases the writer has *used* the aneroid as its inventor intended it *should be used*; and its movements are so perfect that they merit the calm and impartial investigation of the true philosopher, whose vocation is to aid the development of ingenuity, and not crush its efforts because they are not perfection."

11. In the journal of the Franklin institute for December 1858, the following passage occurs. "Travellers usually employ the mountain barometer (mercurial) for the determination of the altitudes of mountains, and for Engineering purposes, it is perhaps the best also. But the "aneroid" is so portable and convenient, and requires such little time for making observations, that on these accounts it is preferable to the mercurial. The difference between the two is at most but little, and the "aneroid" is constantly approaching nearer and nearer to perfection. As bearing upon the relative accuracy of the mercurial and aneroid barometers, the following mean result of fifty-six comparative and simultaneous observations made upon them by Belville of the Royal Observatory, Greenwich, is given

Mercurial...	29. 61
Aneroid...	29. 59

twenty of the observations agreed exactly.
The greatest difference was .03, and it occurred only three times."

12. The above quotations shew what is thought of the aneroid as a substitute for the mercurial barometer, and pioneer to the levelling instrument, in England and America, and the experience of Major Horsley, who has carried one about with him for years in this country, along with mercurial barometers, tends to confirm me in the opinion expressed in my letter, dated 24th June 1859, No. 1988, that great advantage is likely to result if the officers of the Public Works Department are provided generally with such instruments, and required to make use of them on their tours of inspection, and to send in from time to time the results of their observations in the shape of sections of levels.

13. As respects the tables prepared by Captain O'Connell, which Major Worster seems to think are unnecessarily minute for the purpose for which they are intended, I can only say that I believe him to be mistaken in supposing that the indications of the aneroid can only be estimated to hundredths. The best instruments have verniers attached to them, which read to the nearest hundredth of an inch, and with a little experience in the use of the aneroid, it is very easy, when the zero point has past one hundredth and not reached the second, to judge how much nearer it is to the one point or the other and add the difference which, in fact, brings it to thousandths. This can be done almost as correctly even without a vernier scale. But were it otherwise, it surely cannot be wrong to make the tables, which are required for comparisons, as minute and correct as possible. They will answer for mercurial as well as aneroid barometers, and the more such tables there are, derived from fixed observations at the different stations of the Presidency, the greater will be the dependance that can be placed upon the observation of officers moving about their districts.

No. 169.

ORDER THEREON, 4th October 1859, No. 2367.

1. The question of instructing pupils in the use of the aneroid was first mooted by Colonel Cotton who suggested that a stock of aneroids should be kept at the College, compared with the barometer, and the result recorded in a memorandum to be issued with each instrument.

From Colonel Cotton No. 230 paragraph 4 4th June 1859.

2. These suggestions were referred to the Chief Engineer and to the Principal of the Civil Engineering College. The former officer was decidedly of opinion that great advantage would result from the use of the aneroid by officers in the Department Public Works, who should be instructed to report the result of these observations in the shape of sections of levels.

From Chief Engineer paragraph 1 24th June 1859 No. 1988.

The Principal of the Civil Engineering College however whilst cordially supporting the proposed plan of instructing pupils took exception to the practical value of the aneroid on the ground of the shifting of the needles on the knife edges, thus vitiating all readings and entailing a continued comparison with a mercurial barometer. Captain Winscom also was of opinion that the variation of the barometer at Madras would be altogether insufficient for testing the aneroid.

27th June 1859 No. 379.

Paragraph 4.

3. The Astronomer to whom Captain Winscom's letter was referred considered that the aneroid as a subsidiary instrument to the barometer, would be very useful, but that it should never be relied on for independant observations.

From Astronomer 13th July 1859 No. 1701.

4. The Government have perused the above correspondence with great interest. It never was intended, as Colonel Bell remarks, to place the aneroid on an equality with the standard barometer, and Government are of opinion that Colonel Cotton's suggestions on the more enlarged use of the aneroid when carried out will prove of much advantage.

From Chief Engineer paragraph 3 8th September 1859 No. 4741.

5. On the recommendation of Colonel Cotton, and approval of Colonel Bell, it is accordingly resolved that immediate arrangements be made for instructing pupils in the use of the aneroid, and that a stock of these instruments be kept at the College to be issued to the officers of the Department Public Works accompanied with a carefully drawn up memorandum shewing the results of comparing the aneroids with the barometer. The effect of the temperature on each aneroid should be also recorded in the memorandum.

(Signed) T. PYCROFT,
Chief Secretary.

No 4741

Central Office of D.P.W.
Fort Saint George
8 September 1859

From,
The Chief Engineer
&c &c &c
To,
The Secretary
to Government D.P.W.

Public.

Sir,

I have the honor to acknowledge the receipt of the Proceedings of Government, dated 2nd August No 1838, communicating Copy of a letter from Major Worster on the subject of Aneroids and calling for any further remarks that I may wish to offer.

2. I observe that Major Worster allows that as a subsidiary instrument to the Barometer the Aneroid, in careful hands, will no doubt be found very useful from its portability and being less liable to serious injury, but he adds, it never should be relied on for independent observations.

3. In so saying Major Worster grants the whole question, for it was never intended either

by

by myself or by Colonel R. Cotton to put the Aneriod on an equality with the Standard Barometer as a Scientific instrument. Colonel Cotton expressly states, that each Aneriod is to be compared with the Barometer, and a Memorandum prepared to accompany it at ~~ten~~ when it is issued, showing its heights corresponding to those of the Barometer. —

Letter dated 24th June 1230.

4. Major Forster suggests that, if it be resolved to meet the wishes of the Commandant of Engineers, it will also be necessary to supply good Standard Barometers to each District Officer, to afford the means of frequent comparison, and that if these means exist, then, and then only, the instrument may be usefully employed for preliminary observations, as suggested by Colonel R. Cotton. —

5. Here I cannot altogether agree with Major Forster, for while granting the desirableness of having Standard Barometers in as many localities as possible to afford the means of comparison, I do not admit that such frequent comparison is necessary, much less a sine quâ non to the utility of the Aneriod. —

6. Major Forster admits that the Aneriod is less liable to serious injury than the Barometer. If then the aneriod is found on comparison with a Standard Barometer to be a good one of its kind at starting, (and if otherwise of course it should not be issued) there is no more reason why it should get out of order than a Barometer, and even supposing that it should alter its Zero point, and there be no Standard Barometer at hand to correct it by, it can nevertheless be set sufficiently correct for all practical purposes by means of the Screw at the back of the instrument and a reference to the table prepared by Captain O'Connell, which gives the monthly mean pressure of the atmosphere at Madras and other places with their heights respectively above the Sea level. With the aid of the Screw and this table, the instrument can be set at any Station, the height of which above the Sea has been previously

The Lieut Gov. [illegible]

previously ascertained. —

7 Major Woodward remarks that if we could ensure sufficient stability in the mechanism, with the requisite sensitiveness to change, the same confidence might be placed in its readings as in those of a mountain Barometer, which, in like manner, has its Zero determined by comparison with a standard instrument. As respects stability of the mechanism, this will depend in a great measure upon the goodness or otherwise of the instrument as it comes out of the hands of the maker, but supposing it to have been procured from a first rate maker, and common care to be used in carrying it from place to place, I do not think there is any reason to fear for its stability. And with respect to its sensitiveness to change, it is generally considered to be more sensitive than the mercurial barometer.

8 Mr. J. W. Belville of the Royal Observatory Greenwich, in his Manual on the mercurial and Aneroid Barometer, states as follows, "though for purely scientific purposes the Aneroid is at present far removed from competition

competition with the mercurial barometer, it nevertheless has some advantages in its extreme sensibility and its portability." —

9 As a proof of the portability and at the same time the stability of the aneroid, Mr. J. W. Belville gives at pages 45 to 47 of the same manual, the readings of the instrument he carried with him during an excursion into Wales in the summer of 1848. While on this journey a storm occurred exceeding any on record since January 1839. On this occasion the aneroid showed a depression of nearly 3/4 of an inch within a few hours. after an absence of about a month Mr. Belville returned to Greenwich on the 8th September, and on the instrument being again suspended in its usual place, it was found that the Zero point had remained perfectly steady. —

10 Mr. Belville concludes his remarks on the aneroid in these words. "In consulting the above Journals, we find that the movements of the Aneroid were always consistent. It was a delightful companion, and highly useful, its indications

indications preventing many an excursion which would have ended in disappointment. The tourist should never travel without it, and the seaman will find it a safe guide when the motion of the mercurial column renders the marine barometer almost useless. In all cases the writer has used the Aneroid as its inventor intended it should be used; and its movements are so perfect that they merit the calm and impartial investigation of the true philosopher, whose vocation is to aid the development of ingenuity, and not crush its efforts because they are not perfection". —

11 In the Journal of the Franklin Institute for December 1858, the following passage occurs. "Travellers usually employ the mountain Barometer (mercurial) for the determination of the Altitudes of mountains, and for engineering purposes, it is perhaps the best also. But the 'Aneroid' is so portable and convenient, and requires such little time for making observations, that on these accounts it is preferable to the mercurial. The difference between the two is at most but little, and the 'Aneroid' is constantly approaching nearer and nearer to perfection.

As

As bearing upon the relative accuracy of the mercurial and Aneroid barometers, the following mean result of fifty six comparative and simultaneous observations made upon them by Belville of the Royal Observatory Greenwich, is given: —

Mercurial 29. 61

Aneroid 29. 57

Twenty of the observations agreed exactly — The greatest difference was .03, and it occurred only three times". —

12. The above quotations shew what is thought of the aneroid as a substitute for the mercurial barometer, and pioneer to the levelling instrument, in England and America, and the experience of Major Hartley, who has carried one about with him for years in this Country, along with mercurial barometers, tends to confirm me in the opinion expressed in my letter dated 24th June 1859, No. 1988, that great advantage is likely to result if the Officers of the Public Works Department are provided generally with such instruments, and required to make use of them on their tours of inspection and to send in from time

to

to time the results of steam observations in the shape of sections of levels.

13. As respects the tables prepared by Captain O'Connell, which Major Worsley seems to think are unnecessarily minute for the purposes for which they are intended, I can only say that I believe him to be mistaken in supposing that the indications of the aneroids can only be estimated to hundredths. The best instruments have Verniers attached to them, which read to the nearest hundredth of an inch, and with a little experience in the use of the aneroid, it is very easy, when the Zero point has past one hundredth and not reached the second, to judge how much nearer it is to the one point or the other and add the difference which, in fact, brings it to thousandths. This can be done almost as correctly even without a Vernier Scale. But were it otherwise, it surely cannot be wrong to make the tables, which are required for comparisons, as minute and correct as possible. They will answer for mercurial as well as Aneroid Barometers, and the more such tables there are, derived from fit observations at the different stations

of the Presidency, the greater will be the dependance that can be placed upon the observations of Officers moving about their Districts.

I have the honor to be,
Sir,
Your most obedient Servant

Central Office of I.S.K.
Fort Saint George
8 September 1859

J. H. Hall Lieut Colonel
Chief Engineer

D.F.W. Major
Dy Chief Engr Presidency

Comp.
M. Thuillier Chudleigh

Ste Civil Engr College

No 2367. Pub. Works Dept. 15

Proceedings of the Madras Government
Under date the 4th September 1859
Read the following letter
from the Chief Engineer —

Submits with reference to the Proceedings of Government dated 1st Aug. last 1859 No 1838 further remarks on the subject of Aneroids —

(Hereunder 8th Sept/59 No 4741)

1. The question of instructing pupils in the use of the Aneroid was first mooted by Col. Cotton who suggested that a stock of Aneroids should be kept at the College, compared with the Barometer, and the result recorded in a form to be agreed with each instrument.

2. These suggestions were rep.d to the Ch.: Engr. and to the Principal of the Civil Engr. College. The former officer was decidedly of opinion that great advantage would result from the use of the Aneroid by officers in the Department Public Works, who should be instructed to report the result of their observations in the shape of sections of roads. The Principal of the Civil Engr. College [illegible]

From Ch: Engr. Cotton No 230 par 4. 4th June 1859

From Ch: Engr. par 1. 22nd June/59 No 1980

To PWD Secretariat
Rep. of Govt No 2367 dated 4th Sept 1859

Chief Engineer 5th August/59 No 2728
" " 15th " " 2755
" " 22nd " " 1851/1859.

Chief Engineer

Chief Secretary

Govt. Secretary (illegible)

Value of 9 Aneroids supplied on 8th September 1859
Rupees 8 8 0

No 1741

Superintendent Public Works
Remitting Rupees Eight Eight Only
Price of Aneroids supplied on the subject noted in the margin.

No 1681

Collector Trichinopoly

Copy forwarded for information.

No 2367-4 Dated 15th Sept 1859

Copy forwarded for information.

Sd/- [illegible]
Secretary to Government

Sd/- [illegible]
Under Secretary to Government

No 2367-4 Dated 15th Sept 1859

whilst cordially supporting
the proposed plan of instructing
pupils took exception to the
practical value of the
Aneroid on the ground of
the shifting of the needles
on the knife edges, thus
vitiating all readings
and entailing a continued
comparison with a
Mercurial Barometer.
Capt. Wilson also was
of opinion that the
variation of the Barometer
at Madras would be
altogether insufficient
for testing the Aneroid.

27th June /59 enc. 377.

3. The Astronomer
Royal from Capt. Wilson &
Colton was of opinion
that the Aneroid as a
subsidiary instrument
to the Barometer, would
be very useful, but that
it should never be relied
on for independant Obser-
vations.

From Astronomer
13th July /59 enc. No 1701.

4. The Govt. have perused
the above correspondence

however was intended, as Col.
Bell remarks, to place the
Aneroid on an equality with
the Standard Barometer, and
Govt. are of opinion that Col.
Colton's suggestions on the more
enlarged use of the Aneroid
when carried out will prove
of much advantage
by providing a complete
set of levels sufficiently
trustworthy for all ordinary
purposes.

From Ch: Engr
Govt. 8th Sept /59 enc 4741

17

5. On the recommendation
of Col. Colton, and approval
of Col. Bell, it is accordingly
resolved that immediate
arrangements be made
for instructing pupils in
the use of the Aneroid, and
that a stock of these instruments
be kept at the College ready
issued to the Officers of the P.W.D.
accompanied with a carefully
drawn up Memo showing
the results of comparing
the Aneroids with the Barometer
the effect of the temperature
on each Aneroid should
be also recorded in the
Memo.

2 Copies to Col. A.T. Colton.
Engr. C.
10 — Chief Engrs
2 — Dr. Pub. Instrn
1 — Pr. Engr. College

Public Works 1855 Dept.
Pro: of Govt 4th October
No 2367.

Pro: of the Madras Govt
Dy 4th October 1855.

On instructing
pupils in the use of
Aneroid.

No 1684-169