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The Canadian Journal.

TORONTO, MARCH, 1855.

The Solar Eclipse of May 26th, 1854.

Extract from the Minutes of the Council of the Canadian Institute.

"*Resolved*, That Professors Cherriman and Irving be appointed a Committee to draw up instructions for general distribution relative to the approaching Solar Eclipse."

Supplementary Report of the above Committee.

Read before the Institute, January 13th, 1855.

The Committee, appointed by the Council of the Canadian Institute to draw up suggestions for observers of the Solar Eclipse of May 26, 1854, having received from several stations in Canada accounts of observations made with reference to the instructions published by order of the Institute, have thought it advisable to lay them before the Institute in a connected form, and at the same time, as several of the phenomena mentioned in their former report have escaped observation, it appeared desirable to enter at some length into the grounds on which these phenomena were expected to occur and to examine the probable cause of their not having been observed. Many of the points thus involved are of considerable general interest, and the explanation of them is in some cases not easy and even doubtful; neither is information regarding them very accessible: your Committee, therefore, will claim the indulgence of the Institute while discussing these points with a minuteness, which might be tedious and superfluous were they addressing professed astronomers, but which may not be deemed improper in offering to amateur-observers the received or probable explanations of the points in question.

Notices of observations have been received from the following stations:—

1. Kingston, by Lieut. Col. Baron de Rottenburg and Fred. J. Rowan, Esq., from a position contiguous to Murney's tower. Mr. Rowan used a small telescope, by Troughton & Sims, attached to a transit theodolite; Baron de Rottenburg a telescope by Dolland, three and a quarter feet focal length, with an object glass two and a quarter inches. The mean time was obtained from several double altitudes of the sun taken on the days preceding the eclipse and continued up to the day itself by Mr. Rowan. The watches used were of a description to be depended upon, with a probable error of three or four seconds only. The register of the thermometers was carefully attended to by the Messrs. Williams, of Kingston; one thermometer was placed in sunshine, the other kept in the shade; the one placed in sunshine had its bulb blackened. The day throughout was most serene and cloudless, and highly favourable in all respects.

2. At St Martin, Isle Jesus, Montreal, by Dr. Chas. Smallwood, who contributes a series of physical observations made at intervals of fifteen minutes. It is to be regretted that the day was unfavourable, and thus diminished the importance which the excellence of the instruments and Dr. Smallwood's well known experience and skill would have given to such a series. He observes, "Clouds (Cum. Strat.) had been somewhat heavy for some hours previous, but a few minutes before four o'clock they cleared away and left the first contact visible, and remained so with light clouds occasionally passing over the sun's disc until after the greatest obscuration The final contact was obscured by dense (Stratus) clouds which continued until 6h.-45m., when the sun re-appeared under its usual aspect."

3. Toronto, the Observatory, by Sergeant Jas. Walker, Corporal A. Stewart, and Gunner James Lily, R.A. Physical observations were taken every five minutes with the Observatory instruments, under the usual precautions. The small portable Azimuth-transit telescope was used for noting the times of contact, which were given by the Observatory Chronometer (2393), whose error and rate were known. The day was in every respect favourable.

4. Prescott, C W., by the members of the sub-committee, Sergeant Thos Menzies, R A., Mr. Ed. Fitzgerald, B.A., and Mr. William Cooper. The telescopes employed were a two-feet Gregorian reflector, by Watkins & Hill, four inches diameter, and a three and a half feet refractor, by Dunn, with two and three quarter inches aperture. The magnifying power employed in each was forty. The time was given by an excellent portable chronometer by Arnold, whose error and rate for Toronto were known, an approximate allowance of 15*m.* 20*s.* being made for the difference of longitude between Prescott and Toronto. The observations were made on the West Bastion of the Fort which is situated on a gentle rising ground to the east of Prescott The day was very favourable, the sky being perfectly cloudless, though a boisterous wind interfered with the steadiness of the telescopes.

5. Observations were also attempted at Montreal, by Lieut. A. Noble, R.A., but were prevented by clouds.

The following table gives the times of occurrence of the various phases at the stations named.

	Kingston Lat. 44°8′ N.? Long. 76°49′ W.?	Toronto Lat. 43°39′4 N. Long. 79°21′ W	Prescott.* Lat. 44°42′ N.? Long. 75°31′58″ W?
Local times of	Eclipse annular but not central	Partial, eleven digits obscured	Annular and nearly central
Commencement of Eclipse	*h* *m.* *s.* 3 57 18	*h* *m* *s* 3 44 42·5	*h* *m.* *s.* (1) 4 03 17 (2) 4 03 19·5 †
Com of Annularity	5 12 38		(1) 5 17 09·2 (2) 5 17 09·0
End of Annularity	5 15 42		(1) 5 21 02·5 (2) Missed
End of Eclipse.........	6 22 25	6 14 07·7	(1) 6 27 05·5 (2) 6 27 05·8

The astronomical application of these *times* is to furnish, by comparison of numerous other stations, corrections to the tables of the sun and moon, and also to give approximately the differences of longitude of the stations themselves; but to enter into these particulars does not fall within the scope of the present paper.

The following tables embrace the Meteorological Observations forwarded from the different stations:—

* No. (1), Refracting telescope, J. B. C.; No. (2) Reflector, G. C. I.

† This observation is too late, a violent gust of wind at that time shaking the telescopes so as to render distinct vision impossible.

Kingston.

Local Mean Time.			Thermometer in sun with blackened bulb.	Thermometer in shade.
h.	*m.*	*s.*		
3	57	18	82°	72°
4	09	15	79	71
4	37	29	77	70
4	48	40	74	69
4	57	00	72	66
5	12	55	67	66
5	15	59	66	65
5	25	00	67	64
5	30	00	69	65
5	35	00	71	65
5	45	00	73	67
6	00	00	75	65
6	15	00	76	66
6	22	42	75	...

St. Martin, Isle Jesus, Montreal: height above level of sea 118 feet.

Local Mean Time.	Bar. reduced to 32° Fah.	Temperature of Air.	Tem. of Dew-point.	Tension of Aqu. Vapour.	Humidity.	Direction of Wind.	Velocity in miles per hour.	Cloudiness. Overcast = 10.	Course of Clouds from.	Thermometer in Sun with blackened Bulb.	REMARKS.
h. m.	Inches.	Fah.		Inches							
2.00	29.671	73.0°	60.8°	0.534	.65	N E b E	...	Cum. Str. 4	N E	95.0°	Sun clear of Clouds.
3.00	.678	70.1	58.8	.491	.68	do.	7.27	do. 8	N E	85.0	Sun clouded.
4.00	.705	69.1	57.8	.486	.69	do.	1.75	do. 6	N E	75.3	Do.
4.11	.705	71.0	57.5	.481	.64	do.	1.75	do. 2	N E	95.0	Sun clear. First contact.
4.30	.705	73.5	59.3	.508	.63	do.	1.60	do. 2	N E	104.0	Do.
4.45	.708	72.4	60.0	.523	.67	do.	1.12	do. 4	N E	94.3	Do.
5.00	.718	71.6	58.6	.498	.64	do.	0.55	do. 4	N E	86.1	Do.
5.15	.722	68.0	56.2	.461	.65	E N E	0.50	do. 4	N	75.2	Do.
5.27	.722	66.5	56.4	.461	.72	do.	0.25	do. 4	N	71.3	Greatest Obscuration.
5.30	.728	66.0	58.0	.489	.76	do.	0.12	do. 4	N	72.5	Sun clear.
5.45	.729	65.1	58.6	.499	.80	do.	0.20	do. 4	N	71.2	Sun clouded with dense *Stratus.*
6.00	.733	64.7	55.5	.450	.72	do.	0.15	do. 2	E N E	67.6	[Zenith clear.
6.15	.739	64.0	55.5	.425	.71	do.	0.15	do. 2	E N E	66.0	Do.
6.30	.740	63.6	54.5	.435	.73	do.	0.62	do. 2	E N E	65.6	Do.
6.45	.740	63.6	54.5	.435	.73	do.	0.10	do. 2	E N E	71.0	Sun clear. End of Eclipse.
7.00	.748	64.0	55.5	.450	.75	E b N	1.30	do. 2	E N E	70.7	Do.

Prescott.

Local Mean Time.	Thermometer in Shade.			Aqu. Vapour.		Radiation.	
	Dry Bulb.	Wet Bulb.	Difference.	Ten. in inches.	Humidity.	Solar.	Terrestrial.
h. m.							
4.08	71.5°	57.5°	14.0°	0.304	.40	81.0°	72.5°
.11	71 0	57.0	14.0	.294	.40	82.5	71.5
.16	71.2	57.2	14 0	.299	.40	82.2	71.5
.21	70.2	57.5	12.7	.321	.45	82.2	69.0
.26	70.0	56.0	14.0	.279	.39	81.0	69.0
.31	69 8	56 5	13.3	.296	.41	79.5	68.5
.36	69 8	56.8	13.0	.301	.43	78.7	66.4
.41	69.6	56.4	13.2	.294	.41	76.0	66.6
.46	69.5	56 0	13.5	.289	.41	76.0	68.0
.51	69.2	55.8	13.4	.283	.41	75.8	68.4
.56	68.2	55.8	12.4	.296	.44	75.6	67.4
5.01	67 0	55.2	11.8	.308	.46	73 4	67.0
.06	67.7	54.8	12 9	.276	.42	71.7	66.6
.11	66.8	54.4	12.4	.275	.43	70 1	65.8
.16	66.2	54.2	12.0	.276	.44	68.8	65.0
.17	66.2	54.2	12.0	.276	.44	68.0	64.6
.22	66.1	54.2	11.9	.277	.44	68.0	64.2
.26	66.2	53.8	12.4	.266	.42	68.4	64.8
.31	65.5	54.0	11.5	.278	.45	68.8	64.5
.36	65.0	53 8	11.2	.278	.46	69.2	64.0
.41	65.0	53.8	11.2	.278	.46	70.0	64.0
.46	65.0	54.0	11.0	.284	.47	70.8	63.8
.51	65.4	54 4	11 0	.289	.47	71.4	64.4
.56	65.6	54 4	11.2	.286	.46	72 2	64.8
6 01	65.2	54.7	10.5	.299	.49	73.8	64.4
.06	65.2	54.8	10.4	.305	.50	74 5	64.3
.11	65 8	55.2	10.6	.307	.50	75 2	64.7
.16	65 8	54.8	11.0	.296	.48	76.0	64.4
.21	65.5	55.0	10.5	.304	.50	76.2	64.6
.26	65.5	55.5	10.0	.309	.52	76.8	65.0
.27	65.2	54.8	10.4	.304	.50	75.8	64.4
.31	65.7	55.0	10.7	.316	.50	75.8	64.7

At the beginning of the eclipse, the wind was blowing fresh from W.N.W., and continued so until 4*h*.45*m*., from which time it gradually decreased till, at the annularity and afterwards, it was almost calm.

The thermometers (dry and wet bulb) were mercurial by Negretti No. 42: they were attached to the N.E. end of the platform in perfect shade, the bulb about three feet above the tread of the banquette, which is gravelled, but shaded by the parapet.

The solar-radiation thermometer was a Kew Standard (No. 63), with its bulb coated with lamp-black: it was suspended in the entrance of a sentry-box facing South, the box being painted a dark leaden colour, and forming a good position.

The thermometer for terrestrial-radiation was also a Kew Standard (No. 64), protected from the sun's direct rays, and also by a concave of tin from the radiation of the ground, but the exposure of this instrument was imperfect, and the results are not to be depended on.

Toronto Observatory. Height above sea level 342 feet.

Local Mean Time.	Ther. in Shade.			Aqueous Vapour.		Radiation.		Barom. reduced to 32°.	Wind.	
	Dry Bulb.	Wet Bulb.	Difference.	Ten. in inches.	Humidity.	Solar.	Terrestrial.		Direction.	Velocity in miles.
h. m.	°	°	°			°	°			
3.30	66.9	61.1	5.8	0.459	.71	86.4	60.1	29.632	SW b S	
.35	67.0	61.1	5.9	.458	.71	86.2	60.1			
.40	66.7	60.7	6.0	.454	.71	86.9	60.0	29.630		
.45	66.9	60.9	6.0	.454	.71	84.0	59.8			
.50	65.8	59.9	5.9	.426	.70	82.7	59.2			
.55	66.1	60.0	6.1	.437	.70	82.8	59.0	29.628		
4.00	66.0	60.0	6.0	.438	.71	82.6	59.2		SW b S	2.9
.05	65.8	59.6	6.2	.428	.70	82.5	59.0			
.10	65.7	59.6	6.1	.429	.70	82.4	58.2	29.628		
.15	65.6	59.5	6.1	.427	.70	80.1	57.9			
.20	65.6	59.5	6.1	.427	.70	77.8	57.8			
.25	65.2	58.5	6.7	.402	.67	77.6	58.0	29.620		
.30	65.4	58.3	6.1	.408	.70	75.0	58.0			
.35	65.0	58.6	6.4	.408	.68	74.1	57.8			
.40	64.9	57.6	7.3	.381	.64	72.6	58.0			
.45	64.9	58.8	6.1	.416	.70	72.4	58.0			
.50	64.8	58.3	6.5	.402	.67	69.4	58.0	29.624		
.55	64.0	58.1	5.9	.405	.70	67.2	57.8			
5.00	64.0	57.9	6.1	.401	.69	65.1	57.2		SW b S	2.7
.05	64.1	57.7	6.4	.393	.68	63.1	56.8			
.10	64.0	57.6	6.4	.391	.68	63.5	55.4			
.15	63.8	57.1	6.7	.379	.66	64.2	54.8	29.626		
.20	64.0	56.8	7.2	.368	.64	65.4	53.8			
.25	62.3	56.9	5.4	.390	.72	67.2	54.3			
.30	62.6	57.1	5.5	.393	.72	69.8	53.2			
.35	62.8	56.8	6.0	.381	.68	71.6	53.2			
.40	63.1	57.0	6.1	.385	.69	72.4	53.0	29.626		
.45	63.0	56.1	6.9	.359	.64	73.2	53.8			
.50	63.1	56.6	6.5	.373	.66	73.6	54.2			
.55	63.1	56.8	6.3	.378	.67	73.8	54.8			
6.00	63.6	57.0	6.6	.378	.66	73.5	55.0			
.05	64.1	57.1	7.0	.376	.65		55.4	29.626	SW b S	1.2
.10	64.3	57.3	7.0	.380	.65		55.2			
.15	64.1	57.1	7.0	.376	.65	76.4	55.2			
.20	64.8	57.5	7.3	.381	.64	78.2	54.8			
.25	65.3	57.6	7.7	.381	.62	76.4	51.6			
.30	65.3	57.5	7.8	.374	.61	75.6	51.0	29.626	SW b S	0.8

The dry and wet bulb thermometers were the Observatory Standards in their usual position.

The thermometer for solar radiation was a mercurial by Watkins & Hill, its bulb covered with a coating of lamp-black dissolved in spirits of wine, and freely exposed to the sun's rays.

The usual thermometer for terrestrial-radiation was employed, its bulb in the focus of a polished planisphere, and protected from the sun's direct rays.

In considering the meteorological effects produced by the abnormal extinction of the sun's heat in an eclipse, it is evident that these effect are always mixed up with the ordinary changes that are produced by the ever-varying conditions of the atmosphere and the other causes that determine the meteorological conditions at a given time and place, and it is only by a comparison of results obtained at numerous stations that these latter can be eliminated. Still, an examination of even the few sets in the preceding tables will furnish several points of interest. Thus, at Montreal, the rise of the barometer is marked and steady; at Toronto, on the contrary, the barometer sank during the early part of the eclipse, and then, after a slight rise, remained perfectly steady during the latter half of the period, showing that the rise at Montreal was not a phenomenon peculiarly connected with the eclipse. Again, at Prescott, the tension of aqueous vapour fell somewhat suddenly about ten minutes before the annularity, reached its lowest point five minutes after the end of the annularity, and then increased during the remaining period; at Toronto, the changes are more irregular, but indicate, on the whole, a descent throughout; while at Montreal the same fact may be noted, though with still greater irregularity.

The following abstract gives the values of this tension for the three places at the times of beginning and end, and greatest obscuration, and also the mean values for the first and latter halves of the duration of the eclipse:—

Tension of Vapour.........	Prescott.	Toronto.	Montreal.
Beginning of Eclipse.......	0·304	0·459	0·481
Middle...........	·276	·393	·464
End	·304	·376	·435
Mean of First Half..... ...	·293	·418	·489
Mean of Latter Half.......	·289	·369	·457

In the total eclipse of 1842, it was noticed at Perpignan that a strong dew was deposited after the total obscuration, falling in drops from the leaves, the explanation of which is clearly that the temperature of the earth had been more reduced by radiation than that of the air by the deprivation of the sun's rays, and to such an extent as to reduce the contiguous strata of air below the dew-point temperature, and thus cause them to deposit dew. It is, therefore, a point of interest to examine if, during the eclipse, any increase of humidity can be detected in the atmosphere, which can fairly be traced to such a cause. An examination of the tables shows that none such can be detected, the humidity decreasing at Toronto and increasing at Prescott with about equal steadiness, while at Montreal the changes are less regular, but give an increase in the latter half of the period over the former.

As might be expected, the effect of the deprivation of the sun's heat on the temperature of the air is decisively manifested by the thermometrical observations, of which those at Toronto and Prescott, having been made by standard instruments and with all possible precautions, may claim a certain degree of precision; those at Montreal are less available by reason of the unfavourable nature of the day. As regards the march of the ordinary dry bulb thermometer, two causes are involved, at first conspiring but afterwards opposing each other, namely, —the ordinary diminution of temperature by the decline of day, and the gradual extinction and subsequent restoration of the sun's rays. In the earlier interval of the period of eclipse both combine to lower the temperature, but, later on, the descent of the sun and the gradual enlargement of his visible disc produce opposite effects, and we are thus prepared to find the fall of the thermometer not afterwards compensated for by the subsequent rise. At Prescott, the fall during the eclipse was 6°·5, and the subsequent rise only 0°·8; at Toronto, these quantities were 4°·6 and 3°·0; at Kingston 8° and 3°. The lowest temperature occurred not at the period of greatest obscuration, but, as might have been anticipated, somewhat later—at Prescott, 16 minutes after the middle of annularity; at Kingston, about 12 minutes; and at Toronto, 20 minutes after the greatest obscuration.

The normal fall of the temperature at Toronto on that day from the beginning of the eclipse to the greatest obscuration is 1°·0, and that from the greatest obscuration to the end is 2°·2; so that the diminution and increase of temperature due to the obscuration and re-appearance of eleven digits of the sun's disc would be respectively 3°·6 and 5°·2, the mean of which is 4°·4—a result which is approximative only in so far as the actual march of the temperature of that day may have coincided with the normal: and the elimination of this possible discrepancy is precisely one of those points which can only be effected by comparison of similar results at many stations.

The effect on a thermometer with blackened bulb freely exposed to the sun's rays is of course much greater. At Toronto the fall was 23°·0, at Prescott 13°·0, at Kingston 16°—the minimum occurring in all at the greatest obscuration; the subsequent rise to the end of the eclipse was at these stations 12°·2, 7°·8, and 9°, the excess of the fall above the rise being due to the sun's descent in the heavens.

It may be mentioned that at the Observatory, Toronto, in addition to the usual photographic traces of the self-recording magnetic instruments, eye-observations of all the instruments were made consecutively during the eclipse, but no unusual disturbance of any of the magnetic elements occurred.

Among the most striking natural phenomena attending a solar eclipse are the changes in the colour of the sky and the aspect of terrestrial objects. Such changes are attested by observers on all occasions, but the precise nature of them varies considerably with the particular circumstances of the locality, the nature of the day, and, in no slight degree, depends also on the idiosyncrasy of the observer himself. Thus we find, in the historical records of different eclipses, from the year 840 A.D. downwards, that "the blue tint of the sky became a livid colour, mixed with a shade of purple;"[1] that "the solar light passed during the progress of a solar eclipse, from its ordinary white to yellow, then to orange, and finally, before complete immersion, the last rays were reddish;"[2] that the character of the complete obscurity was a "tint wan and livid, a shading of olive-grey, which threw over nature, as it were, a veil of woe;"[3] that "on the horizon over the sea line was a large band of red orange;"[4] and again, "on the horizon opposite the sun rose a belt of from 15 to 20 degrees in altitude, whose colour resembled that of red copper, while higher up, the sky was of a sombre violet-tinted azure."[5] In another account, we read that as the obscurity increased, the remaining daylight had a yellowish tinge, and the azure blue of the sky deepened to a purplish violet hue, and during the complete immersion, the heavens, in the neighborhood of the sun, were of a uniform purple grey colour, in the zenith of a purplish violet, and opposite the sun, broad bands of yellowish-crimson, intensely bright, pervaded large portions of the sky, while the sea turned lurid red.[6] Other observers note the increasing darkness to be accompanied by a peculiar greenish hue;[7] in the zenith the clear blue turning purple black;[8] and opposite the sun, upwards from the horizon, the sky being largely and brilliantly illuminated with rosy red;[9] or as others describe it, "with magnificent yellow-orange or amber colour, contrasting strongly with the dark purplish-grey of the sky overhead, while in the neighbourhood of the sun a sombre leaden hue prevailed."[10]

Equally striking are the various notices of the changes in the aspect of terrestrial objects. So far back as 1706, it was observed by Plantade and Clapiés, that "when eight digits were eclipsed, objects appeared of an orange-yellow, and at eleven and a half they assumed a red tinge." The attention of observers having been especially directed to this point by Arago, the eclipse of 1842 furnished numerous data from different quarters extremely curious and interesting. All agree that a little before the commencement of the total obscuration the colour of surrounding objects became livid, and, in particular, the faces of persons assumed a wan and cadaverous appearance, the precise tint, however, being variously represented; thus, in some we read that objects appeared slightly yellowish or reddish; in others, that the paleness partook of an olive or olive-green hue: again, that from a greenish tint they passed gradually to saffron according to some observers; to violet, according to others; described by another, as if they had been seen by a Bengal light. So the landscape of an extended plain had a greenish cast, and the waters of lake and river assumed a frightful leaden appearance, while the sea is described elsewhere as glowing with lurid red.

Before entering on the various explanations that may be offered for these phenomena, we may examine what was remarked in the present eclipse, bearing in mind that we can only expect in a partial eclipse indications, probably faint, of those great changes attendant on a total one.

From Kingston, we learn that "at the period of greatest obscuration, the appearance of the landscape under the sun was lurid, and seemed as if viewed through glasses of a neutral tint. The obscuration was very palpable, and quite different from the ordinary shades of evening. Nothing remarkable was observed in the portion of the heavens opposite the sun in the eastern horizon."

At St. Martin, "at 4*h.* 50*m.*, till some time after the greatest obscuration, the heavens appeared of a pale yellow hue. . . A large mass of clouds (cum. strat.) lay on the eastern horizon, which increased in blackness as the light of the sun decreased."

At Toronto, "at the greatest obscuration (5*h.* 04*m.*) a dull red or brown tinge round the horizon, to E. and S.E., reflected so strongly as to affect the appearance of terrestrial objects, of individuals, and their dress."

At Prescott, a curious instance occurred of the variations that may happen in the description of the same phenomena of shade and colour by different individuals.

Some time before the annularity commenced, one of the observers detected a red tinge in the increasing darkness on the horizon towards the S.E., and called the attention of the rest to it, but all of them denied any perception of it. Thinking it might be an optical illusion arising from the continued use of a coloured glass, this person rested his eye for some time, and on again looking in that direction, was convinced of the existence of the tint still more strongly. It was again denied by the rest, who could see only a gray like that of early dawn. The observation was of course set down as doubtful, but is de-

1. Halley, 1715. 2. Brau, 1842.
3. Pinaud and Boigiraud, 1842. 4. De Passa, 1842.
5. Piola, 1842. 6. Hind, 1851.
7. Robertson, 1851. 8. Airy, 1851.
9. Airy, 1851. 10. Swan, 1851.

cisively confirmed by the evidence of several in the observations at Toronto.

As the annularity approached, the landscape assumed a peculiar sombre hue, differing sensibly, though in what it is hard to say, from the shades of evening, or of a sky overcast with clouds, and during the annularity that strange lurid appearance, so often remarked, rested on terrestrial objects, giving to the grey stone buildings of the Fort a greenish tinge, and making the faces of individuals look ghastly and corpse-like.

It will be collected from what has preceded, that the changes of coloration referred to, though varying in detail on different occasions, and even variously represented by different persons at the same time and place, present some features in which all agree, such as the red or orange tinge on the horizon, the purple gray of the zenith, and the lurid green of light-coloured terrestrial objects. The question arises—Can these circumstances be accounted for, considering them as due to the varying action of the sun's light on our atmosphere? or are we to infer that the quality of the sun's light is different at different points of his disc? To the latter we are able to reply in the negative; for in this case the solar spectrum formed by refracting the sun's rays through a prism would undergo modification in color during the progress of the eclipse. The experiment was tried on this occasion by Dr Smallwood, who states that "the spectrum exhibited a very slight increase of the red ray," which is sufficiently accounted for by the descent of the sun towards the horizon. Conclusive as this is, another test of the same might have been afforded by an observation suggested by the Committee, namely—an examination of the coronæ formed occasionally when a light cloud or haze interposes before the sun's disc. The colors of these rings (first recognized by the celebrated Young as a problem of interferences on the undulatory hypothesis of light) would have varied from those of the uneclipsed sun; but the circumstances favourable to their occurrence appear to have been wanting on the present occasion.

Dismissing, then, the hypothesis of any sensible variation in the quality of the sun's light in different points of his surface, it remains only to see if the observed facts can be accounted for as atmospheric phenomena. The whole question of the illumination of the sky is one of great subtlety and delicacy, and to the sagacity of the great Newton we owe the fundamental idea of its explanation, namely—"that the particles of the atmosphere have no proper colour of their own, but that they more easily reflect the blue and transmit the red rays of the white solar beam." So that of a pencil of parallel rays falling on a spherical particle of air or vapour, one part is transmitted, another is reflected in all directions as if the particle itself were a source of radiant light; in the former, the colours towards the red end of the spectrum predominating; in the latter, those towards the blue. It is to this reflection or scattering we owe the general blue colour of the heavens, the illumination of twilight, and the diffusion of light in the daytime. "Were it not for this," says Herschel, "no objects would be visible to us out of direct sunshine; every shadow of a passing cloud would be pitchy darkness; the stars would be visible all day; and every apartment, into which the sun had not direct admission, would be involved in nocturnal obscurity." Suppose, now, a spectator to direct his sight towards one point of the sky, his eye will receive from the aerial particles along the line of vision, first—those rays of the sun which, falling on them after direct passage through the atmosphere, are reflected to the eye; secondly, those, also, which, having been already reflected one or more times among the whole mass of particles of the atmosphere, have also fallen on this line of particles, and been by them again reflected in the same direction as the former to his eye.

The colour of the spot of sky at which he looks will be determined by the combination of these two lights, which we may distinguish by the terms "direct" and "indirect;" the former being, under ordinary circumstances, much the stronger of the two, and giving the character to the colour. This direct light, as already stated, loses its blue by transmission and its red by reflection, so that the final tint, on reaching the eye, and by consequence, also, the colour of the sky, will depend on the length of path and the density and moisture of the strata traversed by it. Thus, under all circumstances, in a clear sky, the zenith will be decidedly bluer than the horizon, the blue tint diminishing as we descend, both on account of the smaller vertical height compared with the horizontal range of the air, and also on account of the increased density and moisture of the strata nearest the earth's surface.

Again, at mid-day, when the sun is at his highest, the length of path for the zenithal regions will then be the shortest, and the blue tint of the zenith will be stronger than at any other time of day, and on the horizon, for similar reasons, a grey tint prevails, often nearly white. As the sun descends, the blue in the zenith fades, and the red predominates on the horizon, till at sunset the *direct* light transmitted through the lowest strata of air, often charged with moisture, furnishes on the horizon, in the neighbourhood of the sun and extending from him on both sides, a brilliant red, which whitens towards the zenith, and may often be seen to assume, as we ascend, the successive colours of the spectrum from red to blue-gray. Opposite to the sun may often be seen a patch of red light, which attains its greatest intensity just as the sun sinks below the horizon, and is even more decided than that in the west, the rays forming it having twice had to traverse the lowest stratum of air and vapour. When the sun sinks below the horizon, the *direct* light is intercepted from the east by the interposition of the earth, whose shadow is projected on the sky in the form of a circular segment; the sky w[illegible] this is illuminated solely by the *indirect* light which has proceeded by reflection through the higher strata, and is consequently blue, rendered still more marked by contrast with the surrounding red. When the sun has sunk, and the *direct* light is wholly cut off, the only illumination of the heavens is by the *indirect* which, as night proceeds, is given by more and more numerous reflections, and becomes in proportion more and more blue. Applying the same explanation to the effect produced by the opaque body of the moon interposing between the sun and spectator, we see that in a partial eclipse, the *direct* light being more or less cut off, the *indirect* becomes proportionally of more importance, and has more effect in determining the resultant colour of the portion of sky considered. It is also evident that its effect must depend much on the altitude of the sun at the time, and the position of the spectator in the shadow. In the zenith the *direct* light being intercepted more or less, we should expect the blue to be more decided, and if the sun be somewhat low in the heavens, this blue would be mixed with the *indirect* rays from the horizon, and thus acquire a purple tint. On the horizon, again, the part in deepest shadow loses not only its *direct* light, but also that portion of the *indirect* which is ordinarily furnished to it by the zenithal regions; its remaining illumination coming from strata lower down would necessarily show the red tint so constantly observed. For intermediate portions of the sky, the prevailing tint would be intermediate to these, and much the greater portion of the heavens would be tinted with green, as we often see, in a fine sunset, the green commencing within 15° of the horizon. We are thus furnished with the clue to the various and even discordant appearances cited above—the lurid red on the horizon, the sombre purple of the zenith, the leaden sky, the green tint of the landscape, and the ghastly appearance of persons by means of this green tint (rendered more striking by contrast when projected against the "burning" horizon), and also the reddish tinge of objects when seen by this same light from the horizon reflected on them.

In the suggestions published by the Institute, it was remarked that we could not expect that "the effects described as produced on the animal and vegetable creation by the entire deprivation of the sun's light in a total eclipse will be at all noticeable in the present case." This expectation has been to some degree falsified by the event. Dr. Smallwood records that at the time of greatest obscuration "a melancholy stillness prevailed; sounds seemed more perceptible; frogs commenced their croaking, and my own fowls retired to roost, and did not re-appear that evening." At Prescott, some tame pigeons, which were flying about the fort, retired to their cote some time before the annularity commenced, and did not re-appear; a great number of martins had been also flying about during the earlier part of the eclipse, but during the annularity not one was visible; the various sounds of animated life were all hushed during this period, except the croaking of frogs, which went on with increased vigor.

In opposition to this, we find at Toronto that, at the greatest obscuration and throughout the eclipse, "birds are singing cheerfully on the trees and cows lowing," and yet the darkness could hardly have been perceptibly less at Toronto than at Montreal or Prescott.*

It was suggested in the Instructions, that it should be noticed whether a well-defined shadow of a cross or staff thrown on a wall, be subject to any flickering motion, especially about the edges, and whether any moving bands or patches of light are seen to traverse the wall or ground.

Neither of these phenomena was observed,* and probably for the same reason, viz., that the diminution of light was not sufficient to admit of their becoming so marked as not to escape observation. These variations of light had been observed by M. Arago when the sun was shining on a screen under ordinary circumstances. He at once attributed the phenomena to the changes going on in the different strata of the atmosphere, by means of currents, variation of temperature, &c., and also perceived that the appearance ought to be more marked in proportion as a less amount of the sun's disc should remain visible. He accordingly desired several observers to direct their attention to a wall on which the sun was shining during the progress of the eclipse, but without telling them the result which he expected. The testimony borne by these persons was decisive; they all describe the sun's light as becoming *flickering* just before the commencement of the totality, and state that alternate bands of light and shade, in some cases of various colours, seemed to run over the surface of the wall; these were in some instances so marked as to attract the attention of children, who tried to run after and lay their hands upon them. The same phenomena recurred at the end of the totality, lasting, however, only a few seconds. It is, therefore, quite possible that though the phenomenon in question did exist during the eclipse of 1854, and in a greater degree than during ordinary sunlight, yet the diminution of the visible surface of the sun may not have been sufficient to exaggerate the appearance to such an extent as to make it remarkable to an unpractised eye. The only peculiarity remarked by any of the observers, with regard to shadows, was that it was noticed at Kingston that when the annulus was formed, the double shadows cast by the sun were very perceptible.

It was, perhaps, scarcely to be expected that any trace of the moon's shadow should be seen in the present instance. Its appearance at the end of the totality of the eclipse of 1851 is thus noticed by Mr. Airy. He says, after describing the reappearance of the sun, "I withdrew from the telescope and looked around; the country seemed, though rapidly, yet half unwillingly to be recovering its usual cheerfulness. My eye, however, was caught by a duskiness in the S.E., and I immediately perceived that it was the eclipse-shadow in the air, travelling away in the direction of the shadow's path. For at least six seconds this shadow remained in sight, far more conspicuous to the eye than I had anticipated." In the case of the annular eclipse, it is to be presumed that the atmospheric illumination was generally too great to admit of the shadow being thus visible.

Among the astronomical observations suggested in the Instructions are the following:—

I. The moon's limb appeared serrated at Toronto and at Kingston. The observer at Toronto remarks that at *4h. 35m.*, when six digits were eclipsed, "the edge of the moon in passing over the sun's surface, appears jagged or serrated;" and again, at *5h. 38 m.*, "the edge of the moon on the sun's surface very jagged, the sun's disc and cusps well defined." In the report from Kingston we have the following, "The moon's limb was remarked as slightly serrated in passing over the sun's disc, the greatest amount of inequality being towards the extremity of the eastern limb. At Prescott, however, the limb, as viewed through telescopes of considerably higher power, appeared remarkably free from all irregularities. This appearance of a serrated edge is caused by the existence of large mountains on that part of the moon's surface, which forms the boundary of the hemisphere visible from the earth.* We have other indications sufficiently decisive of the existence of such mountains on the lunar surface. For instance, were the moon's surface perfectly smooth, the line which divides the bright and dark portions of the disc, when partially illuminated by the sun, would be even and sharp; whereas it is perceptibly jagged, even to the naked eye: the mountains in the neighbourhood of the dividing line having the sun nearly in their horizon, and therefore throwing very large shadows; and, on the other hand, bright spots are often to be seen on the dark side of the

* When this paper was read at the meeting of the Institute, Prof. Croft made some remarks on this subject, which he has obligingly communicated to us, as follows:—

"Previous to the eclipse, I had carefully noticed the time at which the poultry in my yard went to roost: and having observed it for ten or twelve days, found that they all retired a few minutes before six, or about that time, excepting some Shanghaes, which were always active till seven, or even later. On the day of the eclipse, being busily engaged making such observations on the obscuration as I could, I forgot to look after the fowls, until about five or ten minutes after four, when, on looking round for them, I discovered they had all gone to roost. At this time, scarcely any difference was perceptible in the light of the sky, and yet the fowls were all sensible of it, excepting the Shanghaes, who, however, also vanished about half-past four. At half-past five, almost all of them were again running about the yard. I fancied, but I will not state positively, that I noticed a great diminution in the number of flies, which at that time of the day are generally very plentiful. I beg also to confirm your statement with regard to the 'ghastly appearance' produced; this was particularly remarked by a number of ladies who were using my telescope."

boundary, being, in fact, the peaks of high mountains on which the sun is shining, although his rays are intercepted from the valleys in the same neighbourhood. Again, when a star is occulted by the moon, it is sometimes seen to run along the extremity of the dis', alternately appearing and disappearing as it is successively h dden by the mountains on the edge, and allowed to shine through the hollows between them. These mountains may be much more considerable at one part of the circumference than at another: and although, speaking roughly, the moon always keeps the same face turned towards the earth, yet in consequence of her librations, and the different positions of observers, the portion which forms the boundary of her visible hemisphere will vary, though within small limits. Consequently, it is quite possible that the edge of the moon's disc might appear serrated during one eclipse, and smooth during another; but it is difficult to understand why at the same time the moon's limb should have appeared serrated to one observer, and to another, at a comparatively short distance from the former, perfectly sharp and smooth. This is the more remarkable, because, at Prescott, a phenomenon *was* observed which depends upon this mountainous boundary of the moon, viz., "Baily's beads." These have been observed both in total and annular eclipses. In the case of a total eclipse, just at the commencement of the totality, that is, just at the moment when the eastern limb of the moon is coming into contact with the eastern limb of the sun, the very narrow bright segment of the latter body becomes broken up into brilliant irregular portions called, from the person who first observed them, "Baily's beads." The same appearance is also observed at the end of the totality. This phenomenon is certainly a result of the unevenness of the lunar surface; the "beads" being nothing else than gaps between the mountains, through which the sun can still be seen. The Astronomer Royal thus describes their appearance at the beginning of the totality of the eclipse of 1851, pointing out very distinctly the cause to which he considers them due. He says, "I took off the higher power, with which I had scrutinized the sun, and put on the lowest power (magnifying about 34 times). With this I saw the mountains of the moon perfectly well. I watched carefully the approach of the moon's limb to the sun's limb, which my graduated dark glass enabled me to do in great per'ection. I saw both limbs perfectly well defined to the last, and saw the line becoming narrower, and the cusps becoming sharper without any distortion or prolongation of the limbs. I saw the moon's serrated limb advance up to the sun's, and the light of the sun glimmering through the hollows between the mountain peaks, and saw these glimmering spots extinguished, one after the other, in extremely rapid succession." In the case of an annular eclipse, the same phenomena are observed, but in an inverted order. The first appearance of the beads is at the moment when the western edge of the moon is just detaching itself from the western edge of the sun. If the boundary of the disc of the former body were perfectly smooth, we should see the bright disc of the sun surrounding it gradually and continuously, until the whole surface of the moon became projected upon that of the sun. Instead of this, however, when the annularity has very nearly commenced, and consequently only a very small segment of the circumference of the sun is obscured, that remaining segment, instead of being gradually revealed, becomes suddenly bright in a number of points, with dark spaces intervening; the bright spots increase in size, and seem to run into each other, until the moon's limb is at length wholly surrounded by the bright disc of the sun. A similar appearance recurs at the end of the annularity, when the eastern limb of the moon joins the eastern limb of the sun. These beads were seen by one of the observers at Prescott, distinctly at the beginning of the annularity, and with less clearness at the end; and the fact that they were visible is sufficient to prove that, althought the moon's limb did not *appear* jagged in passing over the sun's disc, it really was uneven, and that it must have been in consequence of some peculiarity in the instruments or colored glasses employed that the serrated edge was not previously observed. The beads were not distinctly observed at Kingston, but we have the following remark in the report from that station, "On the first contact of the western limbs of the sun and moon, Baron de Rottenburg remarked a slight appearance of the light as it were running along the line of contact, but not with that degree of brilliancy or certainty which has been recorded on similar occasions."

Another indication of the unevenness of the surface of the moon appears in the fact, that at one time during the progress of the eclipse, the horn or cusp of the solar disc was observed at Montreal to be slightly blunted, which must have been caused by the existence of a large mountain just at that part of the moon's limb which, at the time in question, appeared to join the sun's limb. It has, indeed, been suggested that this appearance of bluntness in the cusp might be produced by a lunar atmosphere. The effect of such an atmosphere would certainly be to distort perceptibly the shape of the narrow crescent of light, when the eclipse was considerably advanced. The rays of the sun would be bent inwards by passing through this medium, and thus a small portion of the sun would become visible, which would not be seen if this lunar atmosphere did not exist, and the extremity of the bright segment would, in consequence, appear blunted. The existence, therefore, of a lunar atmosphere would account for such an appearance as that noted by Dr. Smallwood; but we must not infer from the phenomenon that such an atmosphere really does exist. As has been before remarked, the existence of a large mountain at the part of the moon's disc which intersects that of the sun would also account for the appearance: and that this, and not the former explanation, is the true one, is evident from several considerations. In the first place, there is pretty conclusive evidence, from other sources, that no such atmosphere does exist in the moon: no atmosphere, that is to say, capable of sensibly refracting light passing through it. Thus, in the case of the occultation of a star by the moon, if a lunar atmosphere existed the star would continue to be visible by reason of the refraction after the moon's disc was really interposed, so that the disappearance of the star would be postponed in consequence of the existence of such an atmosphere; and as the time of re-appearance would be anticipated by the same amount, the observed time of occultation would be shorter by twice that amount than the time given by calculation. No such difference, however, is observed. Again, if the moon were surrounded by an atmosphere containing any appreciable amount of vapour, the extinction of a star's light by an occultation ought to be gradual, and very faint stars ought to become invisible before the proper time of occultation, as the moon's atmosphere would be sufficient to intercept their light. This is also contrary to what is observed; for, during an eclipse of the moon (which, owing to the absence of diffused light, is the most favourable time for making such observations), stars of the tenth magnitude are seen *suddenly* extinguished by the interposition of the moon's disc. And, in addition to this evidence from other sources, it is clear, that in the case of a solar eclipse, any alteration in the shape of the bright crescent produced by an atmosphere about the moon, would be of a comparatively steady and permanent character, being subjected only to variations due to changes in the state of that atmosphere; whereas, on all occasions where a blunted horn has been observed, it has been only a transient phenomenon. Thus, in the eclipse of 1842, M. Arago notices that each cusp was repeatedly blunted and recovered its natural form. Again, there appears to be no evidence of any prolongation of the bright segment, which would certainly be produced by the existence of such an atmosphere. And, what is perhaps the most conclusive evidence of all, eclipses have been repeatedly observed without the cusps being seen to be blunted at all; as was the case in the eclipse of 1854, the cusps having appeared perfectly sharp, and free from all distortion throughout the eclipse to the observers at Prescott, Kingston and Toronto. We may, therefore, safely ascribe the phenomenon observed by Dr. Smallwood to the existence of a considerable mountain on the portion of the moon's disc forming the extremity of the cusp.

II. At *4h. 49m. 15s.* a minute bright spot was seen at Kingston on the surface of the moon, near the eastern cusp. Several theories have been suggested to account for the appearance of such spots, which have been frequently observed. The first mention of them is by Ulloa, who, in the total eclipse of 1778, "saw in the N. W. region of the moon a luminous point, shining successively as brightly as a star of the 4th, 3rd and 2nd order." This phenomenon received from him a very strange explanation, viz., that the moon is penetrated by a sort of long tunnel, through which the sun's disc could be seen. And the same hypothesis, slightly modified, was adopted by M. Valz, who observed the eclipse of 1842 at Marseilles. It seems strange that such hypotheses could be gravely set forth. It is obvious that, if such were the real cause of the appearance of these luminous spots, instead of being momentary and variable phenomena, they would retain their brilliancy at least for some considerable period; and, moreover, if such gaps existed, they could scarcely fail to be observed as *shadows* on the full moon, considering the magnitude of the astronomical instruments now employed. It has also been supposed that the appearance of such bright spots might be due to the existence of active volcanoes on the moon's surface, which several astronomers have fancied they have seen. Thus Hevelius asserted that the mountain known as Aristarchus "appeared reddish and seemed to burn"; and several other astronomers—among whom we may mention Sir W. Herschel—have recorded similar appearances. It seems, however, probable that the volcanic character of these mountains cannot be maintained. The flickering appearance of the light—on which the hypothesis materially depends—seems wholly due to atmospheric causes, as it is not observed when the sky is clear, and the air still. The other grounds on which the mountain in question has been conjectured to be a volcano, are, that it has been distinctly seen during a lunar eclipse, and that it is often very conspicuous at the time when the moon is nearly new, and when the portion of her disc not illuminated by the sun is seen by aid of the light reflected from the earth. In the latter case, if we suppose the mountain to have a smooth table land at its summit, and the sides to be rugged and broken, it is easy to understand that the plateau at the top would reflect more light than the surrounding regions, and so appear brighter. But it seems almost impossible to account for the continued brightness during a lunar eclipse, when there is actually no light falling upon the moon, except by supposing the spot in question either self-luminous, or, at any rate, capable of giving out during the darkness the light previously absorbed. On either supposition the appearance of a bright spot on the moon during a solar eclipse might be accounted for, supposing it to have been observed by several persons, and for some considerable time. But it seems that whenever such appearances have been observed, they have been temporary, and that they have been noticed only by a few observers. Thus, in the eclipse of 1842, neither Mr. Airy, nor Mr. Baily, nor M. Arago perceived any such bright spots; and, though they were observed by others, the observations do not present accordance either in time or position—which evidently suggests the enquiry, whether these appearances may not be optical illusions. That a person might be deceived in this respect is evident from the fact that one of the observers at Prescott repeatedly thought he saw such a spot, but as on moving the telescope the spot moved with it, it was at once evident that it was due to some particles of dust or accidental inequality on the object-glass scattering the sun's rays.

III. None of the observers of the eclipse of 1854 succeeded in seeing the portion of the moon's disc exterior to that of the sun. It was seen by M. Arago during the eclipse of 1842, and is thus described by him:—"About 40 minutes after the commencement of the eclipse of July 8th, at 5h. 35m. by our clock, I saw the outline of the moon delineated upon the heavens. It formed accurately the prolongation of the dark circular arc which another portion of the same limb traced on the surface of the sun, and joined it at two points on the bright limb of the latter body." The same appearance is thus noticed by M. Flaugergues, who observed the eclipse at Toulon. "Towards the middle of the increase of the eclipse, the disc of the moon was visible about 25° beyond each of the points of intersection of the circumferences. When the eclipse amounted to eleven digits, all the disc of the moon became visible."

In the Instructions printed by order of the Institute, it was pointed out that this phenomenon would certainly escape observation, if the lenses of the telescope were not perfectly polished and scrupulously clean, and it was probably chiefly to the fact of the former condition not being fulfilled, that we must ascribe the failure of the observers in this respect. To explain why these precautions are essential to the success of the observation, it will be necessary to point out the mode in which the moon's disc does become visible under these circumstances.

The explanation which would at first offer itself, and which was assumed to be the true one by some observers in 1842, is that the moon's disc might be rendered visible by the twice-reflected light of the sun, which is called by French astronomers, "la laumière cendrée," and which has been by some English writers termed "earth-shine." That this light is, under certain circumstances, sufficiently strong to render the moon's disc visible, is evident to any one who has remarked the appearance of the moon when very young, when not only the small crescent illuminated by the sun's direct rays is visible, but we can also see the remainder of the disc of a peculiar grey colour. This is owing to the fact that at that time the earth as seen from the moon is nearly full, and that the light reflected from the earth to the moon is strong enough, when reflected again to us, to render visible the part of the moon not illuminated by the direct rays of the sun. Is it possible, then, that when the eclipse has begun, the portion of the moon exterior to the sun should be rendered visible by this light? In order to answer this question, it will be necessary to ascertain under what conditions an object becomes visible, either by the naked eye or through a telescope. It is evident that we have to take into account something besides the actual amount of light coming from the object, since the same degree of illumination which, under certain conditions, will render the body visible, will under other circumstances, fail to produce any sensible impression. Thus, for example, the lumière cendrée, or earth-shine on the moon, which is perceptible by the naked eye after sunset, cannot be detected with the aid of a telescope while the sun is above the horizon. This difference is due to the dispersive power of the atmosphere. When the sun's rays fall upon any one of the minute particles of the air, they are reflected in all directions, and the particle, as has been before remarked, becomes virtually a luminous point. The result of these reflections at all the particles of the air is the appearance of the bright blue sky; and when we turn a telescope towards any portion of the sky the field of view is illuminated by what we may call the light of the sky, that is, by the light of the sun which has been reflected from the particles of the atmosphere. If, now, we direct the telescope, during daylight, to a heavenly body, the field of view will be illuminated *generally* by the light of the sky; and the part of the field where the image of the body is formed will receive the proper light of the body in addition to the light of the sky; consequently, the visibility of the body will depend upon the excess of light upon this spot, above the general illumination of the field; and it is obvious that this excess will bear a ratio to the whole illumination, which will vary with the intensity of the light of the sky. In order that the image may be visible, it is found by experience that this excess must be equal to at least one-sixtieth of the general illumination; if this is not the case, though the image of the body is really formed upon the field of view, our eyes are incapable of distinguishing it from the surrounding parts of the field. Thus the greater the brightness of the field produced by the atmospheric reflection, the less will be our chance of seeing a luminous body situated beyond the atmosphere. As an illustration of this may be noticed the power of seeing the stars by daylight through a long telescope or tube. When the eye is unprotected, the retina is illuminated by rays reflected from nearly half the atmospheric particles above the horizon; whereas, when we look through a long tube, it is only from particles situated in a comparatively small region that the eye can receive light, and thus the light of the star becomes of greater importance—bears a larger proportion to the whole illumination—and may, if the tube be long enough, become as much as one-sixtieth of the general illumination, and thus render the star visible.

To return, then, to the moon's disc as seen beyond the sun during the eclipse. Is it possible that the lumière cendrée can be the cause of its being thus visible? If so, that light must be equal to at least one-sixtieth of the light of the sky received on the field of the telescope in the neighbourhood. Now, this twice reflected light is very feeble, and the exterior portion of the moon was seen by Arago in 1842, when not more than half the sun's diameter was eclipsed, and when the atmospheric illumination must therefore have been far more than sixty times the lumière cendrée. Consequently this explanation of the phenomenon is inadmissible. In fact, according to Arago's explanation, which seems almost certainly the true one, the moon's disc is visible under these circumstances, not because the illumination of her image is greater than that of the surrounding field, but because it is less so. It is seen just as the portion of the moon which is between us and the sun, as a dark object on a bright ground. This bright ground is an object of considerable interest as proving almost conclusively the existence of a non-luminous atmosphere of the sun surrounding the luminous envelope, and capable of reflecting the light proceeding from the latter. The light reflected by this outer atmosphere is so feeble that under ordinary circumstances we cannot perceive it, because it bears so small a proportion to the diffused light of the sky: and even during the progress of an eclipse, although the diffused light becomes more and more feeble as the moon's shadow envelopes more and more of the atmosphere, yet so long as *any* of the rays of the sun are not intercepted, the light of the sky is strong enough to prevent our seeing that reflected by the external envelope of the sun. When, however, the eclipse becomes total, all the direct light of the sun is cut off from the portion of the atmosphere through which we are looking, and the only illumination of the sky in the neighbourhood of the sun is that produced by rays which have been already reflected at distant parts of the earth's atmosphere. The illumination thus produced is very feeble, and the light reflected by the sun's atmosphere then becomes visible as a broad ring of light or corona, surrounding the dark body of the moon, and diminishing in brightness as it recedes from the sun's disc; but the moment the sun re-appears, this corona vanishes again, so that there is no chance of seeing it directly during any partial or annular eclipse however large. When, however, about half the sun's disc is eclipsed, the illumination of the field of a good telescope, arising from the reflected light of the atmosphere, is considerably reduced, and the excess of the illumination of the image of the corona above that of the dark body of the moon becomes perceptible, and renders the outline of the latter body visible. The truth of this explanation is strongly confirmed by the fact that the exterior portion of the moon is most distinctly seen *near* the sun's limb; which is in accordance with the theory, inasmuch as the corona, which forms the bright ground, is more strongly illuminated in that neighbourhood than at a greater distance.

We are now in a position to explain why this observation would very probably fail, if the object glass of the telescope were imperfectly polished, or had any particles of dust or moisture adhering to it. If the object glass were perfectly transparent, every ray falling upon it (provided its path was not inclined at too large an angle to the axis of the lens) would be entirely refracted in its own proper direction. The illumination, therefore, of the field of view, so far as it was due to the light reflected by the atmosphere, would proceed from a comparatively small patch of the sky surrounding the point to which the axis of the telescope was directed: rays proceeding from other parts would, after refraction, be so much inclined to the axis as to strike the blackened sides of the tube of the telescope, and so be absorbed and lost; so that such rays would contribute nothing to the illumination of the field. Let us suppose that with such a glass the dark exterior portion of the moon's disc can just be distinguished; let us call the atmospheric brightness 60; this will be the illumination of that part of the field where the moon's image is,* the part immediately surrounding this receives also the light of the corona, and since it is *perceptibly* brighter than the moon's image, the number expressing its illumination must be at least 61. Now if we suppose the object glass of the telescope to be imperfectly polished, or not perfectly clean, the rays coming from remote parts of the sky will throw an additional light upon the field of view; for whenever one of such rays falls upon an opaque spot or a speck of dust on the object-glass a portion of it will be scattered in all directions, making the spot virtually a new source of

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* Strictly speaking, the moon's image would be illuminated by the lumière cendrée, as well as by the light of the sky; but the former is so inconsiderable in amount, that it may be omitted.

light, a portion of which will fall upon the field of view. Suppose we denote by the number 10 the additional illumination of the field due to this cause; then the brightness of the moon's image will be $60 + 10 = 70$, that of the surrounding image of the corona $61 + 10 = 71$. The excess, therefore, of the brightness of the latter will be now only one-seventieth of the general illumination, which, as we have seen before is not sufficient to render the difference perceptible.* On the other hand, the chance of succeeding in the observation would have been materially increased by placing a diaphragm with a small aperture in front of the lens, thus protecting it from a great portion of the extraneous rays. M. Arago in his account of the total eclipse of 1842, gives a remarkable instance of the way in which the possibility of making this observation depends on the character and condition of the telescope. He was observing at Perpignan, in company with MM. Mauvais and Laugrier, and was himself at once struck with the phenomenon, which he had not expected. He directed the attention of his fellow-observers to it, but it was only with difficulty that M. Mauvais could detect it by means of his telescope, while M. Laugrier's would *not give it* at all, though both those gentlemen saw it distinctly in M. Arago's instrument. The telescopes used at Prescott had been carefully cleaned; but it is very difficult to keep an object glass, and still more an object mirror, perfectly free from all moisture. And, besides, it must be remembered, that no amount of care in cleaning could have ensured the success of the observation, if the object-glass or reflector was imperfectly polished. It is to be regretted that the precaution of placing a diaphragm in front of the object-glass was omitted, as this might very probably have rendered the phenomenon visible.

In conclusion, we may be permitted to observe, that a partial eclipse, however large, fails in exhibiting most of those astonishing phenomena which render a total eclipse the most striking of all celestial occurrences; and that in proportion as the magnitude of the phenomena decreases, so does the difficulty of observation increase. Considering also the shortness of the period to which the manifestation of the phenomena is confined, and the fewness of the opportunities that one person's lifetime affords for such occurrences, if any disappointment be felt that more was not accomplished on the present occasion, we would refer to a remark made by Professor Smith of Edinburgh, on the eclipse of 1851. He says, "on asking a worthy American, who had come with his instruments from the other side of the world, pointedly to observe the eclipse, what he had succeeded in doing? He merely answered, with much quiet impressiveness, that if it was to be observed over again, he hoped that he would then be able to do something, but as it was he had done nothing; it had been too much for him."

* This illustration is not strictly accurate, inasmuch as the effect of a film of dust or moisture on the object glass would be not only to increase the general illumination of the field, but to *diminish* the direct light received from the corona and the sky in the neighbourhood. It will be seen, however, that if we take this into consideration, the effect of the film in preventing our seeing the moon's disc projected on the corona will be increased. Thus, if we denote by a, the general illumination of the field, and by b, the additional light of the corona when the object glass is clean, the ratio of the excess of brightness of the image of the corona, to that of the portion of the field where the image of the moon is formed, will be $\frac{b}{a}$; when the general brightness of the field is increased by a quantity, c, in consequence of the interposition of a film on the object glass, the corresponding ratio will be $\frac{b}{a+c}$ the *difference* of the brightness remaining the same. This is obviously less than the former ratio. If, now, we take into account the effect of the film in diminishing the direct light, since the light of the corona and the atmospheric illumination will be diminished in the same ratio, we may write ma and mb for a and b, m being some proper fraction. Thus the ratio on which the visibility depends, will become $\frac{mb}{ma+c}$ which is less than $\frac{b}{a+c}$, and so, *a fortiori*, less than $\frac{b}{a}$

Note on the Object of the Salt Condition of the Sea.

BY PROF. CHAPMAN, UNIVERSITY COLLEGE, TORONTO.

[*Communicated to the Canadian Institute, January* 20, 1855.]

For what beneficent purpose has the great Creator of all things ordained that the sea shall be salt? To this often mooted question, no satisfactory answer has hitherto been returned. So far as I can ascertain, the following suggestions are all that have been proposed as yet in elucidation of the subject: First, that the sea is salt, in order to preserve it in a state of purity. Secondly, in order to render the water of greater density, and consequently to impart a greater buoyancy to bodies floating in it. And thirdly, in order to cause its freezing point to be lower than that of fresh water, and hence to preserve it from congelation to within a shorter distance of the poles than would otherwise be the case.

The first suggestion is scarcely tenable, because, without the intervention of other conditions, the amount of saline matter present in the sea is not sufficient to prevent the putrefaction or decomposition of organic bodies. In many salt marshes and on sheltered coasts, it is well known for instance, that after heavy gales at sea, accumulations of sea-weed frequently collect to such an extent as to occasion by their decomposition the most injurious miasma. During calms, again, on low tropical coasts, gaseous emanations arising from the decomposition of animal matter in the sea, have often been remarked. In these and other similar cases, it is to be borne in mind, however, that the decomposing matters are present in unusual quantities under the influence of peculiar or temporary causes. Under ordinary conditions, it has now been satisfactorily shewn that organic impurities—and these only can affect the present question—diffused through a vast body of moving water, whether fresh or salt, become altogether lost, and with extreme rapidity: so much so, indeed, as apparently to have called forth a special agency to arrest the total destruction of organised matter in its final oscillation between the organic and inorganic worlds. I allude to the myriads of microscopic creatures which inhabit all waters, and whose primary function is ably surmised by England's great anatomist, Professor Owen, to be that of feeding upon, and thus restoring to the living chain, the almost unorganised matters diffused through their various zones of habitation. Not only do we find these creatures in every stagnant pool, but the sea itself teems with them in all their varied types. "The application of the microscope," says Humboldt, "increases in the most striking manner our impression of the rich luxuriance of animal life in the ocean, and reveals to the astonished senses a consciousness of the universality of life. In the oceanic depths, far exceeding the height of our loftiest mountain chains, every stratum of water is animated with polygastric sea-worms, Cyclidiæ, and Ophrydinæ. The waters swarm with countless hosts of small luminiferous animalcules, Mammaria (of the order Acalephæ), Crustacea, Pteridinia, and circling Nereides, which, when attracted to the surface by peculiar meteorological conditions, convert every wave into a foaming band of flashing light."* These creatures preying upon one another, and being preyed upon by others in their turn, the circulation of organic matter is kept up, and carried through its appointed rounds. If we do not adopt this view, we must at least look upon the animal infusoria, the foraminifera, and many other forms of higher types of organisation, as scavenger agents appointed to prevent an undue accumulation of decaying matter; and in either case, so far as regards the object under discussion, the oceanic waters might have been as well fresh, as salt.

According to the second suggestion, the sea holds saline matter in solution, in order to render it of greater density. The superior density of sea-water as compared to fresh, undoubtedly plays an important part in many of the physical phenomena of which the ocean is the stage. A greater counterpoise is thus necessarily offered to lunar and other cosmical attractions; and the effects produced by winds and atmospheric disturbances must be modified also by this principle to no slight extent; but causes such as these, when considered in their fullest relations, can scarcely be considered adequate to meet the entire solution of so vast and grand a problem as that which is manifestly involved in the salt condition of the sea. Neither can the third supposition, as given above, be considered of greater value in this respect, because the difference between the freezing points of fresh and sea-water is under 4° Fah.; and hence, with the present distribution of land and water, and still less probably with that of former geological epochs, no very important effects would have resulted from this cause, if the ocean had been fresh instead of salt. So far as regards the habitable portions of the world for instance, the present difference would be next to nothing. I do not mean to imply, nevertheless, that this principle may not be without some secondary bearings on the phenomenon in question; but I do not consider it sufficient for the complete elucidation of the same.

The suggestion which I have now to lay before the Institute, as an attempt to explain the object in view—although confessedly not free from certain difficulties—will be found, I think, of a far more satisfactory character than those hitherto advanced. As already mentioned, I am not aware of any previous application of the principle which it embodies, to the solution of the present question. Without further preface, then, I may state that I regard the salt condition of the sea *as mainly intended to regulate evaporation*, and to prevent within certain limits, an undue excess of that phenomenon under the influence of any disturbing causes that might from time to time arise. It has been long known that different liquids boil at the same atmospheric pressure, under very different degrees of temperature; and that, of two saline solutions, the more strongly saturated requires the higher temperature to be raised to the boiling point. In like manner, evaporation at natural temperatures, other conditions being equal, proceeds far more slowly from saturated than from weak solutions; and, necessarily, more slowly also from these latter, than from ordinary water. In sea-water we have, as a mean, about three and a half per cent. of solid matters: 2·6 of this, on an average, consisting of chloride of sodium.

In order to observe the effects produced in retarding evaporation by so small a quantity of solid matter in solution, but without attempting to imitate the complex composition of sea-water, I placed a weighed quantity of ordinary rain water, and the same holding in solution 2·6 per cent. of Na Cl, in porcelain vessels of equal diameter; and exposed the two, side by side, to spontaneous evaporation: re-weighing them every twenty-four hours for six days. The experiment was then repeated, but with an exchange of vessels, so as to eliminate any errors that might arise from a slight difference in the diameters of the capsules employed. The results of each set of experiments were strikingly in accordance. The mean results of the two weighings, reduced to their per centage quantities, are given in the annexed table. Column A shews the evaporation loss resulting from the water. Column B, the same from the water of the salt solution: the amount of salt being deducted throughout as a constant quantity, and its weight confirmed by evaporation and re-weighing at the close of the experiment. Column C exhibits the excess of evaporation of A over B.

Hours.	A Loss from the Rain Water.	B Loss of Water from the Salt Solution.	C Excess of loss of A over B.
24	8.83	8.29	.54
48	19.12	18.08	1.04
72	26.63	25.17	1.46
96	30.82	29.05	1.77
120	39.00	36.76	2.24
144	44.99	42.43	2.56

An excess of 0.54 per cent. in twenty-four hours, in the evaporation of fresh water over water containing 2.6 per cent. of Na Cl, may seem at first sight of little moment; but when we consider that this arose from a surface under two inches square, we may easily conceive how enormous would be the difference between surfaces of fresh and salt water so vast as that of the present ocean, even; and so exposed over wide areas to evaporation-tending influences. Besides which, it must be remembered that the salt solution of the above table, contained at the commencement of the experiment, 1 per cent. less of solid matter than that present in the waters of the sea. It will be remarked, that as the salt solution becomes more and more concentrated, the excess of evaporation of A over B becomes higher and higher.

Here then we have a self-adjusting phenomenon; one of those admirable contrivances in the balance of forces, which an attentive study of nature reveals to us in every direction. If, other conditions being the same, any temporary cause render the amount of saline matter in the sea above its normal value, evaporation goes on the more and more slowly; and, on the other hand, if this value be depreciated by the addition of fresh water in undue excess, the evaporating power is the more and more increased; thus aiding time, in either instance, to restore the balance.

In conclusion I would observe, that the consideration of this principle may shed some further light on the geographical distribution of fresh and salt-water lakes on the present surface of the globe.

* Cosmos, vol. 1.

On the Transfusion of Milk, as practised in Cholera, at the Cholera Sheds, Toronto, July, 1854.

By James Bovell, M.D., Trin. Coll., Toronto.

(*Read before the Canadian Institute, January 27th*, 1855.)

Mr. President.

As I am quite aware that the Council of the Institute, as well as many of its members, wish to confine within proper limits the introduction of purely professional matters at the usual evening meetings, I have endeavoured to divest the subject which I purpose to bring before you this evening, as much as possible, of what you might consider its technical features; and instead of presenting to the Society a Report on the Cholera of 1854, I now venture to claim your attention to a single fact connected with that visitation,—one which I believe will be received by the members of the Institute with interest.

The possibility of saving human life by the transfusion of new blood into the system is not of very ancient date, and I believe that the records of antiquity furnish us with no instance of the introduction of blood into the system by operation. It was however practised, says Dr. Rhamsbotham, "by some in the last century; and some physiologists contend that the operation of transfusing medicated fluids, and blood itself, into the system of man, is of very remote origin; and they ground their supposition on some passages in the ancient poets." Thus Ovid represents Medea as renewing the youth Œson by injecting the juice of herbs into his veins.

"Quod simul ac vidit, stricto Medea recludit
Ense senis jugulum: veteremque exire cruorem
Passa replet succis. Quos postquam combibit Œson
Aut ore acceptos, aut vulnere, barba, comæque
Canitie posita, nigrum rapuere calorem."

This is no warrant for such a belief; and the probability is, that the fancy originated, not in any practice then pursued, but merely in an adventurous flight of poetry. It has been even supposed that in these early times blood was actually transmitted from one person to another, and a second passage in the same author, where he describes Medea's fiend-like deception practised upon the unsuspecting daughters of Pelias, has been quoted in proof.

.... Quid nunc dubitatis inertes?
Stringite, ait, gladios, veteremque haurite cruorem
Ut repleam vacuas juvenili sanguine venas.

Lib. vii.—5.

That these lines will not bear any such interpretation, the whole context, and the pretended sanitary preparations she makes, abundantly testify.

My relative, Dr. Leacock, in his Inaugural Thesis, published at Edinburgh, in, I think, 1816, again directed the attention of physicians to the real benefits which might be expected from the employment of such means for the restoration of life; and his opinions meeting with a warm advocacy from the justly celebrated Dr. Blundell, the operation of transfusion received an impress which it has never entirely lost. Various physiologists have, since the re-introduction of transfusion by Dr. Leacock, performed on the lower animals experiments, with the view to ascertain how far the blood of one animal may be substituted for that of another. As might have been expected, it was soon discovered that it was impossible to so far pervert the laws of physiology as to build up tissues from blood formed for the support of structures typically distinct; accordingly the law has been established, that an animal can only be restored to health by the introduction into its veins of blood taken from one of its own species But intelligible as this law is, it is, nevertheless, found, that many conditions contribute to its successful working. Constituted as blood is, possessing a highly complex organisation, consisting of many parts—organized solids and fluids, and inorganic salts, wonderfully and inseparably joined together, living very quickly and dying as instantly, in obedience to laws which govern its origin and death—blood cannot be for any appreciable time removed from the circulatory condition without undergoing change. It is a completed organism when withdrawn from the body of the animal; already has it lived out more than half its time, and all its tendencies are not to live on, but to die out: hence experiment has shewn that even with the blood of the same animal the effects of its transfusion have not been invariably satisfactory, and various propositions have been made to modify the introduction of the blood, in order to render it better fitted for the end in view. Thus the French philosophers have endeavoured to show that the de-fibrination of the blood was more likely to secure the benefits sought to be obtained, than when the whole organized compound was employed. Be this as it may, it is quite certain, that in case of epidemic visitations, which cut down, not an individual here and there, but which decimate a population, be transfusion never so successful, yet it would be an impossibility to employ it on a general scale, since the physician would not be justified in depriving the as yet unattacked man, of blood, every drop of which he may require shortly himself, even if it were possible to induce the disaffected to part with what is really under such a condition to them "their life's blood."

The appreciation of this truth evidently led our authorities to introduce other menstrua, and as Animal Chemistry pointed out in the destroying discharges the presence of the saline constituents, it was thought advisable to inject into the system a supply of similar material to fill up the place of that drained away. That this plan has been occasionally successful experiment fully attests; but it is nevertheless admitted, that it has not fulfilled the expectations of its originators. In the first place, this doctrine fails to take cognizance of that portion of the blood which remains in the vessels, it fails to recognise the prime fact that the serum and salts of the blood are drained away, not so much in consequence of changes which have ensued in the vascular canals, as from a tendency in the blood itself to separate into its constituent parts—in short, to die. The introduction, therefore, of the saline ingredients into the body is not a restoring to the blood that which it had lost, but it is a restoring to the system of a part only of its usual circulating pabulum, the thick, black decaying blood-corpuscles being altogether unfit to carry on the vital processes requisite for the maintenance of the animal fabric. Thus reasoning, the thought suggested itself that nature herself provided us with the means of accomplishing the renovation of the blood, and that we had prepared ready for our use a liquid possessing the requisite qualities of a blood forming fluid, and, above all, that which no art or power of man could bestow, viz, vitality—a compound mixed in the great laboratory of life.

The experiments performed by M. Magendie were, however, not very encouraging, and tended rather to throw a shade of doubt over the utility of milk as an agent in transfusion. This distinguished physiologist injected various substances into the arterial system of dogs, and amongst them milk, the results of which was by no means satisfactory.

In Mr. Hassall's very excellent work on the Microscopic Anatomy of the Human Body, in the chapter on the blood, the following remarkable observations, cited from M. Donne's Papers, occurs:—

"Now, with regard to actual experiments with milk, we have the testimony of M. Donne, that about two hours after its injection, rabbits, birds and dogs have been opened, 'I have collected,' he says, 'the blood in the different organs, in the lungs, the liver, the spleen, and everywhere I have found the blood containing a certain number of white globules in all stages of formation, and of red globules more or less perfect: invariably the spleen has presented to me special circumstances, so established and constant that it behoves me to mention them.' M. Donne further adds, 'that he believes that he has also traced, by direct observation and experiment the transformation of the minute oily and fatty particles found in the milk into white globules.' He injected numerous animals, birds, reptiles and mammals with various proportions of milk; and, strange to say," observes Mr. Hassall, "the creatures thus experimented upon experienced no injurious effect beyond a momentary shock, with, however, the single exception of the horse, to which the experiment proved fatal in seven different cases. If almost immediately after the injection of milk, a drop of blood be withdrawn from the system at a distance from the point where the milk was introduced, a number of the globules of the milk may be detected quite unaltered, and which may be recognised by their general appearance, their smaller size, and, lastly, by the action of acetic acid, which dissolves the red globules, renders apparent the granular texture of the white, but leaves untouched the molecules of the milk. If the blood be again examined, at about the expiration of two hours, the smallest milk globules will be seen to have united themselves with each other by threes and fours, and to have become enveloped, by circulating in the blood, in an albuminous layer, which forms around them a vesicle analogous to that which surrounds the white globules; the largest remain single, but are equally enveloped in a like covering. These soon break up into granules, in which state the milk globules of the blood bear a close resemblance to the white globules of the blood, from which finally they are not to be distinguished. The blood, Donne then remarks, 'shows itself very rich in white globules, but little by little these undergo changes more profound; their internal molecules become effaced and dissolved in the interior of the vesicle, the globule is depressed, and soon it presents a faint yellow colouration: they yet resist better the action of water and acetic acid than the fully formed blood globules, and it is by this that they are still to be distinguished. At length, after twenty-four hours, or at latest after forty-eight hours, matters have returned to their normal state; no more milk globules are to be seen, the proportion between the white and red globules has returned to what it ordinarily was.' In only one instance have I had the opportunity of noticing the changes spoken of by Donne, and that in the case of the man J. Pickles. He died about fourteen hours after transfusion, and I procured some blood from veins in the feet, and from the opposite arm; on submitting this blood to the microscope it was found to be loaded with white globules, presenting one of the best marked cases of Leucocythemia I ever saw. I failed, however, to notice a single milk globule; the red-corpuscles were very jagged."

Now, by reference to the Tables of Analysis of Milk and Blood by Simon and Mulder, we note the very close relationship which exists between them, and couple with this the facts as observed by Donne, viz., the evident convertibility of milk into blood, and the conclusion is almost irresistible that it must be a valuable agent for transfusion. Yet we had no precedent to direct us; and although I searched all the medical records within my reach I could not find a single case to guide us.

It will be noted by the Institute, that it was on the 10th of July, 1854, that the first case of transfusion with milk was effected in Toronto. In the *Association Medical Journal*, edited by Dr. Rose Cormack, under date Sept. 1st, 1854, the following letter, from William Bird Herapath, M.D., F.R.S., is published:—

On the Employment of Injections of Milk, or Milk and Water, into the Peritoneal Cavity, Cellular Tissue, or Venous System, in the Collapse of Cholera.

SIR.—In a paper read to the East Surrey Cholera Society, and published in the last number of the *Association Journal*, by Dr. Richardson, a proposal is made to inject the peritoneum and cellular tissue of cholera patients in the stage of collapse, with large quantities of water, for the purpose of rapidly supplying the loss of serum experienced by the excessive discharges from the intestinal mucous membrane. This extremely philosophical and ingenious suggestion is certainly highly deserving of a mature consideration, and a careful digest of properly conducted experiments. But it has occurred to me, whilst reading these remarks, that the injection of a fluid more closely approaching the character of serum in its chemical constitution would be more likely to give permanent benefit, and avoid the chances of destruction of the blood-corpuscles, occasioned by the difference existing between the specific gravity of their contents and of the rapidly imbibed water.

The most readily obtained liquid, having all the qualities we can desire is most assuredly cow's milk: it is always at hand in any quantity, whilst its tendency to coagulate may be obviated by adding a little solution of carbonate of soda or potassa, perhaps about one scruple of the salt to a pint of milk would be sufficient.

The only difficulties about the matter, would be the adulterations to which it may be subjected by fraudulent dealers, and the accidental presence of foreign bodies. Investigations at home and abroad have however shown that nothing enters more largely into the adulteration of milk than water. This is of no importance; but were the world-renowned "chalk and water" compound employed, fatal consequences would assuredly follow.

The entrance of foreign bodies into the circulation, or into the cavity of the peritoneum, or the muscles of the cellular tissue, may be easily prevented by attaching a fine muslin or gauze filter, or seive, to the mouth of the injecting syringe. It remains to be proved whether this fluid would be absorbed by the peritoneal vessels as readily as water, or with sufficient facility to be of service.

The specific gravity of good pure milk varies from 1.041 to 1.033 or 1.020; serum varies from 1.026 to 1.037, and even 1.050, according to the presence of health or disease. Now to produce the difference in specific gravity required by the laws of endosmosis to act in a state of health, water may be added to the milk. But the *viscidity of cholera blood* would assuredly indicate an increase in the specific gravity, and no dilution would be *necessary* in this disease; but if it were adulterated with water only, it would be a matter of no great importance.

It seems highly probable that milk, or milk and water, would be a much more successful fluid for this purpose than water only, and would certainly offer many great advantages, especially if the injection were to be made directly into the venous system, as the corpuscles of the blood do not suffer any material alteration in form, when examined microscopically, after dilution with milk; *they suffer nothing from the admixture*, especially if the milk is obtained from an animal of the same kind as the blood experimented on, *and if the milk used be pure* and unmixed with water.

I apprehend also that the introduction of an albuminous constituent is essentially necessary, to supply the waste of this vital pabulum experienced during the exhaustive dicharges of this disease.

It is quite a question whether the subsequent symptoms and fever, exhibited during the recovery from collapse, do not depend as much upon the loss of the albumen and salts of the serum, as upon the great difference subsequently existing in the relation between the quantity of the *solids and watery fluid* of the blood.

The chemical constitution of milk does not differ very materially from that of the chyle obtained by healthy digestion, which would of course be the only means *nature* would employ to regenerate slowly the lost liquor sanguinis.

Art physiologically directed comes to aid of nature, and, by employing her own Divine laws, assists her early efforts and wonderfully aids the cure—*gains time*, an element of vital importance in this marvellously rapid and fatal disease.

Nature would then merely have to regenerate the lost epithelial cells, which would of course be a work of time, and no efforts of art could remedy this defect; if the amount of the epithelial exfoliation had been very excessive, the exhaustive discharges of the choleraic diarrhœa would go in spite of all our injections; for the intestinal mucous membrane would then be in the condition of the dermis denuded of its epidermis by artificial vesication, exosmosis must occur by serous transudation until the protective covering had been reformed, when endosmosis would again recommence from the re-establishment of the physiological action of these wonderful cells.

Hoping that some members of the Association may have the opportunity to put these suggestions in practice, and be able to communicate the results through the *Journal* to the profession.

I am, etc., W. B. Herapath.

Bristol, August 1854.

This letter, coming from so distinguished a chemist, gratified me very much; and from it I gather that the use of milk in transfusion, and as a substitute for blood, is novel, and whatever little credit, therefore, is due to so humble a suggestion, must be awarded to Toronto, where its use was not only suggested, but actually put into practice.

The fact that milk (provided it has not parted with life) may be injected into the human system by the veins is now established; and it remains to be seen how far it may be useful as a remedial agent, not only in cholera, but as a restorative in cases of Uterine Hœmorrhage, or Hœmorrhage from loss by wounds. In the cases in which it has yet been tried, all other means were exhausted before the attempt was made to inject the milk; and I am informed, both by Dr. Daniels and Mr. McKenzie, that after my attendance on the cholera patients ceased, in no case was transfusion attempted, until every one present concluded that the patient was actually dying. I regret exceedingly that my own serious illness should have prevented my continuing to visit the patients, as I was thus prevented carrying out the observations; enough, however, was witnessed to show, that, while we may expect much good from transfusion, it cannot be expected to restore to health the body in which serious local disorganisation has taken place: the earlier the collapse, and the sooner the milk be used, the better.

Dr. Owen Rees, in a very late publication, thus expresses himself:—"With regard to the chemical constitution of the fluid, it would appear that we can scarcely venture to interfere with the organic constituents of the blood, nor imitate the animal extractions and protein compounds of the circulating fluid, in order to supply them if deficient. There is, however, *no occasion for this in Asiatic cholera, for the evacuations* from the intestinal surface which destroy the healthy character of the blood in that disease, appear to contain but little organic matter, being chiefly made up of water, holding the salts of the blood in solution. Thus Vogel and Wittstock agree in describing cholera evacuations as containing intestinal mucous, traces of albumen, and the ordinary salts of the blood with carbonate of soda somewhat in excess. The analysis of cholera blood again points clearly to the necessity of supplying more especially salts and water, if we desire to restore it to the healthy standard." Now, if we take a review of the composition and properties of milk, it will be found to possess all the qualities above desired by Dr. Rees. Thus the distinguished chemist Simon remarks, "that perfectly fresh milk has always a decidedly alkaline re-action, and it retains this property for a longer or shorter time: the milk of woman retains its alkaline re-action longer than that of cows, and the milk of healthy women longer than that of invalids."

On examining the milk under the microscope, we perceive a great number of fat vesicles of very different sizes swimming in a clear fluid, and occasionally epithelium cells. From repeated comparisons I have found that the fat vesicles in the milk of women are generally larger than those in the milk of cows In addition to these, we observe, under certain circumstances, other microscopic objects. The fat vesicles have, as Raspail declared, a solid envelope, a point which has been confirmed beyond dispute by Henle. Raspail considers that it is composed of coagulated albumen; it is, however, more than probable that it consists of caseine. Henle has shown that this capsule may be dissolved by acetic acid, and that butter then issues from it. It is probable, however, that this fluid fat becomes enclosed in a new envelope, for Ascherson has observed that a membrane immediately forms around every drop of fat that is brought in contact with a solution of albumen; and have found, says M. Simon, that fat shaken with a caseous substance (crystalline) in a state of solution, causes a partial coagulation by the formation of such membranes or capsules.

"When milk is left to itself," continues Simon, "for a considerable time, it coagulates, in consequence of the conversion of a portion of its sugar into lactic acid. This change often takes place *very rapidly in cow's milk*, and generally more quickly than in woman's milk." By reference to the analysis, it will be seen that in every particular cow's milk alive, and therefore fresh, possesses every necessary quality, as already observed; there is fuel for the sustentation of animal heat, and salts to supply the place of those drained away, mixed not by any cunningly contrived art of man, but in vital combination with a living fluid; for I think that we ought not to lose sight of the fact that, when we speak even of the water of blood, that we speak of water in a particular state, for it certainly must possess properties differing from the ordinary properties of water, and so on with every other constituent of the blood.

COW'S MILK.

Water	857·0		861·0	823·0		F. Simon.
Solid constituents	148 0		139·0	177·0		
Butter	40·0		38·0	55·0		
Cassia	72·0 .		68·0	67·0		
Sugar and Extractine Matter	28·0		29·0	51·0		
Fixed Salts	6·2		6·1	13·0		
Earthy Salts						
Phosphate of Lime	2·31	47·1		3·44	50·7	
Phosphate of Magnesia	0·42	8·6		0·64	9·5	
Phosphate Peroxide Iron	0·07	1.4		0 07	1·0	
Chloride of Potassium	1·44	29.4		1.83	27·1	
Chloride of Sodium	0 24	4·9		0.34	5·0	
Soda	0·42	8.6		0.45	6·7	

PROXIMATE CONSTITUENTS OF THE BLOOD.

Protein Compounds:—Fibrin, Albumen, Globulin,

Colouring Matters:—Hœmatin, Hœmaphein.

Extractive Matters:—Alcohol extract, Spirit extract, Water extract.

Fats:—Cholesterin, Serolin, red and white solid fat, containing Phosphorus, Margaric acid, Oleic acid.

Salts:—Iron. Albuminate of Soda. Phosphates of Lime, Magnesia and Soda. Sulphate of Potash. Carbonate of Lime, Magnesia and Soda. Chlorides of Sodium and Potassium. Lactate of Soda. Oleate and Manganate of Soda.

Gases:—Oxygen. Nitrogen. Carbonic. Sulphur, &c. Phosphorus.

DR. REES' ANALYSIS OF CHYLE.

Water	902·37
Solid constituents	97·63
Fibrin	3·70
Fat	36·01
Albumen	35·16

Extractive matters soluble in alcohol and water	3·32
Do. do. in water only	12·33
Salts as in lymph	7·11

Salts—chloride sodium.
Lime—sulphate and phosphate.
Other soluble salts—peroxide of iron.
Earthy salts.

CASE 1ST.

Thomas Harrison, aged 40, a native of Ireland, a farmer, resident near Brockville, admitted into the Cholera Sheds, General Hospital, July 10th, 1854, states that he was quite well when he left his home, and for some time after leaving the steamer; indeed, until the evening of July 9th, when he was seized, about 10 o'clock, with nausea, accompanied almost immediately with tendency to fainting and diarrhœa. He continued ill throughout the night, and received no benefit from the medicines which were then administered. Finding that he was seriously ill, he was brought to the Hospital. On his arrival, 10 o'clock a.m., he was placed in bed, covered with warm blankets, and was given hydrg. submur. gr. x. dry on the tongue, merely washing it down with a little iced water. His countenance was pale and cadaverous, sunken and cold, particularly the alæ of nose, the tongue was contracted, pointed, and cold as ice; fingers shrivelled, cold, and pointed; vomiting of liquid, having all the characters of similar fluid passed constantly and freely from bowels; cramps in bowels very severe, less so in legs; pulse small, contracted, 120; breath cold; gave calomel every 20 minutes; at 11 o'clock, vomiting continuing, he got—

R. Argenti: nitr: gr. j.
Aq. distill. oz. j, ft. haust.
To be taken every half hour.

At 1 o'clock p.m.—Finding that there was no improvement, but, on the contrary, that the symptoms had not yielded, I proposed to my friend and colleague, Dr. Hodder, to follow out a plan of treatment which had already been discussed between us, namely, that we should transfuse warm fresh milk into the veins. Dr. Hodder coinciding in my opinion, and satisfied with the physiological data on which that opinion was based, readily assented to the operation. Previous, however, to undertaking one of so serious a nature, as we then deemed it to be, I sought the advice of some other medical friends, among the number, Dr. Widmer, who, by message, as I could not see him, requested us to be very cautious as to what we did, least, in case of immediate death, the public mind should become excited. One of my colleagues, also, could not bring his mind to approve of the step. We determined, therefore, to delay the operation until there could scarcely be a doubt that death was imminent. At about 3 o'clock the prostration had greatly increased; the man lay on his back, with his eyes sunken, countenance of ashy hue, hands cold, tongue equally so, breath drawn, in gasping sighs, and the pulse gone from the wrist. We now, therefore, commenced the operation. Dr. Hodder kindly undertook to introduce the tube and to inject, whilst I superintended the procuration of the milk. An ordinary glazed earthenware bowl was placed in warm water at the temperature of the blood. A cow, which was grazing close at hand, was brought up to the shed, and the nurse, with great care, keeping the teat close against the side of the vessel, to prevent frothing, drew off the milk in sufficient quantity; the syringe—a brass, anatomical injecting 4 oz. syringe, made by Neeves of London—having been warmed, was now filled with the fresh living milk. Dr. Hodder with considerable care introduced it into the tube previously inserted, and tied in the median vein; by a slow, steady motion the fluid was pressed on, while a gentleman present kept his finger on the pulse; in a few seconds the pulse was distinctly felt, first weakly, then more perceptibly, until at last he exclaimed, "How the pulse rises!" almost simultaneously the eyes responded, the half-closed lids being raised, the lustreless orbs giving utterance to the relief which was being given, while deep and well-drawn inspirations told how readily the lungs responded to the vital tide which now flowed towards them. Three syringes full having been passed into the system, the following effects were noticed—repeated sighing the breath being drawn deeply and fully, with evident sensations of relief; the pulse quite perceptible and steady, 100 in the minute; the voice, which was unearthly before, was clear, though not strong; and whereas, before the operation he was perfectly careless and, indeed, reckless as to his personal safety and the care of his family, almost his earliest thoughts were directed to the welfare of his children and wife. The arm being bound up, Harrison, with much strength, turned himself on his side, and desired to sleep. Knowing that, under the condition to which he had been reduced, it was not at all probable that he would be enabled to keep up the animal heat of his body, care was taken, by artificial means, to attain this desirable end; while, therefore, hot bottles were placed against his feet, his chest, body, arms, and spine were ordered to be rubbed with hot turpentine, and hot flannels were to be kept constantly over his body; and as nutriment he was supplied with small quantities of strong beef tea whenever he would take it, with white of egg and brandy and water, an oz. of brandy, to white of two eggs.

At 8 o'clock p.m.—Had some good natural sleep; no vomiting, bowels not moved once, no cramps; surface requires to be kept artificially warm; if the applications are discontinued becomes cold; expresses himself greatly relieved, but still feels very weak, has by no means so great thirst as before, kidneys have acted. Treatment continued.

July 11th.—Has had a tolerable night, bowels moved twice, discharges coloured with bilious matter, passed water, has vomited this morning a free quantity of bile; pulse quite perceptible, 100, and easily compressed; no cramps or pain in limbs. My friend, Dr. Clarke, whose valuable services at the General Hospital are too well known to require any commendation from myself, suggested the desirableness of administering a gentle laxative, with a view of procuring a freer discharge of matter from the bowels. Accordingly, it was determined to administer at even-time a couple of grains of pil. hydrg., and a tea spoonful of ol. recini, and continue warm applications.

July 12th.—Medicine has acted freely, but not too much so; he has vomited a large quantity of bile, pulse very much improved; is now painfully sensitive to the application of turpentine, which at first only produced an agreeable glow of heat; enjoys his beef-tea, and takes his brandy and egg. He had after this a troublesome bilious diarrhœa, but progressed towards convalescence, and left Hospital convalescent. I learned on Wednesday last, January 23d, that he was yet alive, and in good health. It was noticed that many patients bore white of egg and brandy with cod-liver oil, when the stomach rejected other nutriment.

CASE 2D.

Mary Hall, an Irish woman, married, and the mother of four children, the youngest being an infant at the breast. This patient had come into Toronto with her husband to attend the demonstration made by the Orange Society. She was quite well on leaving home, and remained during the day at a small tavern on Queen Street; in the afternoon she was seized with distinct symptoms of cholera. At 10 o'clock p.m., I saw her for the first time. In order to procure for her efficient attendance, she was with some difficulty persuaded to enter the Hospital Sheds. On her arrival she was placed in a comfortable warm bed, and was ordered

Argenti. nitrat. gr. j.
Aq. distill. oz. j, ft. haust.
Every half hour. To have beef-tea, and brandy and egg.

July 13th.—She has passed a restless night, and although the vomiting was considerably lessened, yet the discharge of rice-water evacuations from the bowels continued; her pulse was extremely feeble and quick; countenance pinched and of ghastly hue; tongue cold and pointed; tossing about her arms, and sighing; careless about her fate, and is not roused by any reference to her children or husband. Dr. Hodder, equally interested with myself in the history of the disease, and anxious to do all in his power to mitigate its horrors, came to the sheds, and witnessing the condition of the poor woman, at once agreed to perform transfusion. The same precautions were adopted in this case, as were found necessary in that of Harrison, and with like results. At the time the tube was put into the vein she was pulseless, and although she could be roused, yet was incapable of answering questions, and altogether she presented a hopeless appearance. Two syringes full, equal to 8 oz., of the fresh warm milk from the same cow which afforded the supply to Harrison, were injected into the vein. As soon as the operation was completed, she expressed the greatest relief, and seemed irresistibly impelled to draw deep and frequent inspirations. The arm being bound up, as with Harrison, so with this patient—a desire to sleep was manifested, and turning over on her side, she composed herself to slumber. Hot bottles were kept not only to her feet but about her body, and she was rubbed with hot turpentine, and then swathed in warmed flannels. At evening visit she was evidently improved, had some sleep, the renal secretion was restored; her pulse was steady and quite perceptible; countenance relieved, and not so pale and ashy; no vomiting, nor discharge from bowels.

Ordered to have beef-tea, and brandy and egg.

July 14th.—Improving, although very weak, has had occasional vomiting of bile, and has had several bilious evacuations. She was carefully watched, allowed to have nothing but beef-tea and brandy and egg occasionally, and was finally discharged convalesing on the 17th July.

Two other cases were transfused by myself, both immediately after being brought into hospital, and when *in articulo mortis*, the one a man named James Pickles, and the other a female. In the last case it was quite evident that life was ebbing fast, and to complicate her difficulties, the veins were so empty and small, that I was for some time foiled in my endeavours to find one; after some difficulty, I succeeded in getting a pipe into the vein of the arm, and injected two syringes full, equal to 8 oz., the effect was to recall the pulse at the wrist, to enliven the countenance, and restore strength and fulness to the voice From the lateness of the period at which the operation was performed, and from the disease having nearly done its work ere she was brought into Hospital, her rally was only temporary; for four or five hours she gave promise of amendment, and seemed greatly relieved; but afterwards she again began to sink, without, however, any renewal of the diarrhœa or vomiting, and finally died on the following morning. In reference to this case, I think it right to state that I intended to transfuse a second time, but, being seized with alarming illness, neither in it nor in any case was the operation repeated.

The next cases are kindly furnished me by one of our most industrious medical pupils, Mr. John Mackenzie, whose devotion to the sick during the whole of the cholera visitation was truly praiseworthy, and deserved to be honourably rewarded by the Board o Health. When others refused to lay hands on the dead, this gentleman removed them without any hesitation, to make room for the living.

TRANSFUSED.

1.—*Wm. Fraser*, admitted July 16th, was a very athletic young man, in the employ of Mr. Tuminey, was a carpenter by trade, formerly lived in country, had had Diarrhœa for several days, on Saturday, 15th inst., eat a great many cherries; on Sunday morning early, or on Saturday night, he was taken with violent vomiting and purging; on admission he had violent vomiting of Rice water, together with cramps. Nitrate of silver was tried, together with calomel, brandy and water, beef tea, &c.

On Monday, 17th, pulse scarcely to be felt, cramps less frequent, but vomiting continues; evidently sinking fast; at 10 A.M., median basilic opened, and tube introduced without difficulty; about 10 oz. of milk thrown up. Pulse in 10 minutes could be felt, and voice, which before was scarcely audible, could now be heard; the patient expressed himself far stronger; and though he was greatly revived by transfusion, yet vomiting continued in spite of everything, and he died at about 2 P.M.

2.—*James Conway*, admitted July 12th, an able-bodied labourer, brought to hospital in state of collapse, pulse scarcely perceptible, eyes sunken; mouth open, with that peculiar dropping of jaw, tongue cold as ice. Saw him a few minutes after he was laid on bed. I then thought the man would die before the tube could be introduced, and as his wife was piteously imploring something to be done, I determined to attempt it alone. Introduced the tube, and transfused about 8 oz. milk. Went and got brandy, and made his wife give it to him, and though he remained insensible during the time I was introducing tube, yet he so far recovered as to be able to speak to his wife, but died about 1 P.M.

This man had no vomiting latterly, though his wife stated he had vomited during night. Was taken during previous night.

3.—Dutch woman, admitted July 18th, unable to speak English, came in state of collapse; pulse absent, tongue cold; eyes sunken, the fingers wrinkled, and nails blue, having the appearance as if wrinkled by cold,—evidently dying. Brandy and water was given. Transfused about 11 P. M., rallied a little, but died in afternoon, about 2 P. M.

Such is the brief account of the cholera cases which I have the honor to submit to the Institute. In conclusion, I would venture to express a hope that the Corporation of the city will not again permit themselves to be taken by surprise, as we unquestionably were last summer. The pestilence came on us suddenly, and cases poured into the sheds ere the fitting accommodation could be provided. In this way, wards became overcrowded, the sick had neither utensils nor proper bedding, nor food for their accommodation; and much distress arose. By enlarging the Board of Health, and placing it on a better footing, much good would result. Why not empower the Members of the Corporation for each ward to associate with themselves a medical man, resident in their own or in the nearest ward, to act as a health committee. In May let these committees commence their work, visiting first the worst streets, and ordering the removal of all nuisances and filth; and, in case of disease, looking after the sick in their districts. There are many old decaying wooden houses in our lanes and bye-streets, which are not even good enough for kennels; surely the owners of such places ought to be compelled to remove them, or, at all events, to cleanse and drain their premises. It is well known that cholera delights in filth and moisture. No allusion is made to the important question of water supply, as the proper authorities have taken up the matter, it may, therefore, be hoped that the detestable liquid quaffed last year, and even at this time, will not be much longer supplied to us. Money ought not to be the sole object when the health of a whole city is concerned, and the guardians of the public health ought to be entrusted with full powers to act for the good of those placed under their care.

I trust that these few remarks, uttered in no captious spirit, but from an earnest desire to prevent a recurrence of perhaps scenes then unavoidable, will not be misconstrued.

Observations on the Colouring Matters of Flowers.

BY E. FILHOL.

WHITE FLOWERS.—If flowers of *Viburnum opulus*, *Philadelphus coronaria*, *Chrysanthemum vulgare*, white roses, and a number of other flowers, be exposed for a few moments to the action of ammonia, they acquire a yellow tinge of greater or less intensity, which remains for a considerable time. Flowers of *Viburnum opulus* by this treatment acquire a yellow colour as fine as that of *Cytisus laburnum*. The matter which thus becomes yellow under the influence of alkalies appears to be present in all white flowers, some flowers contain only a small quantity of it, but these are rare.

In variegated flowers of which the corolla is partially white, these portions usually acquire a fine yellow tint under the influence of ammonia. The stamina, the pistils, and in general all the white parts of flowers, act in the same manner. The leaves themselves become yellow when they are accidently deprived of chlorophylle. I ascertained this fact with a plant of *Convallaria polygonatum*, of which the leaves presented alternate green and white bands. The latter became bright yellow from the action of ammonia, exactly like flowers. The tissue of some fruits also becomes yellow, although less distinctly, under the influence of alkalies.

The most convenient mode of converting a white flower into a yellow one is to introduce it into a wide-mouthed flask containing a little liquid ammonia, and to expose it to the action of the alkaline vapour. The change then takes place very rapidly. When the greatest part of the flower has become yellow, it may be taken out of the flask and exposed to the air, when the parts which still remained white will gradually change until the flower acquires a uniform tint. The flower may also be dipped into water, alcohol or æther, mixed with a little ammonia. The latter fluids should be preferred when the flower is covered with a fatty coating, which would prevent their being moistened by a watery fluid. If a white flower that has been rendered yellow be dipped into acidulated water, it gradually recovers its white colour.

These experiments remind one that when dyers wish to employ the colour of woad in dyeing, they add a little carbonate of soda to their vat, which gives considerable brightness to the tint. It is easy to prove also that acids, even when very weak, cause the disappearance of the greater part of the colour of a decoction of woad. From this it seems not improbable that the substance which communicates to white flowers the property of becoming yellow when in contact with alkalies may be *luteoline.*

If the petals of white roses be boiled with distilled water, and a little carbonate of soda and sulphate of copper be added to the decoction, as is done with the decoction of woad, a liquid is obtained possessing a bright golden-yellow colour which may be employed in dyeing yellow. This liquid will give a fine yellow tint to linen and cotton fabrics, and nearly all white flowers will furnish similar results. I have dyed pieces of linen and cotton with decoctions of white roses, of the flowers of *Spiræa filipendula, Philadelphus coronaria* and *Galium Mollugo.*

The matter to which white flowers are indebted for this property of acquiring a yellow colour under the influence of alkalies, dissolves readily in water, still more so in alcohol, but less in æther. When the superficial layer of the petals of flowers which have been coloured yellow by ammonia is removed, all the cells are seen to be filled with a yellow fluid, in which no granules are to be perceived.

Dark Red Flowers.—With boiling water or alcohol, the flowers of the wild poppy furnish a violet-red solution. This acquires a fine scarlet colour by the action of acids, even when very weak. If ammonia be poured into the liquid thus acidulated, it becomes of a fine violet colour, without the least mixture of green. But if, instead of adding ammonia to the acidulated liquid, it is added directly to the infusion, this acquires a dirty greenish-red tint. When the flowers themselves are exposed to the action of ammonia, they acquire a fine violet color, like that obtained with the acidulated fluid. The colouring matter of the poppy therefore differs greatly from the cyanine of M.M. Fremy and Cloez, for alkalies do not give it a green colour.

The flowers of *Pelargonium zonale* also become of a fine violet colour under the influence of ammonia: their colouring matter behaves like that of the poppy. The dark red garden verbena gives a violet-red tint to alcohol. The alcoholic solution, treated with ammonia, acquires a vinous colour with a slight greenish tint. If the alcoholic infusion of these flowers be digested with a little dry powdered hydrate of alumina, the latter acquires a light yellow colour, and the supernatant fluid becomes of a fine red colour under the influence of acids, and of a blue without the least mixture of green by the action of bases. The verbena consequently contains two distinct matters, of which one becomes blue under the influence of bases, whilst the other becomes yellow; it is to the mixture of these two matters that the green colour of the alcoholic tincture of these flowers is due.

The petals of *Anemone hortensis* act like those of the verbena. The flowers of the red pæony become of a pure blue colour under the influence of ammonia. These flowers are rapidly deprived of colour by alcohol; the tincture which they furnish is but slightly coloured, but it becomes of a deep and bright red by the addition of the smallest trace of acid. The acidulated liquid becomes blue with ammonia, whilst the non-acidulated alcoholic solution acquires a greenish tint. The petals of dark red roses become blue when exposed to ammoniacal vapours, but the colour soon passes to a greenish-blue. Alcohol readily dissolves the colouring matter of roses, but acquires very little colour. The slightest addition of acid communicates a deep red color to the alcoholic solution; ammonia poured into the acidulated liquid changes it to a greenish blue.

Rose-coloured Flowers.—These flowers contain a mixture of two juices, of which one is colourless in acid liquids, whilst the other is red. The former becomes yellow when mixed with alkalies, the second becomes blue, and the mixture of these latter colours produces a green tint. Hence the tints which will be acquired by red or rose-coloured flowers, when exposed to the action of ammoniacal vapours, may be easily indicated beforehand. It is clear that the green colour will approach yellow more and more in proportion to the paleness of the rose, and that it will have a blue tendency in proportion as the colour becomes deeper.

Blue Flowers.—The preceding statements regarding red and rose-coloured flowers applies also to blue flowers. The green colour produced in blue flowers by the action of watery ammonia tends more and more to yellow in proportion to the paleness of the flower.

Effects of the Mixture of the white and colored juices of Flowers.—When flowers of iris, of violets, pæonies, of *Cereus siliquastrum,* &c., are infused in alcohol, one is struck with the weakness of tint of the alcoholic solution, even when the petals are completely deprived of colour. It appears natural, at first sight, to attribute this decoloration to the influence of the alcohol, which may act as a reducing agent, but a close examination of the facts does not permit us to rest satisfied with this explanation; and without denying that alcohol may exercise the influence attributed to it by M M. Fremy and Cloez, I think that the following theory, either alone or combined with that just referred to, may readily account for the circumstances in question. In fact, if, instead of treating the above-mentioned flowers with alcohol, they are infused in boiling water, the watery solution is not more deeply coloured than the alcoholic tincture. It would be necessary therefore to admit that water itself is a reducing agent, which is by no means probable.

If into these solutions, whether watery or alcoholic, the smallest quantity of a soluble acid be poured, they instantly acquire a bright red colour, far deeper in tint than the original liquid. The kind of acid is quite immaterial, for even sulphurous acid immediately brightens the shade, and reproduces the colour which was only concealed. The prolonged action of this acid however soon destroys the colour. Can it be imagined that the colouring matter would reappear immediately upon the addition of *any* acid, if it had been reduced? and especially on this hypothesis, can we account for the action of sulphurous acid? I think not.

In my opinion, the decoloration is due to the mixture of the juice contained in the colourless cells with that of the coloured cells. When alcohol or boiling water acts upon a flower, its organization is destroyed, the juices contained in its cells become mixed, and the colouring matter disappears. The following experiment lends support to this explanation.

If two equal volumes of a slightly acidulated infusion, either watery or alcoholic, of pæony flowers be diluted, the one with four times its volume of water, the other with four times its volume of an infusion of white flowers, it will be seen that the latter will retain much less color than the former.

The white juices consequently destroy, or rather dissemble the colouring matter. The question now arises whether these juices act as reducing bodies, or whether they simply form colorless combinations. The experiments to which I have referred above may, I think, serve to answer this question; for if reduction takes place, sulphurous acid would not reproduce the colour. I consider therefore that the colouring matter does not experience any reduction, and that it forms with the elements of the colourless juices or a colourless combination. In infusions prepared by the action of alcohol or water upon flowers, one portion of the colouring matter remains free, whilst the other enters into the combination just mentioned. It is easy to separate the coloured portion from the colourless, by triturating the liquid with a little artificial phosphate of lime or dry hydrate of alumina; the coloured part is the first to fix upon the solid body, whilst that of which the colour is dissembled remains for the most part dissolved. If the liquid be filtered, it passes without colour. It may then be colored red by acid, and green or blue by an alkaline solution.—*Comptes Rendus,* July 24, 1854, p. 194.

On the Discovery of Microscopic Shells in the Lower Silurian Rocks.*

BY PROF. EHRENBERG.

(Communicated by Mr. Leonard Horner.)

The minute grains of greensand, which are characteristic of many rocks, have a different nature from the green earth often met with in concretionary masses. The former, from the *glauconie* of the Paris *calcaire grossier* to the azoic green sand, near Petersburgh, appears to consist of green opalescent casts of Polythalamia, composed of a hydrosilicate of iron. The cretaceous greensands of England contain unmistakeably, these stony casts. In the *calcaire grossier* and nummulite limestones occur beautifully preserved and perfect examples of Quinqueloculina, Rotalia, Textularia, Grammostoma and Alveolina. In the Lower Silurian greensand casts of detached cells of Textularia and Nodosaria were found. Prof. Forbes said, that Mr. Sorby had discovered Foraminifera in the Aymestry limestone; but as some of the beds with green grains were of freshwater origin, it was almost impossible that all greensand should be derived from this source. Prof. Sedgwick pointed out instances in which the green colour was due to particles of chlorite.—Sir R. I. Murchison stated, that the whole group of Lower Silurian strata existed near Petersburgh, though only 1,000 feet thick. the upper part, representing the Bala limestone,

* British Association.

was 50 to 80 feet thick: next came a sandy bed, with green grains: then brown sandstone, with oboli; and lowest of all, shale, with green grains and crustaceans, once supposed to be fishes, in which it appeared that Prof. Ehrenberg had discovered these Foraminifera.—Mr. A. Bryson said, he had sometimes obtained the silicious shields of Diatomaceæ from boulder clay by means of a fine sieve, when other means had failed, because the objects adhered to the minute particles of mica.

CANADIAN INSTITUTE ESTABLISHED 1849

CANADIAN INSTITUTE—SESSION 1854-55.

Seventh Ordinary Meeting—Saturday, February 3d, 1855.

The names of the following candidates for membership were read:—

John Helliwell .... Toronto.
Edward Berry.. Quebec.
Henry May .... Quebec.

The following gentlemen were elected members:—

Robert Bell .... Carleton Place.
Robert Grier.. Toronto.

A paper, communicated by Major Lachlan of Montreal, was read by the Corresponding Secretary, being "An Account of an extraordinary sudden fall in the waters of the Niagara River in March, 1848, caused by a temporary obstruction of the outlet of Lake Erie by the ice."

Professor Hind illustrated the method of manufacturing gun cotton.

Eighth Ordinary Meeting—February 10th, 1855.

The names of the following candidates for membership were read:—

A. N. Buell .... Toronto.
W. Thompson .... Toronto.

The following gentlemen were elected members:—

John Helliwell.. Toronto.
Edward Berry.. Quebec
Henry May .... Quebec.

Thomas Henning read a paper "On the Asteroids."

James Bovell, M.D., communicated "Some observations on microscopic preparations of Chalk from Barbadoes, containing some infusoria."

Ninth Ordinary Meeting—February 17th, 1855.

The names of the following candidates for membership were read:—

C. J. Campbell.. Toronto.
Alex. M'Donald.. "
Edward Shortis.. "
J. C. Clarke .... Port Hope.
Thomas Galt .... Toronto.
Dr. Carter.. Nelson.
William Morris .... Perth.
Alex. Morris.. Montreal.
James Wilson, M.D.. Perth.

The following gentlemen were elected members:—

A. N. Buell .... Toronto.
W. Thompson .... "

The following donations were announced:—

From the Hon. J. M. Brodhead of Washington, by A. H. Armour, Toronto—

Compendium of the United States' Census, 1850.
Penal Codes in Europe, by H. S. Sandford.
Cruise of the Dolphin, by Lieut. Lee.
Exploration of the Red River of Louisiana, by Lieut. Marcy.
Mexican Claims; Report of the Select Committee.
Exploration of the Valley of the Amazon, by Lieut. Gibbon.
Sickness and Mortality on Emigrant Ships.
Maps to accompany Lieut. Lee's Report.
Do. do. do. Marcy's do.
Do. do. do. Gibbon's do.

From A. H. Armour, Toronto:—

Railroad to the Pacific, Northern Route; its general character, relative merits, &c. By Edwin F. Johnson, C.E. With Maps and sections.

From the Hon. East India Company:—

Meteorological Observations at the Hon. East India Company's Magnetic Observatory at Madras, in the years 1846-50.

The thanks of the Institute were ordered to be presented to the Hon. Mr. Brodhead, Mr. Armour, and the Hon. East India Company.

Professor D. Wilson, LL.D., read a paper "On some physical elements of Ethnological classification, and their bearing on the question of the unity of the human race."

Tenth Ordinary Meeting—February 24th, 1855.

The names of the following candidates for membership were read:—

D. L. Macpherson .... Toronto.
Patrick Macgregor .... "
Alexander Grant .... "
Alexander Logie. .... Hamilton.
James Dundar Pringle .... "
T. S. Hunt.. Montreal.

The following gentlemen were elected members:—

C. J. Campbell.. Toronto.
Alex. M'Donald.. "
Edward Shortis.. "
J. C. Clarke .... Port Hope.
Thomas Galt.. Toronto.
Dr. Carter.. Nelson.
William Morris.. Perth.
Alex. Morris .... Montreal.
James Wilson, M.D.. Perth.

The following donations were announced:—

From E. C. Hancock, Toronto—

Britannia Depicta, or Ogilby Improved, by John Owen.

From the Hon. J. H. Brodhead, Washington:—

The Case of the Black Warrior, 1854.
Report of an Expedition down the Zuni and Colerado Rivers, by Capt. Sitgreaves, C.T.E.

From A. H. Armour, Toronto:—

Montreal and the Ottawa, by T. C. Keefer.

The thanks of the Institute were ordered to be transmitted to the above-named gentlemen.

Professor Hind read a paper "On the North American drift."

LITERARY AND HISTORICAL SOCIETY OF QUEBEC.

LITERARY AND STATED MEETING.

WEDNESDAY, 3rd JANUARY, 1855.

Lieut. T. C. Malony, R. A., and T. B. Harvey Esq., were proposed as associate Members.

ANNUAL GENERAL MEETING.

WEDNESDAY, 10TH JANUARY, 1855.

Report of the Council of the Literary and Historical Society of Quebec, for 1854.

The Council of the Literary and Historical Society respectfully submit, in accordance with the usual practice, a Report of the Proceedings of the Society during the year which has just closed. That year has been marked by events of more than ordinary interest and importance to the Society. We have on the one hand, serious losses and misfortunes to deplore, while on the other, we are consoled by the progress which, in spite of every obstacle and trial, the Society has made during the last twelve months

Our last annual meeting was held, as you remember, in the Rooms which the Society had, for many years, been allowed to occupy in the old Parliament buildings. Within little more than a fortnight from the day of that meeting, the whole of those buildings were destroyed by fire. In that calamitous fire, the Society sustained a severe loss. Nearly the whole of its well selected and very extensive Museum of natural history and mineralogy, the fruits of the labor and expenditure of many years, embracing a unique collection of American birds, and specimens of almost all the natural productions of the country, as well as many antiquarian objects of interest perished in the flames. Through the praiseworthy exertions of some of the members of the Society, a large portion of our Literary, and almost the whole of our valuable manuscripts relating to the early history of the country, were rescued from destruction. But a serious inroad was, notwithstanding, made upon our library shelves, and many valuable sets of books have been rendered comparatively useless by the loss of one or more volumes from among them. The pecuniary loss which the Society sustained on that occasion has been estimated at about £1400, but many of the most interesting objects which were destroyed in the Museum are such as cannot be replaced.

Under these circumstances immediate steps were taken by the Council to meet the emergency, and to repair as far as possible the severe losses of the Society. In the first place rooms were secured, fitted up and furnished for the Society's meetings, and for the temporary reception of the remains of the Library, and the wreck of the Museum, and an appeal was made to other Institutions of a similar nature with our own for contributions to enable us to commence the re-construction of our Museum.

The first meeting of the Society was held in our present rooms, on the 8th March. When it is borne in mind that the Council, had to provide, fit up and furnish the rooms, it will, we think, be admitted that no time was lost in providing the Society with the necessary accommodation. The fitting up and furnishing of the Society's rooms involved an outlay of a considerable sum, as compared with the resources of the Society, but the Council did not hesitate to assume the responsibility of incurring it, and notwithstanding the expenses thus entailed, and other extraordinary drains upon our finances, we have been almost enabled, from the increase of the number of our members during the year, to meet our expenditure from our ordinary resources.

It is with great pleasure we record that during the past year the Society has published two numbers of its Transactions. One of these is composed wholly of communications read before the Society many years back, the publication of which, after they had been placed in the printer's hand, had, for various reasons, been delayed. The other is made up of communications read before the Society during the last twelve or fifteen months.

A list of all the Papers read during the course of the past year is subjoined. The papers are principally upon subjects of a local and practical character. It is satisfactory to be able to add that, with scarcely an exception, an interesting paper, sometimes more than one, was read at each of the literary meetings. Those that have been selected for publication will be found to contain much valuable information. The Meteorological Observations alone will form a most important addition to the mass of information which is being collected, both in Europe and America, on the subject: more especially as the locality of Quebec appears to be peculiarly favourable for the examination of some of the most interesting Meteorological phenomena.

In connection with this matter, it may be mentioned that the Society has long been anxious to secure a building for its own use, where its Museum and Library might be deposited in safety, and in such a way as to be available, as heretofore, to the public generally, and in which we may be able eventually to establish an Astronomical and Meteorological Observatory in connection with and under the auspices of the Society.

In order to carry out these objects, the Council applied to the head of the Government for a grant of a portion of the Ordnance property on the north side of the Government Gardens in this city, sufficiently large for such a building as they thought necessary. We regret to say, that this application, although favourably received by the head of the Government here, has been refused by the Ordnance Department at home; the reason assigned that the ground may be required for military purposes, in the event of the Head Quarters of the Military Government of the Province being transferred to this city.

It is much to be regretted, for many reasons, that the prospect of being possessed of a building of our own is not likely soon to be realized; yet we hope that our successors in office will not be discouraged by the failure of our efforts in that respect—but that they will endeavour to devise some expedient for securing for the Society a local habitation, in the enjoyment of which they cannot be disturbed.

We have now to call the attention of the Society to an important step which has been taken by the Council since the commencement of the present Literary Session, with a view to bring the Society more prominently than heretofore before the public. We allude to the publication of the Monthly Proceedings of the Society in the columns of the *Canadian Journal* of Toronto. It had long been felt to be most desirable to publish regularly the ordinary proceedings of the Society at its general and stated, or literary meetings. The publication of the *Canadian Journal*, under the auspices of that young, but rapidly growing and most useful sister Society, the "Canadian Institute," of Toronto, seemed to the Council to present a most suitable medium for the publication of their proceedings. Upon being applied to for that purpose, the Council of the Institute expressed, in the most liberal manner, their desire to meet the wishes of the Society, and offered to allow an account of our Proceedings to appear gratuitously in the columns of their Journal. Since the commencement of the present Session our proceedings have accordingly been published in that Journal, the first publication being prefaced by a short sketch of the history and objects of the Society, furnished by the Council to the Editor at the request of the latter. The Council trust that their successors will see the expediency of keeping up the system of publishing our proceedings on the terms in every way advantageous to the Society.

It is gratifying to be able to state that the Legislature has considerably augmented the amount of the annual grant to the Society, having raised it from £50 to £250. It must, however, be observed that as an indemnity for our losses occasioned by fire, this sum is altogether inadequate. We think, however, we should not regard it in that light; and we have little doubt that if the Society continue to act with the energy and zeal which has marked the present Session, and, above all, if we evidence our existence to the outer world by the publication of useful papers, we shall have little difficulty in obtaining an equally liberal, or even a more liberal grant from the Legislature at its next Session.

One of the most satisfactory proofs of the progress which the Society has already made in public estimation, will be found in the number of members who have during the year been added to its lists. We cannot now give the precise number, but we are sure that they form a very considerable portion of the Society; and we believe we may add that among the recent additions will be found some of our most zealous and useful members.

On the whole, it seems to the Council that the review of the events of the past year presents much that is encouraging. It was indeed ushered in with a heavy disaster, but the effects of that disaster have been more than atoned for, by the zeal and energy of the Society; and at the end of the year we find our finances in a flourishing condition, our numbers rapidly augmenting, our Transactions enriched by two parts, our communications increased in number and importance, and our proceedings, for the first time for many years, published regularly and in such a shape as to bring the Society most favorably before the public.

We think, therefore, we have much reason to congratulate the Society on the manner in which it has struggled through the past year. In truth those trials and reverses should not be regarded as subjects of unmixed regret, for doubtless to them is due, in a great degree, the unusual spirit and energy which has characterized the Society during the last twelve months.

"Duris ut ilex tonsa bipennibus
Nigræ feraci frondis in Algido,
Per damna, per cœdes, ab ipso
Ducit opes, animumque ferro."

E. A. MEREDITH. L. L. B.
1st Vice President.

Quebec, January 10, 1855.

OFFICERS ELECTED FOR THE YEAR 1855

President:
E. A. MEREDITH, L L B.

Vice-Presidents—G. T. KINGSTON, A. M.; REV. A. W. MOUNTAIN, B. A.; W. D. CAMPBELL; LIEUT. H. G. SAVAGE, R. E.

Recording Secretary—HENRY E. STEELE.

Corresponding Secretary—A. R. ROCHE.

Council Secretary—N. R. BOWEN.

Treasurer—GEO. T. CARY.

Librarian—E. T. FLETCHER.

Curator of Museum—ROBT. H. RUSSELL, M.D.

Curator of Apparatus—LIEUT. E. ASHE, R.N., F.R.A.S.

Lieut T. C. Malony, R.A., and T. B. Harvey, Esq., were elected Associate Members of the Society.

LITERARY AND STATED MEETING.

WEDNESDAY, 18TH JANUARY.

A Paper was read by Lieut. H. G. Savage, R E., on the History of Quebec from the Earliest times.

HENRY E. STEELE,
Recording Secretary.

Address to the Governor-General.

On Friday, January 19th, the President and Members of the Literary and Historical Society, waited upon His Excellency the Governor General, at Government House Quebec, and presented the following

ADDRESS.

To His Excellency Sir Edmund Walker Head, Baronet, Governor General of British North America, and Captain General and Governor in Chief in and over the Provinces of Canada, Nova-Scotia, New-Brunswick and the Island of Prince Edward, and Vice Admiral of the same, &c.

MAY IT PLEASE YOUR EXCELLENCY,

We the President, Vice Presidents, and Members of the Literary and Historical Society of Quebec, desire respectfully to approach your Excellency to tender our sincere congratulations on your assumption of the Government of this important portion of Her Majesty's dominions.

We cannot but feel that, we, in common with the other inhabitants of this Province, have much reason to rejoice that Her Majesty should have selected for the Government of this Colony, one whose recent administration of the Government of a neighbouring and sister Colony has been marked with such distinguished success.

It is however as a Society separated from the strife of politics and devoted to the peaceful pursuits of History and Literature and to the advancement of the interests of Art and Science in the Province, that we conceive we have peculiar reason to hail your Excellency's elevation to the high position of Governor of British North America.

Your Excellency's well known devotion to and high attainments in the walks of literature and science, afford our Society an earnest that, while labouring to advance the physical interests of this great and growing country you will study equally to develope its moral and intellectual resources.

By the calamitous fire which destroyed the Parliament Buildings in this city, in the month of February last, the Society sustained a heavy blow in the loss of a large portion of its Library and nearly the whole of its extensive and well selected Museum of Natural History and Geology.

The efforts which the society is now making, to re-construct its Museum, and to repair the other losses then sustained, will, we feel assured, meet with your Excellency's sympathy and good wishes.

We venture to express the hope that, following the example of your Excellency's predecessors, since the foundation of the Society under the auspices of the Earl of Dalhousie, you will do the Society the honour of allowing yourself to be named its Patron.

In conclusion we beg to express our best wishes for the health and happiness of your Excellency, Lady Head, and family.

Quebec, January, 1855.

To which His Excellency was pleased to return the following

REPLY.

Mr. President and Gentlemen of the Literary and Historical Society of Quebec.

I esteem it an honour that you ask me to assume the position of Patron of your Society. But that honour is greatly enhanced by the flattering terms in which you address me on the present occasion. You overrate my literary attainments, but you do not overrate my wish to promote in every way the pursuits of literature and science. According to my firm conviction it is of the highest importance that these peaceful studies should hold their rightful place in the progress of a great and growing country. That they should mitigate the constant pressure of material interests, and soften down those harder tendencies which must always more or less characterize the outposts of advancing civilization. All institutions that tend to promote such objects in Canada are of the highest value, and among them your incorporated Society maintains a distinguished place. I thank you much for the congratulations, and your good wishes for the health and happiness of myself and my family.

The Temperature of the Cold Days of February 1855, at St. Martin's, Isle Jesus, Canada East.

(*Communicated by Dr. Smallwood.*)

The Thermometer at 10 p.m. on Saturday, 3rd February, stood 9°·0 Fahrenheit. On the

4th at 6,	a.m.	at	—14°·8	(or below zero)
2,	p.m.	...	—10°·3	do.
10,	p.m.	...	—22°·3	do.
5th at 6,	a.m.	...	—26°·1	do.
2,	p.m.	...	— 5°·5	do.
10,	p.m.	...	—20°·0	do.
6th at 6,	a.m.	...	—32°·6	do.
2,	p.m.	...	—18°·6	do.
10,	p.m.	...	—24°·5	do.
7th at 6,	a.m.	...	—33°·9	do.
2,	p.m.	...	— 6°·2	do.
10,	p.m.	...	—11°·0	do.
8th at 6,	a.m.	...	— 5°·1	do.
2,	p.m.	...	+ 5°·5	(above zero.)

On Charcoal as a Disinfectant.*

By MR. J. G. BARFORD,—*St. Bartholomew's Hospital.*

Dr. Stenhouse lately called attention to his very ingenious ori-nasal respirator, which depends on charcoal for its efficacy, the action of which is given in the *Journal of the Society of Arts*, for February, 1854. The respirator having been noticed in the *Lancet* of November 25, I need only mention it as an instance of the powerful disinfecting power of charcoal, but at once call attention to the plan I have adopted in the application of this agent as a disinfectant, bearing in mind the results of Dr. Stenhouse's experiments, which prove that charcoal not only

* From the *Lancet*, Dec. 16.

absorbs noxious vapours and putrescent odours, but at the same time oxidizes them, or in other words, makes them undergo a slow but sure combustion, which must have its end in the conversion of deleterious gasses into compounds whose physical and chymical properties would admit of an easy separation or removal from their bed of formation, and which on evolution would not be the least deleterous. I therefore, previous to its use, heated the charcoal thoroughly in a covered crucible with a small hole in its lid, to allow any oxidized material which it might contain to escape, taking care not to have the hole sufficiently large to allow the charcoal to undergo combustion; when thoroughly heated it was allowed to cool, so that on exposure to the air it should not oxidize; in this state it was put into shallow vessels, and placed wherever putrescent odours existed, and in a few minutes the whole of the smell disappeared; but in a day or two the charcoal lost its power. I then thoroughly heated it again, with the same precautions as before, and placed it to perform its duties a second time, which it did with as much efficacy as on the first application. Thus, by the repeated cleansing of the charcoal every or every other day, it does not deteriorate, but the same quantity will effectually remove noxious gases for an indefinite period of time.

With Mr. Holden's permission I was enabled to give it a most perfect trial in the dissecting-rooms of St. Bartholomew's Hospital, which at this time of the year must abound in noxious gases and putrescent odours. Thoroughly heating the charcoal, and planting it in shallow vessels about the rooms, it acted so promptly that in ten minutes not the least diffused smell could be detected, So quick and effectual was its action that arrangements are being made for its constant use. It answers just as well as a purifier of water closets, drains, wards of hospitals, and sick rooms. As a purifier of hospital wards, both civil and military, it might be applied with great advantage, saving patients from the unpleasant smells and effluvia of gangrenous sores, and for this purpose a wire gauze construction, containing the charcoal, might made to surround the affected part at some distance from the dressing, thus the patient himself and those in adjacent beds would not be subjected to the influence of the putrescent odours. All these the charcoal would effectually absorb, doubtless with advantage to the patient and neighbors also. Other quantities of charcoal might be placed in shallow vessels about the wards, and purified every morning, as above mentioned. Being at the command of the poor as well as the rich, it admits of universal use; and, though it may be objected to as a purifier of the wards of hospitals and chambers of the sick, under the fallacious notion that it would emit carbonic acid, and also on undergoing its daily cleansing would again give off the absorbed gases, yet this notion can never enter the minds of those who understand its action, seeing that carbonic acid cannot be generated unless the charcoal is heated in free contact with the air. This is prevented by having a covered crucible in which it can be heated to any temperature without undergoing combustion; and the supposition that the absorbed gases are given off again when the charcoal is heated will be removed by the fact that they are all oxidised, and converted into sulphuric, nitric, or carbonic acid, and water, &c., and the heating of the charcoal is for the whole and sole purpose of removing these bodies, which exist in so small a quantity that they could not be the least prejudicial, even if driven off in the centre of an inhabited room; but, of course, they all pass up the chimney. Thus charcoal is more efficacious than any other disinfectant when applied as above described, absorbing gases of whatsoever kind, not requiring the presence of any other substance to resist its action, but without stint or scruple collecting noxious vapours from every source, not disguising, but condensing and oxidising the most offensive gases and poisonous effluvia, converting them into simple, inert, stable compounds; it is simple and economical, coming within the reach of the poorest, and can safely be placed in the hands of the most ignorant, thus combining advantages not possessed by any other disinfectant.

Production and Consumption of Iron.

A comparison of the quantities of iron produced in different countries during the twenty years ending with 1850, shows that the production of

Great Britain increased	244 per cent.
United States of America	171 "
France	141 "
German Customs Union	60 "
Austria	130 "
Belgium	217 "
Russia	20 per cent.
Sweden	51 "

and thus the production has increased more rapidly in every country than in Sweden, with the single exception of Russia.

During the year 1850

In the United States of America the consumption was	per head	88 lbs.
Great Britain	"	81
France	"	36
Hanover and Oldenburg	"	29
German Customs Union	"	24
Switzerland	"	18
Sweden	"	11½
Austria	"	11
Russia	"	8

Exports of British Iron, including Unwrought Steel, but not including Machinery and Mill-work.

Where to.	Years 1851.	1852.
	Tons.	Tons.
Colonies	159,709	141,460
United States	464,559	501,158
Other Countries	295,211	393,266
Total Tons	919,479	1,035,884

HARDWARE AND CUTLERY.

	£	£
Colonies	527,879	704,655
United States	1,080,487	968,493
Other Countries	1,218,645	1,018,549
Total	2,827,011	2,691,697
Quantity ... Tons	27,625	25,290
Total Value of Exports ... £	28,594,961	Incomplete.

On Some Stereoscopic Phenomena.

BY M. DOVE.

The author was chiefly induced to draw the attention of the Section to this subject in consequence of Sir David Brewster, who he greatly regretted was not at this meeting, having denied at the Belfast Meeting the soundness of the explanation which the author had given of the cause of the appearance of those bodies which exhibited the metallic lustre. This, he considered to arise from the superficial layers of particles being highly, though still imperfectly, transparent and permitting the inferior layers to be seen through them. This effect we see produced when many watch-glasses are laid in a heap, or when a plate of trasparent mica or taic being heated red hot is thus separated into multitudes of thin layers, each of which, of inconceivable thinness, is found to be highly transparent, while the entire plate assumes the lustre of a plate of silver. This explanation receives a very striking confirmation from the stereoscopic phenomena which he now drew attention to. He then presented to the Section and described a very simple and portable modification of the stereoscope, consisting of two lenticular prisms mounted in a frame like a double eye-glass. Upon examining with this two diagrams drawn one for the right, the other for the left eye, with lines suited to give the idea when viewed together of a pyramid, cube, cone, or other mathematical solid, but the lines on one drawn on a white ground, the other on a dark or coloured ground, on viewing them together the solid appeared with the metallic lustre. The author termed it "Glance." This, he conceived, demonstrated his original idea to be correct.

An Earthquake.

On the morning of the 8th February, 1855, about 7 A.M., the shock of an earthquake was felt at St. John's, Fredericton, and St. Stephens, New Brunswick; at Halifax, Windsor, and Picton, Nova Scotia; and at Charlottetown, Prince Edward Island. Several shocks have been felt, from the 1st February to the 19th, in many parts of the Union and the British Provinces.

Monthly Meteorological Register, at the Provincial Magnetical Observatory, Toronto, Canada West.—January, 1855.

Latitude, 43 deg. 39.4 min. North. Longitude, 79 deg. 21. min. West. Elevation above Lake Ontario, 108 feet.

Day.	Barom. at temp. of 32 deg.				Temp. of the Air.				Mean Temp. + or — of the Average	Tension of Vapour.				Humid'y of Air.				Wind.				Rain in Inch	Snow in Inch.
	6 A.M.	2 P.M.	10 P.M.	Mean.	6 A.M.	2 P.M.	10 P.M.	M'N.		6 A.M.	2 P.M.	10 P.M.	M'N	6 A.M	2 P.M	10 P.M	M'N	6 A.M.	2 P.M.	10 P.M.	Mean Vel'y		
1	29·998	30·003	29·998	30·011	27·4°	28·7°	28·5°	28·4°	+ 3·2°	0·131	0·127	0·129	0·129	·88	·80	·81	82	E b N	E	E b N	9·79	...	...
2	30·006	30 004	30·020	30·011	28·7	38·2	35·5	33·9	+ 8·6	·137	·137	·177	·148	87	60	80	77	E	E	E b N	5·39	...	...
3	30 026	29·991	29·888	29·963	33·7	44 5	37·5	38·0	+12·9	·149	·226	·184	·181	77	78	82	80	E b S	S E	Calm	1·60	...	...
4	29 797	·965	30·261	30·024	41·0	48 2	28·4	38·1	+13·0	·215	·319	·136	·210	81	95	87	88	Calm	NWbW	N b W	3·40	0·070	...
5	30 382	30·333	30·181	30·271	24·4	31 5	28·7	28·2	+ 3·0	·111	·145	·132	·132	82	81	82	84	Calm	E b N	E b N	10·93	0·040	...
6	29·975	29·898	29 799	29·881	35 5	45 8	44·9	41 9	+16·7	·192	·248	·269	·235	93	82	91	89	E b N	S S E	S E b S	4·40	0·015	...
7	·785	30·030	—	—	47·0	36·0	—	—	—	·312	·180	—	—	98	88	—	—	S W	W S W	—	9·40	...	...
8	30·552	30·454	30 279	30·394	21 9	33 2	30·2	27·6	+ 2 5	·103	·111	·150	·123	84	59	89	80	Calm	Calm	Calm	0·43	...	...
9	30·065	30·020	30·088	30·067	26·6	39·1	29·9	31·7	+ 6·6	·123	·138	·141	·131	83	58	84	73	Calm	W b S	Calm	6·32	...	...
10	30·275	30·213	29·935	30·127	21·1	25·1	24·1	23·2	— 1·8	·103	·114	·115	·108	89	82	80	81	N	S E b E	E S E	4·87	...	0 2
11	29·603	29·414	·302	29·427	25·1	31·8	31·0	30 0	+ 4 9	·121	·151	·162	·150	87	85	94	90	Calm	Calm	S W b S	1·55	0 040	...
12	·287	·291	·134	231	34·8	39·5	37·6	37·3	+12·2	·168	·205	·222	·199	84	86	99	90	Calm	Calm	Calm	0·00	...	0 2
13	·026	·316	·728	·104	30·9	25·1	14·7	21·9	— 3·2	·158	·076	·072	·096	92	55	80	75	N W	NWbW	NWbW	18·50	...	...
14	·903	·780	—	—	−4·7	16·0	—	—	—	·028	·076	—	—	73	74	—	—	N b E	S S W	—	6·92	...	0·2
15	·480	·496	·621	·539	24·4	29·2	25·6	26·4	+ 1 3	·089	·133	·125	·115	65	81	89	78	W S W	W b S	NWbW	3·82	...	0·7
16	·619	·712	·714	·691	17·2	25·1	24·8	22·3	— 2·7	·090	·105	·120	·106	91	76	88	85	N E b N	Calm	S E	4·02	...	0·3
17	·390	·304	·364	·350	29·4	38·4	33·0	33·6	+ 8·5	·139	·189	·173	·165	86	81	93	86	E	Calm	Calm	3·95	...	...
18	·393	·467	·537	·469	30 2	36·3	29·8	31·1	+ 6·1	·156	·138	·140	·137	89	64	84	78	Calm	SW b W	NWbW	7·94	...	Inap.
19	·558	·501	·475	·505	26·6	28·4	21 9	25·3	+ 0 5	·134	·105	·085	·109	91	66	70	78	W N W	N W	Calm	5·73	...	...
20	·332	·333	·483	·389	22·3	27·3	29 5	26·6	+ 1·8	·110	·127	·152	·131	88	84	94	89	Calm	N N W	SW b W	1·00	...	Inap.
21	·529	·231	—	—	27·7	28·0	—	—	—	·131	·134	—	—	86	87	—	—	N b E	E N E	—	14·40	0·360	3·0
22	28·717	·036	·411	·097	29·1	25 1	14·0	21 0	— 3·7	·149	·126	·078	·107	94	87	89	89	W S W	SW b W	SW b W	17·39	...	...
23	29.571	·621	·688	·633	5·4	15·1	10·4	9·9	—14·7	·056	·067	·065	·060	90	73	88	81	W	W S W	W b N	6·77	...	...
24	·676	·662	·712	·687	3·6	20·2	8·8	10·4	—14·2	·047	·072	·036	·051	84	64	52	67	Calm	W S W	Calm	2·90	...	...
25	·693	·495	·328	·482	4·0	22·6	21·9	16·8	— 7·9	·053	·103	·102	·086	92	82	84	83	Calm	N W	N	7·87	...	7·0
26	·124	·066	·042	·076	18·3	21·5	10·1	17·0	— 7·5	·091	·101	·064	·087	88	84	88	88	N	N	N N W	15·87	...	3·5
27	·131	·197	·334	·234	12·9	19·9	16·4	16·1	— 8·3	·063	·076	·086	·074	76	69	90	76	W N W	W N W	W S W	13·91	...	0·1
28	·348	·314	—	—	14·0	27·3	—	—	—	·075	·130	—	—	85	90	—	—	W N W	E b S	—	10·52	...	5·5
29	28·917	·034	·247	·080	26·9	23·3	20 2	23 3	— 0·9	·137	·115	·101	·117	93	89	90	91	N b E	S W b S	SW b W	16·52	...	2·0
30	29·385	·439	·593	·492	16·5	21 5	21 2	19 8	— 4 3	·076	092	·103	·092	78	77	88	83	SW b W	SW b W	W S W	14·58	...	0·4
31	·686	·741	·774	·730	22·8	26 9	16·7	20·9	— 3·1	·111	·121	·073	·096	87	81	74	81	W S W	N N W	N	7·20	...	0·2
M	29·617	29 630	29 664	29 639	23 7	30.1	25 0	25·9	+ 1 1	0 119	0 130	0 126	0 125	86	76	85	82	6 93	8 22	7 23	7 67	0·525	23·3

Highest Barometer...... 30 552, at 6 a. m. on 8th } Monthly range.
Lowest Barometer....... 28 717, at 6 a.m. on 22nd } 1 835 inches.
Highest registered temperature 49°·0, at a.m. on 7th } Monthly range:
Lowest registered temperature —5° 4, at a.m. on 14th } 54° 4.
Mean Maximum Thermometer.............. 32° 83 } Mean daily range:
Mean Minimum Thermometer.............. 17° 54 } 15° 29.
Greatest daily range.........35°·0, from a.m. of 13th to a.m. of 14th.
Least daily range .... 5°·6, from p.m. of 1st, to a.m. of 2nd.
Warmest day....... 6th. Mean temperature...... 41°·87 } Difference,
Coldest day......... 23rd. Mean temperature...... 9°·95 } 31°·92.
Greatest intensity of Solar Radiation, 54°·0 on p.m. of 3rd } Range,
Lowest point of Terrestrial Radiation, —7°·8 on a. m. of 14th } 61°·8.
Aurora observed on 1 night: viz. 24th.
Possible to see Aurora on 8 nights.
Impossible to see Aurora on 23 nights.
Raining on 5 days. Raining 9·8 hours; depth, 0·525 inches.
Snowing on 13 days. Snowing 70·1 hours; depth 23·3 inches.
Mean of Cloudiness, 0·79.

Sum of the Atmospheric Current, in miles, resolved into the four Cardinal directions.

North.	West.	South.	East.
1437·11	2890·78	1200·84	1525·57

Mean direction of the Wind, W 10° N.
Mean velocity of the Wind, 7·67 miles per hour.
Maximum velocity, 31·3 miles per hour, from 9 to 10 a. m. on 21st.
Most windy day, the 13th; mean velocity, 18·50 miles per hour.
Least windy day, the 12th; mean velocity, 0·00 " "

The early part of this month was remarkably fine and mild, being distinguished by very high readings of the Barometer. On the 8th, at 6 a.m., the reading was 30°·552, being the highest on record, and the mean for that whole day 30°·3942, is also the highest recorded. A *great depression succeeded, reaching its lowest point between the 21st* and 22nd, from which period the character of the weather changed to cold and stormy, with downfalls of snow, high winds prevailing for the *next 14 days, and giving a mean velocity for that period of 11 48 miles* per hour.

The monthly range of the Barometer (1 835 inches) is the greatest recorded. the temperature on the whole is 1° 6 above the average, and the fall of rain is 1·176 inches less, and that of snow 9·9 inches more than the mean of 15 years.

Comparative Table for January.

Year.	Temperature.					Rain		Snow.		Wind. Mean Velocity.	
	Mean.	Dif. from Av'ge.	Max. obs'vd	Min. obs'vd	Range	D's.	Inch.	D's.	Inch.		
1840	17·0	—7·3	40·6	—13·8	54·4	4	1·395	11	...	...	
1841	25 6	+1·3	41·7	— 4·1	45·8	2	2·150	14	...	0·36	lb.
1842	27·9	+3·6	45·8	+ 1·3	44·5	5	2·170	9	...	0·78	lb.
1843	28·7	+4·4	54·4	+ 1·5	52·9	6	4·295	12	14·2	0·69	lb.
1844	20·2	—4·1	44·6	— 7·7	52·3	7	3·005	11	24·8	0·70	lb.
1845	26·5	+2·2	43·0	— 3·4	46·4	5	Impf.	9	22·7	0·70	lb.
1846	26·7	+2·4	41·2	+ 0·3	40·9	5	2·335	10	6·0	0·55	lb.
1847	23·3	—1·0	42·6	— 2·2	44·8	7	2·135	5	7·5	1·09	lb.
1848	28·7	+4·4	51·5	—12·0	63·5	7	2·245	8	7·1	5·82	Miles.
1849	18·5	—5·8	40·1	—15·2	55·3	4	1·175	10	9·2	6 71	Miles.
1850	29·7	+5·4	46·3	+10·6	35·7	5	1·250	8	5·2	5 80	Miles.
1851	25 5	+1·2	43·2	—12·8	56·0	4	1·275	10	7 8	7·69	Miles.
1852	18 4	—5·9	37·3	— 7·0	44·3	0	0·000	19	30·9	7·67	Miles.
1853	23·0	—1·3	40·9	— 6·6	47·5	1	0·290	6	7·5	6·34	Miles.
1854	23·6	—0·7	45·2	— 4·3	49·5	7	1·270	11	7·5	6·86	Miles.
1855	25·9	+1·6	48·2	— 4·7	52·9	5	0·525	13	23·3	7·67	Miles.
										0·70	lbs.
M'n.	24·32		44·16	—5·01	49·17	4·6	1·701	10·4	13·4	6·82	Miles.

Monthly Meteorological Register, St. Martin, Isle Jesus, Canada East.——January, 1855.

NINE MILES WEST OF MONTREAL.

BY CHARLES SMALLWOOD, M.D.

Latitude—45 deg. 32 min. North. Longitude—73 deg. 36 min. West. Height above the Level of the Sea—118 Feet.

Day.	Barom. corrected and reduced to 32° Fahr.			Temp. of the Air.			Tension of Vapor.			Humidity of Air.			Direction of Wind.			Velocity in Miles per Hour.			Rain in Inch.	Snow in Inch.	Weather, &c. A cloudy sky is represented by 10; A cloudless sky by 0.		
	6 A.M.	2 P.M.	10 P.M.	6 A.M.	2 P.M.	10 P.M.	6 A.M.	2 P.M.	10. P.M.	6 A.M.	2 P.M.	10 P.M.	6 A.M.	2 P.M.	10 P.M.	6 A.M.	2 P.M.	10 P.M.			6 A.M.	2 P.M.	10 P.M.
1	30·390	30·505	30·500	4·8	17·2	7·6	·051	·089	·062	·85	·84	·90	N W b N	E N E	N E b E	Calm	0·92	1·51	...	...	Clear.	Cir. Cum. 4.	Cir Cum. 5.
2	30·511	30·490	30·462	2·2	10·0	5·2	051	062	058	95	80	90	N E b E	N E b E	N E b E	6·25	16·00	3·75	...	...	Cir. Str. 6.	Cir. Str. 10.	Light Cir.*
3	30·122	30·411	30·339	9·0	34·1	25·1	067	204	129	91	94	81	N E b N	S E b S	S E b S	10·73	Calm	Calm	...	...	Clear.	Clear.	Clear.
4	30·195	30·140	30·292	11·7	34·1	36·4	085	204	210	88	94	90	S E	N E	W	Calm	Calm	0·81	Inap.	...	Fog.	Hazy.	Str. 10.†
5	30·706	30·614	30·540	14·6	32·1	28·4	101	191	161	94	91	89	N E b N	N E b N	N E b N	3·62	Calm	0·05	...	...	Clear.	Clear.	Cir. 4 P.M.
6	30·561	30·585	30 386	26·2	30·1	32·1	160	177	191	96	95	96	N E b N	S S E	S S E	11·24	4 85	6·27	...	...	Str. 8.	Sleet.	Cir. Str. 4.
7	30·150	30·142	30·300	37·2	38·0	34·7	218	236	203	99	96	94	S S E	S S E	W b S	10·92	5·62	3·91	0·080	...	Do. 9.	Rain.	Cir. Str. 9.
8	30·685	30·651	30·721	21·2	32·4	18·4	118	191	117	88	87	93	W b N	W b N	W b S	11·65	0·76	1·12	...	...	Clear.	Clear.	Clear.
9	30·330	30·198	30·145	11·4	29·0	32·6	090	156	182	92	87	91	N E	E	W S W	0·03	Calm	1·12	...	...	Str. 9.	Str. 4.	Do.
10	30·550	30·524	30.341	3·0	12·6	0·6	048	078	043	84	90	90	N W b W	W N W	W	12·77	2·90	Calm	...	...	Clear.	Clear.	Do. Auro. Bor.
11	29·999	29·846	29·560	– 0·2	12·1	15·6	044	061	088	95	70	91	N E	N E b E	E N E	0·82	1·11	Calm	...	...	Str. 9.	Do.	Str. 10.
12	·611	·584	·600	17·0	36·4	26·4	102	218	154	86	90	91	N E	N E b E	N E b E	0·25	Calm	0·25	...	1·60	Do. 2.	Snow.	Do. 10.
13	·280	·141	·694	37·0	37·9	9·4	220	226	060	94	90	80	S b E	W	W N W	4·62	4·93	16·85	0·516	...	Rain.	Rain.	Clear.
14	30·090	30·085	30·080	–16·5	– 5·6	– 9·0	020	038	029	90	89	94	W b N	W	W	26·42	10·13	18·46	...	...	Clear.	Clear.	Do.
15	29.784	29·846	29·900	– 5·0	6·0	6·2	031	059	060	85	90	96	N E b E	N E b E	N E b E	3·68	1·46	Inap.	...	3·00	Snow.	Snow.	Str. 8.
16	30·040	30·039	30 060	– 0·8	8·0	7·5	044	063	062	90	89	92	N E b E	N E b E	N E b E	6·36	6·43	11·20	...	Inap.	Str. 10.	Sl'gt snow.	Do. 10.
17	30·020	29·845	29·781	7·3	14·8	29·0	062	087	159	93	90	96	N E b E	N E b E	S b E	8·89	7·50	5·00	...	1·60	Do. 10.	Snow.	Do. 10.
18	29·750	·698	·680	20·6	23·3	20·1	112	125	110	98	95	96	N E b E	N E	N E b N	3·73	4·16	11·62	...	Inap.	Do. 8.	Sl't snow.	Do. 10.
19	·610	·510	·521	23·9	29·2	28·9	125	159	139	95	96	96	N W b W	N W b W	W N W	4·00	0·51	5·18	...	...	Do. 10.	Str. 10.	Do. 10.
20	·501	·500	·546	20·0	29·4	28·6	110	159	145	94	93	89	W b N	W b N	W b N	13·88	0·14	1·11	...	...	Do. 10.	Do. 6.	Do. 10.
21	·881	·880	·719	20·1	28·6	22·5	118	170	136	88	94	94	N E b E	N E b E	N E b E	1·07	1·51	2·41	...	...	Cir. Str. 8.	Cum. Str. 4.	Snow.
22	·050	·060	·470	35·0	33·0	20·0	213	178	107	94	86	82	S E	W S W	W S W	14·68	6·52	18·75	0·840	1·20	Rain.	Cum. Str. 4.	Clear.
23	·833	·891	.910	11·0	23·6	20·0	082	135	114	88	90	87	W	S W b W	S W b W	6 25	0·70	0·70	...	...	Cir. Str. 4.	Cir. 2.	Cum. Str. 8.
24	30·001	30·050	·985	10·0	24·5	11·0	079	115	087	88	80	92	S	S S E	N E b E	7·12	Calm	Inap.	...	...	Clear.	Clear.	Clear.
25	29·935	29·900	·836	1·0	25·0	12·0	018	104	043	90	70	89	N E b N	N E b N	N E b E	Calm	Calm	Calm	...	...	Cir. Str. 4.	Do.	Str. 10.
26	·690	·536	·240	9·6	15·1	15·0	068	088	088	90	93	94	N E b E	N E b E	N E b E	2·64	2·63	27·46	...	...	Str. 10.	Snow.	Snow.
27	·092	·210	·450	18·1	28·4	5·0	106	152	058	94	96	98	W N W	W S W	W S W	18.32	12·27	4·28	...	11·30	Snow.	Do.	Clear.
28	·750	·871	·890	9·0	15·3	11·9	067	081	075	94	85	90	S W b S	N E b E	N E b E	Calm	0·37	7·00	...	...	Str. 10.	Cir. Str. 4.	Cir. 2.
29	·521	·340	·505	16·2	3·2	27·0	091	191	119	94	93	84	N E b E	N E b E	W S W	23·62	11·62	9·29	...	1·40	Snow.	Cir. Cum. Str. 4	Cir. Cum. 4.
30	·630	·630	·660	18·0	29·0	19·2	106	152	117	87	85	93	S b W	W S W	S W	12·39	4·37	21·50	...	...	Cum. Str. 10.	Cum. Str. 4.	Cum. Str. 6.
31	·795	·840	·948	17·4	18·2	4.6	106	105	051	88	87	89	W S W	W N W	N W	16·80	11·25	12·73	...	...	Do. 4.	Do. 2.	Cir. 2.‡

Barometer ....
- Highest, the 8th day .... 30·721
- Lowest, the 22nd day .... 29·050
- Monthly Mean .... 29·926
- " Range .... 1·671

Thermometer.
- Highest, the 7th day .... 41°·7
- Lowest, the 14th day .... —16°·5
- Monthly Mean .... 17°·88
- " Range .... 61°·2
- Mean Humidity .... ·897

Greatest Intensity of the Sun's Rays .... 111°·8

Rain fell on 4 days, amounting to 1·436 inches. Raining 25 hours, 5 minutes.

Snow fell on 8 days, amounting to 20·10 inches. Snowing 78 hours 10 minutes.

Most prevalent Wind, N.E. b E. Least prevalent Wind, E.

Most Windy Day, the 14th day; mean miles per hour, 18·33.

Least Windy Day, the 25th day; mean miles per hour, 0.00

Aurora Borealis visible on 1 night. Might have been seen on 14 nights.

Lunar Halo visible on 2 nights.

Slight shock of an Earthquake on the 13th day, at 5·40 a.m.

The Electrical state of the atmosphere has been marked by moderate intensity, and during the snow storm of the 15th and 27th, indicated a high tension of a negative character.

The amount of *Ozone* has been rather less than usual.

* Lunar Halo, diameter 44°·4. † Rain at 5·40 p.m. ‡ Lunar Halo, diameter 74°·0

Monthly Meteorological Register, Quebec, Canada East, January, 1855.

BY LIEUT. A. NOBLE, R.A., F.R.A.S., AND MR. WM. D. C CAMPBELL.

Latitude. 46 deg. 49·2 min. North; Longitude, 71 deg. 16 min. West. Elevation above the level of the Sea,—Feet.

Date	Barometer corrected and reduced to 32 degrees, Fahr. 6 A.M.	2 P.M.	10 P.M.	MEAN.	Temperature of Air. 6 A.M.	2 P.M.	10 P.M.	MEAN.	Elasticity of Air. 6 A.M.	2 P.M.	10 P.M.	MEAN.	Humid'y of Air. 6 A.M.	2 P.M.	10 P.M.	M'N	Direction of Wind. 6 A.M.	2 P.M.	10 P.M.	Velocity of Wind. A.M.	P.M.	10 P.M.	Rain in Inch.	Snow in Inch.
					°	°	°	°																
1	30·233	30·369	30·478	30·360	0·4	10·1	8·1	6·2	0·042	0·066	0·096	0·068	87	91	63	80	Calm.	E N E	E N E	0·0	6·2	7·2	...	...
2	30·530	30·171	30·419	30·483	4·2	10·0	13·9	9·4	·095	·063	·081	·081	53	86	96	78	E N E	N E	N N W	13·9	14·3	8·8	...	...
3	30·369	30·232	30·166	30·256	18·3	27·3	26·1	23·9	·081	·126	·131	·113	82	84	90	85	Calm.	S W	N W	0·0	3·8	3·8	...	...
4	30·110	29·962	30·046	30·039	22·5	33·0	31·8	30·1	·120	·167	·194	·160	96	89	96	94	W	S W	Calm.	3·8	2·0	0·0	·198	...
5	30·328	30·595	30·730	30·551	21·0	17·8	11·6	16·8	·106	·089	·071	·089	90	86	91	89	N N E	Calm.	N E	11·3	0·0	7·2	·052	Inap
6	30·695	30·190	30·827	30·504	9·7	16·2	21·1	15·7	·100	·077	·115	·097	70	80	99	86	N E	E N E	Calm.	16·0	17·9	0·0	...	...
7	30·115	29·819	30·009	29·981	32·5	43·7	35·7	37·3	·163	·234	·188	·195	89	84	90	88	Calm.	W	W	0·0	2·0	10·1	·092	...
8	30·302	30·536	30·559	30·466	26·1	23·8	17·0	22·3	·108	·086	·088	·094	75	66	89	77	W	W	S W	26·6	5·2	3·8	...	...
9	30·318	30·037	29·840	30·065	12·6	23·7	25·8	20·7	·075	·105	·128	·103	91	80	89	87	N	Calm.	W N W	2·0	0·0	7·2	...	...
10	30·110	30·326	30·220	30·218	6·1	− 0·2	− 3·4	0·8	·026	·035	·036	·032	42	75	90	69	W	W N W	W	27·8	11·5	3·8	...	...
11	30·008	29·705	29·556	29·756	− 2·6	12·9	17·5	9·3	·038	·065	·081	·061	87	78	80	82	N W	S W	Calm.	2·0	2·0	0·0	...	1·1
12	29·442	·533	·531	·502	22·6	27·6	25·8	25·3	·120	·142	·129	·130	96	93	92	94	Calm.	Calm.	E N E	3·0	0·0	13·4	...	1·2
13	·260	28·968	·396	·208	29·2	33·2	0·8	21·1	·146	·169	·018	·121	91	89	95	92	E N E	Calm.	N W	11·3	0·0	21·3	·689	...
14	·663	29·855	·957	·825	−11·3	−10·1	−10·9	−10·8	·027	·026	·025	·026	93	87	87	89	N W	W N W	W N W	16·0	13·9	3·8	...	...
15	·851	·656	·793	·766	− 7·8	6·0	8·3	2·2	·033	·059	·066	·053	94	94	96	95	Calm.	N E	N E	0·0	2·0	8·8	...	3·0
16	·965	30·021	30·070	30·019	2·9	4·8	6·1	4·6	·040	·059	·063	·054	76	98	100	91	N E	N E	N E	11·3	25·4	19·7	...	0·5
17	30·077	29·975	29·852	29·968	5·8	9·7	13·2	9·6	·062	·070	·077	·070	100	96	91	96	N E	N E	N N E	22·7	27·8	22·7	...	2·0
18	29·793	·708	·590	·697	15·4	18·2	21·8	18·5	·090	·104	·116	·103	97	100	96	98	N E	N E	N E	13·9	27·8	39·2	...	15·0
19	·160	·279	·272	·337	28·0	28·6	28·2	28·3	·145	·137	·129	·137	95	87	83	88	N	N E	N E	11·3	42·5	9·3	...	6·0
20	·245	·260	·374	·293	25·9	28·5	21·8	26·4	·134	·134	·116	·128	94	86	85	88	Calm.	W N W	W N W	0·0	3·8	3·8	...	1·8
21	·528	·773	·690	·664	24·0	23·1	24·0	23·7	·112	·098	·115	·108	84	77	86	82	N W	Calm.	N E	3·8	0·0	7·2	...	2·0
22	·276	28·882	·324	·143	26·4	38·5	24·8	29·0	·134	·225	·102	·154	92	97	75	88	N E	N E	W N W	42·5	25·4	22·7	·528	0·6
23	·616	29·721	·856	·741	13·0	18·9	14·4	15·4	·074	·079	·086	·080	88	74	97	86	W S W	W S W	Calm.	6·2	3·8	0·0	...	...
24	·923	·873	·844	·880	6·7	17·2	12·9	12·3	·056	·085	·076	·072	87	84	91	87	S	N N E	Calm.	2·0	3·8	0·0	...	...
25	·806	·733	·746	·762	4·8	15·3	15·4	11·8	·059	·079	·084	·074	100	85	88	91	Calm.	Calm.	Calm.	0·0	0·0	0·0	...	...
26	·706	·556	·224	·495	6·6	15·5	14·6	12·2	·062	·067	·090	·073	97	73	100	90	Calm.	N E	N E	0·0	30·1	34·1	...	4·0
27	28·768	28·920	·336	·008	20·3	25·1	12·1	19·2	·113	·120	·074	·102	98	87	92	92	N E	W S W	W S W	50·8	3·8	7·2	...	2·5
28	29·631	29·817	·900	·783	5·2	14·1	14·4	11·2	·061	·075	·084	·078	98	84	95	92	Calm.	Calm.	Calm.	0·0	0·0	0·0	...	...
29	·761	·423	·270	·485	19·4	29·0	34·9	27·8	·107	·136	·178	·140	98	84	89	90	N E	E N E	Calm.	50·8	48·1	0·0	·100	1·0
30	·476	·421	·450	·449	25·0	24·6	20·8	23·5	·106	·102	·094	·101	80	75	82	79	S W	S	S W	11·3	3·8	10·0	...	0.4
31	·505	·555	·760	·607	18·7	16·8	3·8	13·1	·081	·073	·044	·067	80	74	78	77	N W	W N W	Calm.	11·3	21·3	0·0	...	...
	29·835	29·788	29·826	29·8161	13·92	19·45	16·72	16·70	0·088	0·102	0·097	0·096	87	85	89	87				10·70	11·17	8·87	1·609	41·1

REMARKS.

5th. Corona round moon at 10 p.m. Found that at 15 feet above the level of the high water mark the reduced height of the Barometer at 10 p.m. was 31·058 inches.

8th. Lunar Halo 50° in diameter at 12 p.m.

9th. Aurora observed at 2 a.m., not visible at 11*h.* 30*m.* p.m.

13th. Between 7 p.m. and 8*h.* 30*m.* p.m. the Thermometer fell 23°.

22d. At 3*h.* 30*m.* p.m. wind which was blowing a gale from N. E. suddenly changed to the N. W. blowing with equal force.

28th. Lunar Halo 25° in diameter at 9 p.m.

29th. Between 9 and 10 p.m. thunder and lightning with heavy rain and wind, at 10 p.m. wind suddenly became calm.

Maximum Barometer, 10 p.m. on the 5th	30·730
Minimum Barometer, 6 a.m. on the 27th	28·768
Monthly Range	1·962
Monthly Mean	29·8164
Maximum Thermometer on the 7th	46° 0
Minimum Thermometer on the 14th	—14·3
Monthly Range	60·3
Mean Maximum Thermometer	23·39
Mean Minimum Thermometer	8·07
Mean Daily Range	15·32
Mean Monthly Temperature	16·70

Greatest Daily Range of Thermometer on 13th	48°·5
Least Daily Range of Thermomter on 19th	3°·5
Warmest Day, 7th. Mean Temperature	37·3
Coldest Day, 14th. Mean Temperature	—10·77
Clim[illegible]ic Difference	48·07

Possible to see Aurora on 10 Nights.
Aurora visible on 4 Nights.
Total quantity of Rain, 1·609 inches.
Total quantity of Snow, 41·1 inches.
Rain fell on 6 days.
Snow fell on 15 days.