DO THE CHANGES OF THE MOON AFFECT THE RAINFALL?

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The idea that the changes of the moon do affect the rainfall has widely prevailed from the earliest ages. Thus the Roman poet Virgil :—

"And that by sure prognostics we may know
Both heat and rain and cold-compelling winds,
The Sire himself has fixed the monthly course
Of lunar indications; by what sign
To read the sinking south; what, oft observed,
Should teach the farmer to retain his herds
Within the sheltered precincts of the stall."

Georg I., 351 seqq., Dear's trans.

"Nor less are showerless suns and open sky
Serene by certain signs fore-known; for then
Nor dimly seem the blunted stars to shine,
Nor rises Luna to her brother's beams
Indebted: then nor through the vault of heaven
Sail fleecy clouds; nor to the genial beam
Do Thetis' halcyons spread their azure wings.

* * * *

When the moon,
Collecting first her renovated fires,
A gloomy mist within her horns includes,—
Then on the husbandman and on the deep
Impends a heavy rain; but, if she rise
Her face suffused with virgin blushes, wind
Awaits; the wind on golden Phœbe's cheek
Ever excites a blush; but should she take
At her fourth rising (mark the surest sign)
Her course through heaven's ætherial way with clear
Unclouded aspect, nor with horns obtuse,
Then that whole day and those from thence derived,
E'en to the finished month, shall roll exempt
From wind or rain; and, on the shore secure,
The storm-scaped mariner shall pay his vows
To Glaucus, Panope, and Ino's son."

Ib., 393 seqq.

Ages before, the Babylonian Government astronomers in their reports, which they furnished daily, have such entries as these respecting the supposed influence of the heavenly bodies on the weather :—

"The star of the upper sphere aforesaid causes fog and rain."

"The star Lulu portends extended mists."

"The star of the Wolf portends tempest."

"The stars at sunrise are for windy rain and flood."

Sailors especially are great believers in the influence of the moon on the weather.

I believe it will be found that, where ideas have become deeply rooted and widely spread, it is very seldom, if ever, that they have not some foundation in fact, though the fact may have been distorted, and the truth more or less obscured.

We have been assured, however, by some whose names carry great weight, and whose statements on such matters we should not venture to question, except on the clearest evidence, that the popular notion is a mere delusion, and that the moon's changes have no influence on the weather.

Dr. R. J. Mann, vice-president of the Meteorological Society, in an article on "High Clouds and Moonshine," in "Science for All," part 52, says:—"Amongst the long prevalent notions that have been held concerning the changes of the weather, there are, perhaps, none that have been more generally entertained and cherished than those which connect them with what are termed the changes, or, in other words, recurring phases of illumination of the moon. These notions, in all probability, were in the first instance derived from the accidental coincidence of certain marked conditions of weather with particular aspects of the moon, and from the natural tendency which exists in the minds of superficially instructed people to ascribe to the heavenly bodies a power over human events. A very few words of comment will, nevertheless, suffice to expose the fallacy of this illusion. The proposition, however, to which these remarks are addressed is, it must be remarked, not simply and in a general sense that the moon affects the weather experienced upon the earth, but that the mere aspects of the moon's varying illumination exert an especial influence upon the weather of each particular locality and spot.

"The utter irrationality and absurdity of this idea becomes apparent at a glance the instant it is connected with the obvious fact that the earth is a rotating and not a fixed globe. Assuming, for the mere purpose of illustration, that it were true the new moon, the half moon, and the full moon produced some especial state, whether of storm or of calm, whether of rain or of dryness upon some given spot on the earth, as this passes round in front of the sun-illumined orb, it is manifest the same influence must continue to be exerted entirely round the earth during the subsequent twenty-five hours in which the terrestrial sphere whirls completely round before the moon;" and so on. Further on, he says:—"If the phases of the moon affected the weather, it is obvious that the same weather would prevail wherever analogous relations to the moon obtained.

"The moon, as a matter of fact, does produce a physical

influence upon the earth, but it is an influence of an altogether different kind to the one which is implied by this popular piece of weather delusion; it is the influence which is so grandly expressed in the diurnal roll of the tides of the sea, and which is due to the inter-action of the lunar and terrestrial mass." In regard to the tides the same writer tells us: "It is the moon which is operative in bringing about the result, and not the 'phases' or appearance of the moon."

But, we may ask, is not the distinction here drawn between the moon herself and her "phases" rather one of words than of things? If the moon's changes of position, which we call her "phases," cause corresponding changes in the weather, there certainly would be good reason for associating such changes with the phases under which they occur, whether the popular mode of stating the fact were strictly correct or not.

Dr. Mann goes on to say: "Now, there can be no question that the moon does produce a somewhat similar effect upon the atmosphere to that which it exerts upon the sea. As it goes round the earth, and as the earth whirls upon its axis in front of the attendant orb, a tidal swell is called up in that part of the atmosphere which is most immediately opposite and nearest to the lunar mass;* and this tidal wave in the air undoubtedly is accompanied by some change of physical state which would involve alteration of pressure, and which would be to that extent indicated by the barometer, and would tend to produce movement in the air or wind, and such weather change as is attendant upon wind. But all this, it will be observed, has nothing whatever to do with the phases or changes of the moon. The effect, whatever it may be, is precisely the same whether the moon is new, or half illuminated, or full. It is determined and measured only by the revolution, distance, and mass of the moon, and by the dimensions and rotation of the earth." But the inference is drawn from certain observed facts "that the heat reflected from the full moon does exert a palpable effect upon the atmosphere, although it does not penetrate to the solid surface of the earth;" and Sir John Herschel is said to have noticed "how very commonly the nights of the full moon at the Cape of Good Hope were absolutely cloudless and clear;" and this observation, we are informed, is confirmed by the experience of nearly nine years of the author of the article from which I have quoted in the neighbourhood of Natal.

Dr. Lardner, in his "Weather Prognostics" (Museum of Science and Art, vol. I. p. 80), after reviewing the investigations of different persons on the subject of the moon's

* One cannot help noticing the remarkable coincidence between the words of the ancient poet already quoted, *fratris radiis obnoxia Luna*, and those of the exponent of modern science.

influence on the weather, observes: "Those who are impressed with the feeling that an opinion so universally entertained, even in countries remote from each other, as that which presumes an influence of the moon over the weather, must have some foundation, will do well to remember that against that opinion we have not here opposed mere theory. Nay, we have abandoned for the occasion the support that science might afford, and the light it might shed on the negative of this question, and have dealt with it as a mere question of fact. It matters little, so far as this question is concerned, in what manner the moon and sun may produce an effect on the weather, nor even whether they be active causes in producing such effects at all. The point, and the only point of importance is, whether regarded as a mere *matter of fact*, any such correspondence between the changes of the moon and those of the weather exist, as is popularly supposed? And a short examination of the recorded facts proves that IT DOES NOT." And Dr. Ball, Royal Astronomer of Ireland, in his "Story of the Heavens," published in 1886, p. 59, says: "There is one widely credited myth about the moon which must be regarded as devoid of real foundation. The idea that the moon and the weather are connected has no doubt been entertained by high authority, but careful comparison has shown that there is no definite connection between the two." I venture to think that the results which I shall bring before the members of this Society will show that these opinions are premature, and will have to be modified, and that, after all, the popular persuasion is not without some foundation in fact.

Seeing that the statements of scientific men and the popular notions on the subject of the moon's influence on the weather seemed to be at variance, I resolved to investigate the matter for myself; and accordingly in 1880 I began to keep a meteorological journal in a rough way, and have continued it up to the present time. There is only one hiatus of about a fortnight, caused by my absence from home. Having now ten years' observations to work upon, I thought I might safely proceed to ascertain what conclusions might be drawn from them, and with that view prepared table B appended to this paper.

It should be mentioned that every fall of rain, however slight, unless unintentionally omitted, is recorded; and that rain is noticed in the tables only on the first day on which it occurs in connection with any particular change. When, therefore two or more rain-days come together, only the first is tabulated, the others being omitted: but when a break of a whole day occurs, any subsequent fall of rain is treated as distinct, and tabulated accordingly.

I have thought it better not to go beyond the seventh day, since it is only occasionally that the interval between one change of the moon and another extends beyond that day.

By way of testing the accuracy of my own observations, I constructed another table (A) on the same principles, from the data furnished by the late Mr. F. Abbott, and published in the papers of this Society, taking in the previous ten years, from 1870 to 1879 inclusively. If the two tables be thrown into one, they will embrace a period of twenty years, from 1870 to 1889. In Mr. Abbott's tables, as printed, I found two gaps, one of a month, and another of a fortnight, but was fortunately able to supply the omissions from the meteorological journal kept by Mr. W. E. Shoobridge, which he was kind enough to leave in my hands.

My observations, as thus tabulated, give the following results for the ten years from 1880 to 1889.

Taking first the totals opposite to each day, without reference to the nature of the moon's changes, we find that the number of times on which rain commenced in the decennium as a whole was as follows :—

On the day of the change				...	...	... 114
„	second day	„		...	...	... 103
„	third	„	„	...	...	... 98
„	fourth	„	„	...	...	... 92
„	fifth	„	„	...	...	... 88
„	sixth	„	„	...	...	... 73
„	seventh	„	„	...	...	... 82

It will be seen that the number on the day of change is considerably in excess of the number on any of the other days, being at the rate of 18 per cent. nearly of the whole number (650) on the seven days, while the next highest is only about 16 per cent.

The corresponding numbers for the period 1870-79 were :—

On the day of the change				...	...	... 135
„	second day	„		...	...	... 80
„	third	„	„	...	...	... 97
„	fourth	„	„	...	...	... 81
„	fifth	„	„	...	...	... 93
„	sixth	„	„	...	...	... 83
„	seventh	„	„	...	...	... 84

Here again we find the largest number on the day of the change. But in regard to the other days, the two periods vary. In the first decennium (1870-79) the next largest was on the third day ; in the second decennium (1880-89), on the second.

The proportion which the numbers on the day of change bore to the total (653) on all the seven days in the first period was nearly 21 per cent.

In the second decennium (1880-89) it was found that the next largest figure was that opposite to the second day; while, in the first decennium, the next largest was in connection with the third day. Taking the two periods together the relative frequency of rain in the twenty years would be as follows:—

First day of change	...	...	...	...	249	
Second day	„	...	...	...	..	183	
Third	„	„	...	...	...	...	195	
							— 627
Fourth	„	„	...	...	...	...	173	
Fifth	„	„	...	...	...	...	181	
Sixth	„	„	...	...	..	...	156	
Seventh	„	„	...	...	...	...	166	
							— 676
							1,303

Thus, it appears that 48 per cent. of the rainfalls, as here noted, occurred on the first three days of the moon's changes, being only 2 per cent. less than in the remaining four days. It will be observed that the numbers are appreciably smaller on the sixth and seventh days.

Taking now the totals under each of the moon's quarters, in the two periods, we get the following results:—

1880-89.

Total number of initial rainfalls in the whole period in { Last quarter, 159; New moon, 165; First quarter, 167; Full moon, 162

1870-79.

Total number of initial rainfalls in the whole period in { Last Quarter, 177; New Moon, 146; First Quarter, 177; Full Moon, 150

So far as these periods, taken separately, go, we cannot discover any law of relation between the changes, or quarters, of the moon, and the rain-fall; but when we combine the totals of the two tables and take the whole period of twenty years, the result is similar to that which we get from the latter of the two decennial periods (1870-79), the numbers for the twenty years being:

Last Quarter	...	336
New Moon	...	311
First Quarter	...	344
Full Moon	...	312

The difference between the two pairs, the first and last quarters on the one hand, and the new and full moon on the other, are so marked, as at once to suggest the idea that it is not altogether due to chance. If this be so, then there is a greater probability of rain occurring at the first and last quarters than at the new and full moon.

In my enquiries I have not given any attention to the question how far, if at all, the rain-fall is affected by the moon's apogee or perigee. But it is only reasonable to suppose that, if the greater or less proximity of the moon to the earth affects the tides, it must also cause some corresponding modification in those conditions of the atmosphere which regulate the suspension and condensation of moisture in the upper regions.

Lardner, in the work above cited, tells us that Toaldo, from a comparison of 45 years' observations at Padua, found that in every six passages of the moon through perigee there were five changes of weather, and in every five through apogee there were four changes of weather (p. 72); and that Professor Pilgrim, from a 25 years' series of observations at Vienna, arrived at the result that the influence of perigee is greater than that of any of the phases, while the influence of apogee is equal to that of the quarters and full moon, and greater than that of the new moon (p. 73). But Lardner considers that the mode in which these conclusions were reached was such as to throw some doubt upon the results. He seems to attach more weight to the investigations of M. Schübler, who, from observations taken at Munich, Stuttgard, and Augsburg, for 28 years, found that during the seven days nearest to perigee it rained 1,169 times, and during the seven days nearest to apogee, only 1,096 times. "Thus," remarks Lardner, *cæteris paribus*, the nearer is the moon to the earth the greater would be the chances for rain" (p. 75).

Further on he says: "From all that has been stated it can scarcely be denied that there exists some correspondence between the prevalence of rain and the phases of the moon. What that exact correspondence is, remains for more extended and accurate observations to inform us; but meanwhile it may be safely affirmed that it is not such as to constitute a prognostic in any sense approaching to that in which it has been popularly adopted." *(Ib.)*

With this I entirely agree; and, so far as the foregoing enquiries enable us to pronounce an opinion on the subject, the only thing which we can with any safety assert with regard to this subject, is, that there is a greater probability of having rain on the first than on any succeeding day of any of the moon's changes.

The enquiry, the results of which I have thus attempted to put before the members of this Society, will, I hope, be found to be of some value, however slight, as a contribution towards the investigation of an obscure but highly interesting subject.

Perhaps these remarks may induce others, more competent, to pursue the enquiry in a more scientific manner, and more exhaustively, than I have been able to do.

It will, of course, be understood that the inferences deduced from the appended tables are intended to apply only to the place where the observations were made, namely—Hobart and its vicinity. We may expect to get different results from similar observations at other places, and it remains to be seen whether the same laws hold good elsewhere under different conditions, or whether they are so far modified by local circumstances that each place, or group of places, has a law of its own.

In a work which I was reading a short time since, I came upon this passage:—"It is a scientific fact that virtue and vice are resultant upon the changes of weather. The police of Buenos Ayres find that quarrelling and bloodshed are more frequent when the wind blows from the north, that a sort of moral derangement prevails while it continues. The scientific explanation offered is, that this arises from some malaria engendered in the marshes over which the wind passes." (W. J. Acomb, Larger Hope Lectures, 156.)

This opens up a wide field of study which has not, as far as I know, been systematically cultivated. The present age stands out prominently as one of *disinterment*. Buried cities, such as Nineveh, Babylon, Herculaneum, Pompeii, Troy, have been unearthed; lost languages and literature have been restored. If the same method of enquiry be applied to immaterial things there can be no doubt that similar results will follow. If we closely examine many of the things which in past times were devoutly believed, but which most people in these days look upon as exploded errors, we shall find that, just as gold is embedded in quartz and has to be separated from it, in these old notions there are truths which only require to be set free from the misconceptions which were associated with them to be recognised as scientific facts. Take, for instance, lunacy. The idea was that the aberration of mind so-called, was occasioned by some malign influence of the moon. Increased knowledge has shown that the causes of insanity are very various, and that the moon has little, if anything, to do with them; but if I am not mistaken, many mad people *are* peculiarly affected at certain states of the moon, and the observation of this fact may have led to the

assumption that the moon was the cause of the disease. We have seen that she does produce such an effect upon the atmosphere as to bring on rain under certain conditions. But as the organism of both men and animals is affected by changes of weather, and as such changes are, more or less, brought about by lunar action, it follows of necessity that the moon does exercise a certain amount of control over the bodies and minds of living things, though, doubtless, not in the way and to the extent formerly imagined. Many persons of sensitive temperament are powerfully affected by moonlight; and we can easily understand how much greater the impression must be when the mind is off its balance.

Take, again, astrology. Of course, none of us believes in astrology, as commonly understood—that is, we do not believe that men's future destinies can be read in the stars in the same way as the astrologers pretended; but I think there are grounds for admitting that the stars may, like the moon, only in a less degree, have an influence on human affairs. Some years ago (in 1876) it was predicted that a rare conjunction of the greater planets would cause unusual perturbations on our earth; and certainly in the last ten years there have been greater disturbances in the physical world than have ever occurred before in my time. And in the moral world there have been corresponding disorders. It is quite conceivable that these abnormal phenomena may have had their origin in some changes of the other planets in relation to the earth, altering the force of their attraction, and so, perhaps, the magnetic condition of our globe. Whatever affects our physical state produces a corresponding change in the mind and its affections, and thus many of the remarkable tendencies of our time may be the result of atmospheric or telluric influences due to some obscure changes occurring elsewhere in the universe of which we form a part. If it be true, as modern science teaches, that the whole of creation is so bound together, and so finely adjusted, that whatever takes place anywhere produces some effect on every other portion, we need not stumble at the thought that the vast masses of matter which whirl round the centre of our system may, by their changes of position, alter the condition of things on our planet, and so have an influence upon our physical, moral, social and spiritual life.

If this be so, then it will be within the province of science to extend its researches in this direction, in order to discover, if possible, what are the exact nature and limits of the influence exerted upon the earth and its inhabitants by the moon and the remoter planets—the lesser forces—as well as by the great central source of power—the sun itself.

TABLES.

Number of days on which rain began to fall in the two decennial periods, 1870-79 and 1880-89, in connection with the changes of the moon:—

A. 1870-79.

Days of and following the Moon's Changes.	Last Quarter.	New Moon.	First Quarter.	Full Moon.	Total.
1	37	37	35	26	135
2	20	19	21	20	80
3	22	24	23	28	97
4	19	18	24	20	81
5	27	25	23	18	93
6	21	22	17	23	83
7	13	20	24	27	84
—	159	165	167	162	653

B. 1880-89.

Days of and following the Moon's Changes.	Last Quarter.	New Moon.	First Quarter.	Full Moon.	Total.
1	29	24	34	27	114
2	28	27	25	23	103
3	25	21	31	21	98
4	26	27	17	22	92
5	24	18	26	20	88
6	18	17	16	22	73
7	27	12	28	15	82
—	177	146	177	150	650