MADEIRA METEOROLOGIC

C. PIAZZI SMYTH

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C.P.S. del. Engraved by J. Le Conte, F. dir.

BASE OF THE REMARKABLE CLOUD OF JUNE 26, 1881;
REMARKABLE ROCK ALSO; BROKEN OFF FROM AN OLD LAVA STREAM
ON THE MAINLAND AND NOW HALF SUNK IN DEEP WATER.

MADEIRA

METEOROLOGIC

BEING A PAPER ON THE ABOVE SUBJECT
READ BEFORE THE ROYAL SOCIETY, EDINBURGH,
ON THE 1st OF MAY 1882

By C. PIAZZI SMYTH, F.R.S.E.
AND ASTRONOMER-ROYAL FOR SCOTLAND

EDINBURGH: DAVID DOUGLAS
1882

"*They that go down to the sea in ships, that do business in the great waters;*

"*These see the works of the Lord, and His wonders in the deep.*"

Ps. cvii. 23, 24.

TO

THE METEOROLOGICAL SOCIETY OF SCOTLAND,—

A SOCIETY DISTINGUISHED

BY THE IMMENSE AMOUNT OF WORK IT HAS PERFORMED,

AND IS STILL PERFORMING,

BOTH FOR THE PUBLIC GOOD AND THE HELP OF

GOVERNMENT OFFICES,—

THIS LITTLE ESSAY, IN BOOK SHAPE,

IS NOW DEDICATED,

BY THEIR HUMBLE SERVANT,

C. PIAZZI SMYTH.

EDINBURGH, *June* 1, 1882.

"Dost thou know the balancings of the clouds, the wondrous works of Him who is perfect in knowledge?"

JOB xxxvii. 16.

"For He maketh small the drops of water; they pour down rain according to the vapour thereof;

"Which the clouds do drop and distil upon man abundantly."

JOB xxxvi. 27, 28.

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MADEIRA METEOROLOGIC.

PART I.

INTRODUCTION TO THE CHIEF FEATURE TO BE INQUIRED INTO.

THE ISLAND OF MADEIRA has been so abundantly visited by the educated classes of this country during more than a century past, and for the very sake of its climate, that that climate should be now very fairly understood amongst us. And perhaps it is in many a private family, as well as some medical treatises. Yet, though I have looked over not a few of these latter, there are certain particular points in Madeiran weather,—points, too, wherein the island differs quite abnormally from other places not far either north or south of it,—of which I have not yet found as clear accounts as would seem to be desirable in the present day.

Every one, of course, knows Madeira's geographical position in what, to Great Britain, is the sunny south,—in latitude 33° only from the Equator, where it lies off the much-heated and sunburned West African coast of Morocco,—and perhaps they are somewhat misled

thereby; for the generalities of mathematical geography are one thing, and the intricate working of detail in physical geography is occasionally quite another.

The following, at all events, are the simple phenomena of ordinary observation which offered themselves to my notice when approaching the island last year. We had sailed from England in May, during the prevalence of a bitter, biting, north-east wind; when the sun certainly shone every day, but with a feeble, sickly glare out of a dry, hazy sky, unflecked by any strongly-featured, positive clouds. That wind as to its direction, and that nearly cloudless sky, continued with us in our voyage, which was directed due south. But day after day,—most sensibly too, thanks to the quick pace of the Donald Currie steamship,[1]—the sun at noon rose higher above the masts; the sky became of a purer, deeper blue; and the wind still more rapidly rose in temperature, until it became the genial "Trades" of lower latitudes.

Hence, by the time that we were running along the coast of Portugal, and nearly crossing the parallel of Lisbon, the proverbial laziness of warm climates began to manifest itself amongst the once active young gentlemen on board; who now did little else than lounge at full length on all varieties of triple and quadruple easy-chairs, and complain of the splendid sunshine.

[1] *R.M.S. Dunrobin Castle*, Captain J. B. Harrison, R.N.R., out; *R.M.S. Warwick Castle*, Captain J. C. Robinson, returning; and either captain admirably carrying out the obliging intentions of Sir Donald Currie to facilitate our voyage and transport, either way, of large astronomical instrument boxes.

The next day, when crossing the still farther southern parallel of 35° latitude, the sun smote down on the ship with even more than its Lisboan power. And at evening a preacher-passenger, who had been the greater part of the day usefully conversing with seamen in the fore-castle, came aft amongst the panting, recumbent figures there, and with a face glowing scarlet in the light of the western sky, exclaimed for their encouragement:

"To-day, the boatswain allows, has been *warm;* but to-morrow, he says, near Madeira, it will be *hot.*" And that last word was given out with all the force of Elizabethan days when it was spelt with two t's!

Yet when the morrow came and Madeira was so much closer to us, the weather was not by any means hot. It was barely not cold. No sun was to be seen, and the sky was everywhere covered in with thick, damp, cottony rolls of cloud, packed tightly one against another. After breakfast, land was announced; a dull rocky island, with a pointed mountain peak about 1600 feet high, and a specially wet-looking, extra cloud hanging down over it. This island was Porto Santo, and when we had left that behind us by several more hours of rapid steaming, they told us Madeira was in sight! But how?

The clouds of the sky seemed to have strangely thickened in front, or far to the south, and west, of us. From high above they came down as impalpable mist almost to the very water's edge itself, between which and the clouds' lowest rims lay a narrow vista of distant inscrut-

able darkness—a crevice of unknown gloom, where wave after wave of the Atlantic, impelled by the ever-urging north-east wind, first lifting itself up on the farthest visible brink with all its foaming fury of resistance, plunged unwillingly in, and was lost to our sight for ever.

After speeding along some miles of that horizontal crevice of gray perplexing mystery, positive forms of jagged rocks began to protrude themselves, combating with the waves. This was Cape San Lorenzo at the eastern end of Madeira. But who ever saw such rocks before? They were mere remains of an old volcanic island in the act, though slowly through the ages, of breaking to pieces and sliding down into very deep water; headlands of basaltic lava cracked off, or slunk away, from their central fastnesses, and now hurtling against each other amongst ocean's hungry waves, roaring around them for the remainder of their prey. So that surely any one beholding the scene might well be excused for recalling these grand words of old belief in a higher case—"Therefore will we not fear, though the earth be removed, and though the mountains be carried into the midst of the sea; though the waters thereof roar and be troubled, though the mountains shake with the swelling thereof."

But at last, on our good ship fairly reaching the southern side of the island, the hitherto impenetrable veil of clouds on clouds over all the sky began to break up; the rays of the afternoon sun, as it transfused their sub-

stance and emblazoned their edges, darted out here and there in welcome force, dancing on the wavelets before us, and illuminating the southern slopes of the interior land; when, in place of arid sands and roasted rocks to bespeak it a chip of the Western Saharan termination of Africa, we saw apparently the whole Madeiran country green, green, and still more densely green, from the coast-line right up to the farthest visible hills!

Now all these prospects of Madeiran cloud, rock, and scenery, which we had thus enjoyed the good fortune to behold one after another in such quick succession, were no mere short-lived or trifling accident of that one particular day, but do constitute the standard features, through centuries, of the summer climate and appearance of this, meteorologically, most anomalous little African isle. For its historians have related that, in 1419, the Portuguese had lived more than a year in Porto Santo before they discovered Madeira, or even ventured to sail in its direction; for they imagined there was some dark and dangerous abyss, if not the end of the world, in that quarter; and it required the arrival of two of Prince Dom Henry's most gallant knights — João Gonzalves Zargo and Tristão Vaz Teixeira—to insist on sailing into the mystery.

The late T. M. Hughes, well versed in the old Portuguese literature, does rather contrariwise, in his grand Madeiran poem in ten cantos,[1] makes Zargo take a new

[1] By name, *The Ocean Flower*, published by Longman, Brown, etc. London, 1845. See also Part V., pp. 54, 56, and 64.

departure for the discovery from Lisbon itself, "in three armed ships." The first part of their voyage was bright and sunshiny, so that

> "Along their path, 'mid deep-blue summer seas,
> The porpoise gambolled and the dolphin flew;
>
> "Yet—ere two weeks their slender race had run,
> A cloud of densest vapour seemed to rise
> Full in their course, as if to blot the sun.
> And straight the cry arose, and 'gan to swell,
> That 'twas sulphureous and mephitic smoke
> Vomited from the yawning gulf of hell!
> There to receive them, did they venture on.
>
> "But Zargo—full upon the vapour bore his prow;
> When shadowy forms in midst of it appear,
> And peak on peak careered upon the sight.
> Now breaks the coast from out the sparkling wave;
> A long low promontory eastward falls,
> Which Zargo, from the protomartyr brave,
> His ship's great patron, Point Lorenzo calls."

And then follows his discovery of the bulk of the island, so densely covered with magnificent trees that the ground could only be cleared for cultivation by burning; and the fire, once commenced, continued for seven years.[1] Nor was the primeval timber entirely destroyed

[1] On p. 43 (line 2) of the "Journal of the Scottish Meteorological Society" for April 1870, the primitive Madeiran conflagration is said to have lasted only seven *days*. This, however, is quite opposed to the concurrence of older authorities, amongst whom Manoel Thomas, a dignitary of the cathedral church of Funchal, wrote his "Insulana" within two centuries of the original period of the island's discovery, and fixed the longer duration of the fire, as

even then; for some of the largest ships of the once dread Spanish Armada were either built, or internally decorated, with the dark brown wood of the "giant Tils" and "tall Vinhaticos," which the Spaniards, at that time in possession of Madeira, procured from thence.

How different though is not all, or even any approach to, this style of dense forest vegetation, from the far-between and solitary little stunted bushes of the African desert, lying eastward on the very same parallel of latitude; or from the isolated candelabra-like euphorbias, which perch on the rocks forming the eastern and southern slopes of the Canarian Islands five degrees to the south; or the thirsty look of the coasts of Western Portugal the same distance to the north.

Plants then had evidently found out, and profited by, what was peculiar in Madeiran climate long before man. But he having arrived on the scene at last, it is now his duty to ascertain, if indeed he has not done so yet, how much Madeira's difference from meteorological rule may be, as measured in instrumental numbers of definite elemental bearing. And it is something in that line, though I am sorry to say only approximative, which I would now beg leave to set before the Royal Society, Edinburgh.

being no typographical error, by the following lines as Englished by T. M. Hughes:

"Ere grew that fire extinct, seven annual rounds
Made the Great Planet, four and eighty were
The courses of the lustrous lamp of night."

PART II.

THE CYCLE OF A DAY, AND SUCCESSION OF DAYS.

As illustrative of Madeiran days, to begin with, and only for the Funchal neighbourhood of Madeira, I beg to offer my wife's Meteorological Journal for June and July of last year, taken at the garden house where my solar spectroscope was established.[1] The circumstances of the observations were rather apologetical, and the instrumental results more for differential than absolute purposes; but a comparison of both the aneroid barometer and the thermometers employed, with the daily bulletins from the Government Observatory in Funchal, —as published by the French Central Meteorological Bureau, and which I have introduced into the Tables,— show that there is not much astray in either of these important registrations. (See Appendix I. for the full records.)

The chief force, however, of these Madeiran obser-

[1] By name, "Quinta do Corvalho," but utilised now as Jone's private hotel, and much appreciated as such both by visitors and residents. It is about 270 feet above the level of the sea, and sufficiently far to the W.N.W. of Funchal to be considered a country, rather than a city, residence.

vations comes out on being compared with the similar daily series for the same months, with the same instruments, and by the same lady observer, in Lisbon; during a former year, indeed, but tested also by the French published barometrical and thermometrical records for that city during the same year, and that not accused of being very sensibly different from the Madeiran year (see also Appendix I.). Wherefore we may commence at once on the barometer returns, thus:

The barometric pressure was always above 30 inches at both places, as theoretically suitable for the latitude and season, but higher in Madeira than in Lisbon by 0·09 inch; which is also agreeable to theory, from Madeira being 6° farther into the trade-wind region.

Again, the bi-monthly range of the barometer was smaller in Madeira than in Lisbon, or as 0·29 inch against 0·40 inch. But this is also agreeable to geographical position; and it used at the time to be almost a wonder to us, lately arrived from northern lands, to see how a fall of the mercury, through something under two-tenths of an inch, sufficed to produce all the phenomena of the worst weather we ever had in Madeira,—viz. the breaking in upon the north-east trade-wind of a south-western storm for two or three days, with rain, and then gusty squalls, as the wind gradually veered to the west, then the north-west, and finally fell into the north-eastern quarter once again.

So far we have taken both months together at each

station; and for so indirect or feeble an influence on human feelings or powers of perception as small variations of barometric pressure in themselves, that is probably quite enough. But when we come to temperature, which is so direct and universally appreciated a characteristic of climate, we must be far more particular.

Now in Madeira the mean temperature for June comes out 68·1° Fahr., on which by itself we can say little more than that it is a very comfortable temperature —indeed, almost the exact quantity indicated by the Great Pyramid as being the central temperature for all human kind during the whole human intellectual period of their trial domination, past and future, upon the earth. And if the mean temperature for the same month in Lisbon is only 65·0°, that may be easily attributed to its more northern latitude.

But in July, when the thermometer mean in Madeira has risen from 68·1° to no more than 69·6°, the same element in Lisbon has so far surpassed it, both differentially and absolutely, as to have risen from 65·0° to 73·1°; or the progress of a month, in place of being 1·5°, has actually mounted up to 8·1°; constituting a sort of dynamical phenomenon necessarily endued with the most intense influences.

Take the mean *daily* range of temperature, for instance. Throughout June in Madeira it was the strangely small and mild quantity of 6·5°, while in Lisbon it had the stirring force of 17·3°; and though

by July in Madeira it had reached 9·4°, in Lisbon it attained to 19·3°. And if, leaving means of the whole months, we now cull from the experiences of single days, we shall find that the highest point of temperature ever touched in Madeira during sixty summer days was 79·3°, whereas in Lisbon it actually reached 98·3°.

Wherefore let those who desire to feel the real warmth the summer sun is capable of imparting, by all means rather visit Lisbon than its colonial dependency Madeira, though *it* be actually several degrees of latitude farther to the south!

Yet if Madeira be so much farther in that usually sultry direction, why are solar excesses so little felt there?

The answer is, simply—"Inquire of watery vapour." Not visible mist, or fog, or rain, which the beasts that perish can perceive as well as man, but that invisible quality in science known as "humidity," and which we found to average monthly, even in the crystal-clear atmosphere of Madeira, 73 and 74, but in Lisbon only 62 and 60. And, while the very smallest humidity ever observed by us on a single day in Madeira was still 54, we had twice proved it in Lisbon to be only 26.

These meteorologically derived results were further confirmed by spectroscopy, to whose searching glance the optically invisible watery vapour stands forth marked in darkness proportioned to its quantity. Thus the so-called "rain band" of the pocket spectroscope averaged an intensity of 3·8 in Madeira, but only 3·2 in Lisbon,

while my large solar spectroscope was still more pronounced; for though, in Lisbon, the water vapour lines forming the group known as "little *a*" were generally few and as thin as fine spider lines, in Madeira they were mostly thick, black, and crowded together.

Now this remarkable agreement of these most diverse indications for invisible moisture does so demonstrate the importance of attending in the present day to something more than the barometer and thermometer of former times, that we cannot stop here; but, from the cycle of a day, must go on to ascertain what takes place in the far longer cycle of a year, and over a wider geographical extent than the little step between Lisbon and Madeira. I have not, indeed, sufficient original observations of my own to elucidate this part of the case; but have been collecting and condensing from many good observers, and with such results as the following.

PART III.

THE CYCLE OF A YEAR.

It was to medical men that the public were first distinctly indebted for a knowledge of the temperature-mildness of the Madeiran climate; and the names of Drs. Gourlay, Heberden, Renton, and Heineken are thankfully remembered in the island for what they published in their respective days. But the reason why, of that temperature moderation, was still undiscovered; and an erroneous idea generally prevailed, asserting that the air of Madeira was uniformly, even essentially, dry; and its sky characteristically "of a deep and stainless blue, unsullied by a single cloud." Wherefore, in 1834-5 came the very man whom truth, touching watery vapour in Madeira, required, viz. the young, the enthusiastic, the sadly weak in health, but the devoted student of hygrometry, Dr. J. A. Mason. And though excellent guide-books by Robert White and J. M. Rendell have been written since then, well garnished, too, with scientific observations; and though the present British and German physicians residing on the island, Drs. Grabham

and Goldschmidt, have both of them written on the climate, Dr. Mason's remains the classical work on that climate's ruling feature.

It was a posthumous publication,[1] a monument to his name and labours erected out of the papers he had left behind him, by his widow; for he had meanwhile passed away, in consumption, at the early age of twenty-seven years. But so long as he lived, the fervour with which he threw himself into his peculiar subject of the invisible vapour of water permeating the hard atoms of the permanent gases of the atmosphere,—just as a stream of water transfuses itself among the pebbles of a gravel bed, to use Dalton's simile,—is indescribable. Dr. Mason had, too, taken his own hygrometer with him to Madeira, and forthwith observed it almost continuously by day and by night during nearly two years.

And what was *his* hygrometer? It was what is now generally known as the dry and wet bulb thermometer, for showing the temperature of water evaporation. An instrument too much undervalued then, and long since then, by high science, as compared with any apparatus for giving the still lower reading of the dew-point temperature; but which, though excellent if you can get it, is often only to be reached by a lavish expenditure of sulphuric ether — a fluid not always procurable by

[1] By Title, *Madeira : Its Climate and Meteorology*, by J. A. Mason, M.D. Published by John Churchill, London, 1850.

travellers. Time has now, however, pronounced so decidedly in favour of the dry and wet bulb thermometer with rain-water, as the only practical hygrometer for all international observers, that if the contest respecting whose name it shall be called by is destined to be re-opened, Dr. Mason's claims can hardly but be mentioned in any essay on Madeira, where he used it so early and so well. Where, notwithstanding his deadly illness at the time, he took up the abstract principle, as discovered, and *let alone*, by others before his day; and both practicalised the idea and turned it into an every-day working hygrometer for himself as well as others.

Yet he made few friends by it in his own day; and even fifteen years after his death, a Madeiran writer can speak thus carpingly of him: "The late Dr. Mason, in his treatise on the Climate and Meteorology of Madeira, appears to have detected a greater degree of moisture in the atmosphere around Funchal than is shown by the tables of other observers; and, while writing under the morbid influence of active disease, complained bitterly of the cloudy sky, the high winds, and the variability of temperature encountered in Madeira."

But that too truly active disease under which he did then undoubtedly labour, appears to me to have rather made him a more acute and delicate observer than most men; while it is to the ineffable praise of his soul, that his spirit did so rise superior to the weakness of his body as to enable him to follow up his voluntary scientific

research with a fulness and a fervour thus eulogised by his biographer :

"The exposure and privations which Dr. Mason would have imperatively prohibited a patient from encountering, he fearlessly and enthusiastically contended with in his own person; undeterred by the most trying fluctuations of temperature, the prostration attendant on a constant strain of the mind, and the watching that broke in upon that ordinary rest, which even the robust cannot forego, without some degree of suffering. To none would he for a moment depute the task which he had undertaken; and when all around him were enjoying repose, or courting it, this martyr, as he may be called, to meteorological investigation, passed the night with his instruments and journal; noting down the minutest change which the atmosphere underwent, from the first sinking of the sun to the first indication of its rising."

Why, then, have those subsequent meteorologists, to whom a merciful Providence has permitted a far longer life than twenty-seven years only from birth to death wherein to make their mark in the world,—ejected the name of poor Dr. Mason from all connection with the useful and practical hygrometer he devoted his short but active life and self-sacrificing labours to ?

On turning to the July number of the "Quarterly Journal of the Meteorological Society of London," I find at pp. 175-6 an unfortunately worded notice of him in a general history of all hygrometers by a late President of that Society. On the sole ground of an article in an old monthly serial, viz. "Records of General Science for July 1836," it is declared that the "new hygrometer" alluded to therein by Dr. Mason (or his executors) was

merely a dry and wet bulb arrangement; that he "ignored all previous use of it," though some other persons had published on what was essentially the same in 1830, 1817, and 1802; while the principle may be traced back to Hutton in 1792 and slightly to Cullen in 1777;" and that "the only thing which Mason did was to arrange a compact form of dry and wet for travelling purposes."

This last remark plainly shows that the high official writer in the Society's "Quarterly Journal" of last year knew nothing of the severe battle of hygrometry in Madeira, which the dying Dr. Mason had fought so gallantly and won half a century nearly before, and had not read his Madeiran book, where this historical statement comes out clearly on its p. 4,—"I need only observe here, that the principle of this method of registering humidity and dryness of the atmosphere was first pointed out by the late Dr. James Hutton."

Whether, after all these labours, the posthumous honour can now be procured of connecting Dr. Mason's name once again with his favourite hygrometer, seems doubtful; but every additional inquiry into the climate of Madeira at the place, will infallibly bear him out before successive generations in showing the extraordinary influence therein of that invisible climatic agent to whose study he devoted himself; and which, like some other things we are told of elsewhere, is, though unseen, more important than the things which do appear.

In gathering up, therefore, the materials for a con-

densed view of the annual climate of Madeira, I have thought it a duty to quote principally from Dr. Mason for the temperatures of dry and wet thermometers; while I have culled more equally from all other available authorities for barometric pressure, rain, wind, clouds, and some other accompaniments.

Yet, for "the direction of the wind," I have found it necessary to eschew the most abundant and, at first sight, most unexceptionable returns of all, viz. those of the Government Observatory in Funchal, as published regularly year after year in Lisbon. They are probably quite correct instrumentally for the particular spot where their improved and very modern cup-anemometer stands. But the spot itself is an anomaly, being exposed to a singular caprice of Nature, causing the general law for the whole region to be entirely misapprehended, during the summer season at least.

In that part of the year, the north-east trade-wind, as a rule, blows over the whole island, blows directly upon its northern, eastern, and western sides, and even on portions of its southern side, but not under the lee of the highest land it contains. Wherefore Funchal, the capital city, which is precisely so situated, never experiences anything of the grand trade-wind current which is sweeping over three-fourths of the island, and ruling the ocean far and away around it; but gets at that very time merely a little anomalous indraft from the opposite or south-western quarter; just enough to make an improved self-

registering cup-anemometer revolve merrily. So the military observers told off for the purpose register those revolutions faithfully, and that direction unflinchingly, send the numbers and letters read off to Lisbon; and the Government, through "the Meteorological Observatory of the Infant Dom Luis," so prints the returns from a little protected nook and corner, that they come to stand for a full, true, and particular account of all the wind that blows over all the Madeiran portion of the world.

Mr. White, an earlier and independent observer, knowing that the summer wind in Funchal was merely a little back eddy of what was really blowing at large, used to judge for general purposes, not by what he felt in the city, but by what he could see of the appearance of the sea in the distance, and especially by the sailings of the country coasting boats; evidently, too, he had reason, and has been therefore quoted therein by me.

In this manner, after collecting a set of eclectic meteorological returns for Madeira, as a point in latitude 33°, and through the cycle of a whole year or the mean of many years (as shown in Table 1 of Appendix II.); I then endeavoured to procure comparable returns for Lisbon in latitude 39°; Jerusalem, latitude 32°; and Scotland, central, in latitude 56°. In which inquiry I am happy to say that I was admirably assisted by Mr. Alex. Buchan, who has kindly set before me many volumes of great value, by aid of which I have prepared the Tables 2, 3, and 4 in Appendix II.; and, in fact, am now enabled

to begin a discussion of the four places mentioned, viz. Madeira, Lisbon, Jerusalem, and Scotland, as follows, for

THE CYCLE OF A YEAR IN VARIOUS LOCALITIES.

Pressure and Temperature.

In the matter of mean barometric pressure for the year, the three southernmost of the above stations are very much alike, being all nearly two-tenths of an inch above 30 inches, while the northern station is half a tenth below.

Again, all the stations without exception have greater *ranges* of pressure in the winter than in the summer months; but the mean monthly range for the year is twice as great at Lisbon as it is in either Madeira or Jerusalem, and twice as great again in Scotland as it is at Lisbon; whence we may conclude that Jerusalem is far enough east, and Madeira far enough south, to be out of the track of the severest of the south-western winter storms of the Lisboan, and still more of the British, seas.

In the very important matter, in the next place, of mean temperature for the whole year, Madeira is *facile princeps*, registering 66·2° against 63·4° for Jerusalem, 60·0° for Lisbon (a deficiency explained by its being 7° of latitude to the north), and 46·3° for Scotland, which is 17° of latitude farther north still.

But as the year's *range* of monthly means of temperature amounts only to 12·2° at Madeira, to 21·6° at Lisbon, to 29·0° at Jerusalem, and to 20·7° in Scotland, it results that *summer* monthly means are much higher in Jerusalem than in Madeira or anywhere else—almost as high in Lisbon, and only decidedly lower so far north as Scotland.

On the other hand, *winter* monthly means put Madeira once again into a most enviable position, for while her lowest month averages 60·4°, Lisbon's lowest is so low as 49·5°, Jerusalem's 47·2°, and Scotland's only 36·8°.

While next, taking the mean daily range of the mean temperature throughout the *year*, and finding it at Madeira only 9·2°, but at Lisbon 14·2°, at Jerusalem 18·7°, and even in Scotland 12·4°, we may state that any one may expect, in the middle of the hottest month, to have an average noonday temperature of no more than 77·0° in Madeira, but 78·2° in Lisbon, and 85·6° in Jerusalem (Scotland being 63·7°); while the average midnight temperature in the coldest month of the year will be in Madeira no lower than 55·8°, but in Lisbon 42·4°, in Jerusalem 37·8°, and in Scotland 30·6°.

Wherefore equability of temperature comes out as marked a feature for Madeira, throughout the cycle of a year, as it did before for the cycle of a day; and if the reason why be again demanded, we have once more to inquire of invisible

Watery Vapour.

The simplest and quickest observational indication of the degree of presence of this invisible water-gas element in the air about us is, without doubt, the inverse depression, as with Dr. Mason, of the wet below the dry bulb thermometer, either at the instant or for the mean of the day, or the month, or the year. Now, these last means having been already given, we need only quote in this place that the mean wet-bulb depression for the year at Madeira is only 4·6° below what would be full saturation; while at Lisbon that point is removed further, or to 6·1°; and at Jerusalem to 9·5°. In Scotland, indeed, the wet-bulb depression is only 2·1°, but at so very low a temperature as to represent but a trifling amount of absolute watery vapour really present.

In fact, when this rather intricate matter is duly computed out, it appears that Scotland has the least, and Madeira by far the most, grains weight of invisible watery vapour always present in every cubic foot of its atmosphere of all our four chosen comparing stations. Yet the air of Scotland is by no means, therefore, to be considered a dry air; for, at its already alluded to low temperature, the addition of only half a unit grain of moisture would convert invisible water-gas into visible mist, cloud, or fog; while in Madeira three times as much would have to be added before the same sensible result

would be produced there; in Lisbon four times as much; and in Jerusalem no less than seven times as much.

That, however, is for the average of the whole year; but if we next take account of the variations through the monthly means of the year, we find these so small in Scotland (or 0·6 of a unit grain) that even in summer-time the air can never have any very drying qualities. Nor indeed can it have in Madeira, where the seasonal variation amounts only to 1·3 grains on a large constant supply; but in Lisbon, where the variation mounts up to 3·1 grains, the dryness in summer-time must be remarkable, and in Jerusalem, where it reaches 5·0 grains, the summer droughts must be terrific.

This quality of the air at the surface of the ground is further illustrated by what takes place visibly aloft in the vapour planes where clouds are usually formed. Thus poor Scotland, with her low temperature, and close approach therein to watery saturation, has throughout the year more than $\frac{6}{10}$ths of her hemisphere of sky constantly cloudy, and there is hardly any perceptible difference between summer and winter.

Madeira comes next for cloudiness, having $\frac{5}{10}$ths cloudy on the mean of the whole year; and if one solitary month there has so little as $\frac{3}{10}$ths of cloud, it is the cold and windy month of March.

Lisbon has an annual quantity of $\frac{4}{10}$ths, but can show that two of her summer months have, each of them, only

$\frac{2}{10}$ths of cloud, or a freedom from visible vapour at that time in that latitude, implying much drought.

Finally, Jerusalem has a mean annual quantity of no more than $\frac{3}{10}$ths of cloud; and even that is so thinned away in summer time that two of the months then have less than $\frac{1}{10}$th of cloud each; wherefore the almost blinding intensity of the sunshine, with lip-cracking drought in the air, at that period, in latitude 32°, and at 2500 feet above the sea-level, may just be imagined!

In the matter of actual rainfall, touching both its depth and the duration of its falling, Scotland has the most, Jerusalem by far the least of the four stations; their returns standing thus: Scotland, 39 inches, with 179 days of falling in the course of a year; Lisbon, 31 inches, with 142 days of falling; Madeira, 29 inches, with 79 days of falling; but Jerusalem only 16 inches, with 50 days of falling.

As respects the directions from which the winds blow, they are in Scotland mostly from the west, then the south, the east, and the north; also at Jerusalem, mostly from the west, then the north, the east, and the south; in Lisbon, most from the north, then the west, the south, and the east; but in Madeira, most from the north, then the east, the west, and the south.

While for the mean force of the wind at each of the four localities the velocity returns are as follow: Scotland, the stormy indication of 17·6; Jerusalem, 11·6; Lisbon, 10·4; and Madeira, the mild quantity of only 7·6

miles per hour when the wind does blow. But it has also a maximum of days when there is no wind at all. Of these, or calm days, Jerusalem is said to have 9, Scotland 20, Lisbon 64, but Madeira no less than 78 days of such perfectly quiet air that you can sit out in a garden as if within four walls.[1]

Rain-band, Spectroscopic.

In the final return for indicating—and very directly too—the usually invisible watery vapour dissolved in any atmosphere, which I will venture to touch upon here, viz. the spectroscopic analysis of the daylight which has come through the lower part of the apparent sky, we have unfortunately no returns from Jerusalem; only two months each from Madeira and Lisbon; and though the whole twelve are exhibited for Scotland in Appendix II., they would not have been there but for Mrs. Piazzi Smyth's long-continued enthusiasm for the idea, as an addition of importance to her daily meteorological journal at home.

[1] By aid of the useful little volume published yearly by the Astronomer-Royal of Madrid—*Annuario del Observatorio de Madrid 1879*—I have been enabled to add to Appendix II. a table for the climate of that city, comparable to those of our four chief stations; and it seems to prove that the Madrid meteorology comes very nearly between those of Lisbon and Jerusalem—in such a manner, too, as much to confirm our tables for these two cities, leaving Madeira more than ever unique for equable temperature, and abundance of watery vapour dissolved in her atmosphere all the year round.

Taking, however, first only the two months where Scotland may compare with the two southern stations, we find the rain-band, or the indicated amount of watery vapour dissolved in the air, is double the Scottish amount in Lisbon, and rather more than double in Madeira. At the same time the "low-sun band" appears of nearly the same strength at all three places, as indeed it should do; for this latter band is known to be an affair of dry gas, and is only observed simultaneously with the rain-band as a check on the ideal numbers in which any observer may choose to record his observations, care being always taken to avoid observing at times very near to either sunrise or sunset; and that was accomplished involuntarily for all three stations in June and July by the observing hour being 9 A.M.

But when we examine the whole year in Scotland, a peculiar law of variation, though within narrow limits, comes out for either band. For, first, the low-sun band is at a maximum in winter and also in summer, but is at a minimum at the two equinoxes. That summer maximum is probably due to the greater purity and strength of the light, arising from the greater absence of the city's usual coal smoke, at that season enabling all spectral phenomena to be more clearly seen; and the winter maximum, to the sun being at the 9 A.M. observing hour, on or near the horizon, and having, therefore, just then the short-lived intensity after which it is named; whence it comes that the equinoctial minima of the journal are

merely the necessary results of 9 A.M., then occurring neither with the lowest sun nor with the least smoky atmosphere of the year.

With the rain-band, on the other hand, there is a different order observed throughout the year — viz. a maximum in summer, as agreeable to theory for the greater amount of water-vapour then in the atmosphere; a minimum in winter, as equally agreeable to theory for low temperature and the smaller amount of water-vapour then possible to be carried in suspension and invisibly by the air; and finally another minimum at the vernal, but not at the autumnal, equinox, a result apparently of the drying north-east winds of a Scottish spring.

On the Watery Vapour of several Islands.

Madeira has thus, on almost every point, carried away the palm for abundance of watery vapour always dissolved in her quiet and steady atmosphere, as compared with the three other stations we have put on their trial with her; and a further examination of the tables in our Appendix II. will show that the amounts of temperature variations or ranges, both through the day and through the year, do regularly decrease for each station in direct proportion to the largeness of the stock of such invisible watery vapour there. Wherefore we may now perhaps pretty safely consider the former to be an effect of the latter, and infer the hygrometry of some other stations,

where the wet-bulb thermometer has not been so well observed, from their more easily noted temperature ranges, at least wherever the latitudes do not vary very much; and such may be allowed to be the case with Malta, latitude 36°; Santa Cruz de Teneriffe, latitude 28°; Ponta Delgada in the Azores, latitude 38°; and Madeira, as before, latitude 33°.

Malta, though an island and a very small one, yet being in an inland sea and in a position there essentially dominated by the great African continent, has its range of monthly means of temperature, through the year, rising to 24·7° against the 12·2° of Madeira, and indicates thereby a lamentable want of watery vapour in her air between the sun and herself.[1]

[1] This conclusion so quickly and easily arrived at for Malta, through the method of monthly means of temperature alone, is yet remarkably confirmed by a very important paper in "The Journal of the Scottish Meteorological Society" for April 1870. The paper is by David Milne-Home, Esq., LL.D., of Milne-Graden, Chairman of the Council of that Society. And if its main purpose is to suggest, both on patriotic and scientific grounds, what may be done to improve the climate and increase the rainfall and humidity of that British possession by planting trees there, it begins by setting forth the terrific aridity at present of both its air and soil during a great part of the year as a very clear proof of such improvement being urgently required.

"Although during winter and spring," as he mentions, "the island is swept over by cold northerly winds, yet during the summer months the heat is so excessive, that frequently in the middle of the day labour has to be suspended; and as many persons as can get away from the island during these months, migrate to a cooler residence. Not a blade of green grass or any garden produce is then to be seen in Malta; while the atmosphere, in flowing over the heated surface of the soil,—bare, naked, and treeless—has its natural temperature raised to such an extent as to make it unpleasant, if not

Santa Cruz de Teneriffe, in the open ocean and farther to the south than Madeira, in place of thereby entering the proverbial moisture of the tropics, is drier than the northern island, for it shows 15·1° against the 12·2° of Madeira's thermometrical range.

While Ponta Delgada, though farther north and more in the middle of the Atlantic than Madeira, yet shows 13·7°, or 1·5° more than Madeira of this kind of indication towards the dry. Nor does that apply only to the cycle of a year, for Ponta Delgada's mean range of temperature through the cycle of a *day*, as established by three successive years of observation published by the Portuguese Government, is no less than 1·5° greater than that of Madeira. And as a still further and entirely independent testimony, I may quote the late lamented Sir Wyville Thomson's second volume of *The Voyage of the Challenger*, p. 56, where the semi-annual range of the thermometer is given for Point Delgada = 13·8°, but for Madeira = 8·9° only, or implying a more abundant water-vapour presence than ever in Madeira.

unwholesome to breathe. Moreover at all seasons there is a scarcity of water, whereby health is affected and the productiveness of the soil diminished."

All these items of description evidently making out Malta to be hygrometrically the very opposite of Madeira. Or in one word, the general aspect of Malta, with its light yellow rocks, so destitute of vegetation (see also the note on p. 61), has been too truthfully likened to "a Bath brick;" while Madeira's appearance,—green, green, and still more densely green, with every grateful kind of luxuriant plant growth,—has been already given by us on p. 5, line 7.

Of the source of Madeira's abundant Watery Vapour.

Whence, then, does Madeira derive her anomalous and mostly unseen, yet now fully proved, excess of this solar radiation, damping, watery vapour, above every island or coast-line round about it?

From that most powerful of all sources for giving forth abundance of moisture—viz. a warm ocean current. So far indeed as the classical Gulf Stream is concerned, the chief and warmest part of that keeps, while in low latitudes, more to the westward side of the Atlantic, and should visit neither the Azores nor Madeira. But a recurving branch of it, after entering the Bay of Biscay, turns down southward by the coast of Portugal, and then has more opportunity to dominate Madeira than the Azores. Wherefore, to quote once more *The Voyage of the Challenger*, Vol. II. p. 56 and the maps, we find the sea-temperature at Madeira sensibly higher, viz. 72·0°, than at the Azores, where it is entered as 70·6°; but at both places greatly above the mean temperature of the air for the latitude parallels they are in.

Again we find, by the same admirable authority, that the sea-temperature in the Canarian Archipelago, though that be nearly five degrees of latitude more to the south, is yet very sensibly colder, or 69·25° only. Such an inverted result, of course, implies that the recurving ocean-current which, coming last from the north, warms up Madeira, does not reach the Canarian Islands. What

becomes of it then? It seems to whirl about in the seas between these two places, occasionally even to surround the former island, and then flow away bifurcated and weakened to the south-west.

This idea was published by M. Pegót Ogier in his two-volume book on *The Fortunate Islands.*[1] In voyaging about among these islands, M. Ogier found the native boatmen looking to the north (the direction there towards Madeira), and judging of the weather to come by the more or less clearness wherewith they could perceive, in the extreme distance, the pale blue mountains of the enchanted or wandering island of San Borondon—an island which no voyagers could ever reach, though they sailed directly to it, for it would always vanish on their approach. Once, indeed, it was supposed to have been arrived at, and even landed on; but then it turned out to be the south-west point of Madeira.

Hence it is plain that Madeira—being ever in the neighbourhood of, if not actually surrounded by, circulating sea-water far warmer than her latitude equivalent—must have invisible watery molecules in over-abundance perpetually ascending from the sea-level below to the cloud strata above, with some aid thereto doubtless offered by her massive mountain peaks which do materially connect the two levels at that particular spot.

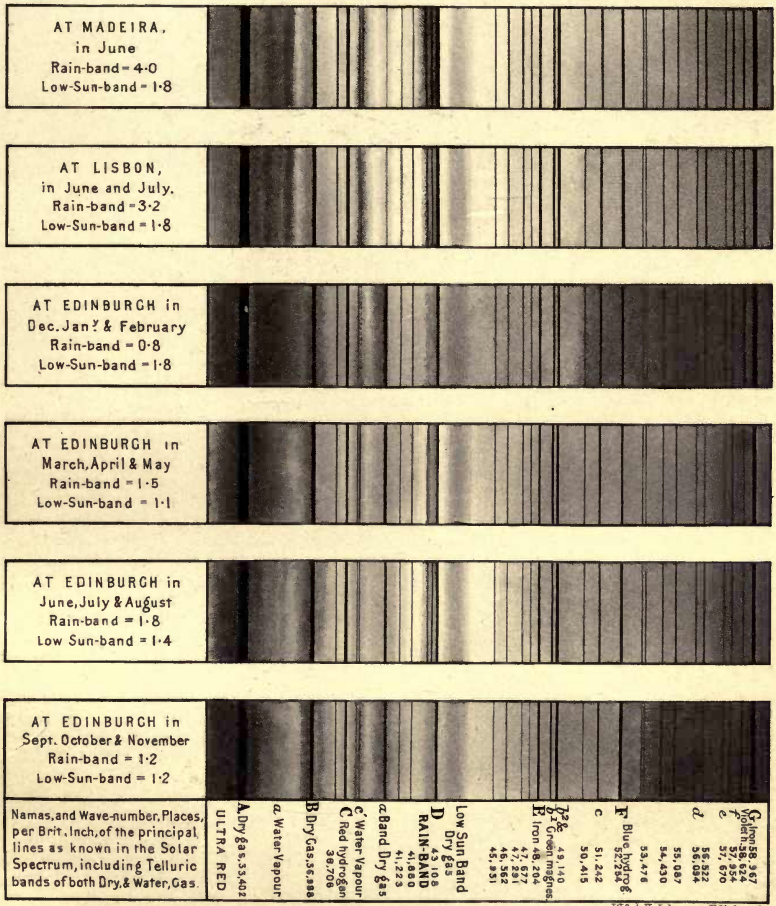
Whence it comes that even in the crystal clearest

[1] Kindly introduced to my notice by Mr. John Small, M.A., the widely experienced Librarian of the Edinburgh University's extensive library.

weather Madeira's sunshine spectrum is inordinately full of water-vapour stopped lines, the sun's direct rays, though to general observation luminous enough, are signally deprived of their proper scorching heat, and the temperature range of the climate is immensely reduced for both the day and the year; while there are still a few other, but rarer, consequences, also well worthy of close attention.

THE SPECTROSCOPIC RAIN-BAND AT VARIOUS LOCALITIES AND VARIOUS SEASONS.

SEE PART 2 P.11 and PART 3. P. 25. *to face p. 32*



W. & A. K. Johnston, Edinburgh.

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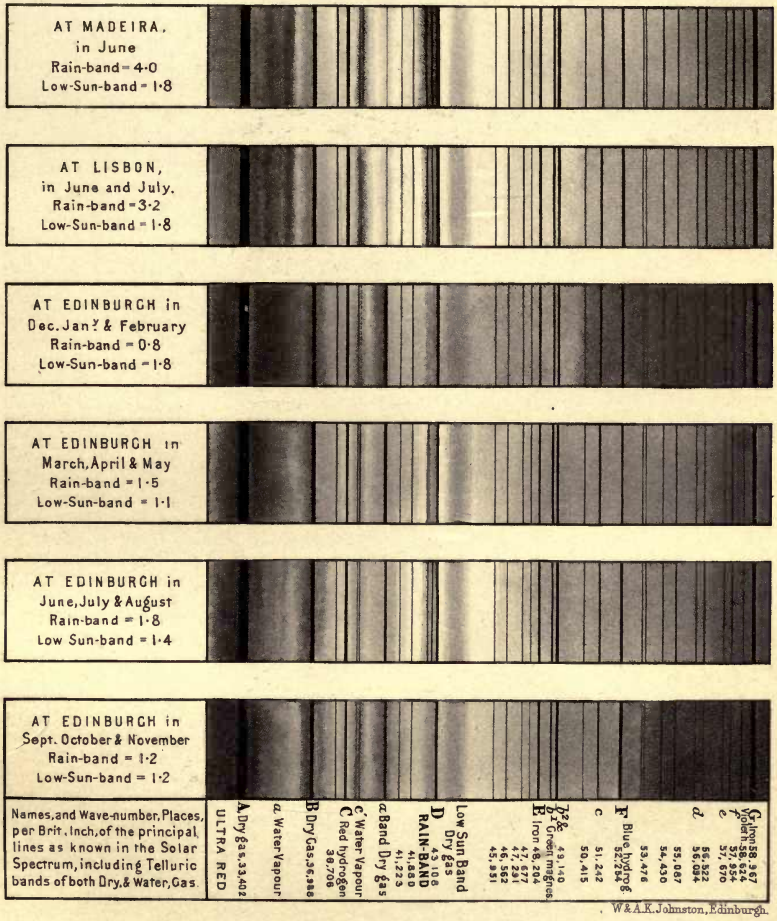

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PART IV.

OCCASIONAL PHENOMENA.

ALTHOUGH the Bermudian Islands are situated on the very same parallel of latitude as Madeira, I have not referred to them in the preceding comparisons. This is because their longitude, so far away to the western side of the Atlantic, brings them within a totally different meteorologic category. And they are also as diverse geographically, being little but low, annular, coral-reef islets. Their winds, too, are mainly from the south, instead of the north-east; and their ocean current being that of the Gulf Stream itself in the most impetuous part of its career, the climate approximates rather to that of the West Indies; whence, moreover, come upon them rather too frequent visitations of destructive hurricanes, tropical rains, and deadly yellow fever.

These scourges are signally absent from the eastern side of the Atlantic; but in their place Madeira has a most noteworthy phenomenon of her own, on which most of her medical authors have written more or less. This phenomenon is the occurrence, at rare intervals, of the

so-called "Leste,"—"a hot, dry wind which," says Dr. Mason, "occasionally visits Madeira from the coast of Africa."

The particular wind elsewhere, he further explains, "called by the Italians *Sirocco*, and which visits Naples and the south of Italy from the opposite shores of the Mediterranean, is hot, *moist*, and relaxing. But the wind called Leste (L'Este, or east wind) in Madeira, is essentially hot and *dry*. It is similar to the *Samiel* or *Simoom*, described as a burning, pestilential blast, extremely arid, which frequently springs up in the vast deserts of Arabia, and rushes forth with tremendous fury, involving whole pillars of sand." As a symptom that the Leste in Madeira is that kind of wind, Dr. Mason mentions that, during the occurrence of one of them, the furniture of his house and the shipping in Funchal Harbour were covered with impalpable red sand. "This sand," says he, "must have passed over more than 200 miles of sea." At a considerable elevation though; and I find recorded in my solar telescopic notes in Madeira, that during June, while clouds from both north-east and west were passing over the sun's disc, there were others apparently higher moving from the east, and distinguished not only by the thin, wiry, cirrous character of their formation, but by their peculiar blackness.

Dr. Heineken again, so far back as 1826, remarked "that it is well established that the Sirocco (as he calls it) in *Madeira* is *perfectly dry*, while that of the *Mediter-*

ranean, strange to say, is loaded with moisture. Notwithstanding, too, that it can reach Madeira only after passing over about 300 miles of sea, yet it encounters you like puffs from the mouth of an oven or furnace, lasts almost invariably three days; when furniture warps and cracks, books gape as they do when exposed to a fire, and some have asserted that it has raised the thermometer to 95° in the shade."

Then why is there nothing of that kind in my Wife's Meteorological Journal for June and July 1881?

Either that no Leste occurred during that period, or that, as we were extensively informed, the Leste is properly felt only at considerable heights on the hill stations in Madeira.

This latter explanation appears to me singularly probable, from much practice in flame spectroscopy with a horizontal blowpipe; for the hot, burning air thereof comes rushing out of its tube directed right at the centre of the anterior object-glass of the spectroscope on its own level; but so far from cracking or fusing the said objective, the current never reaches it; for, rising as it proceeds on its path, the hot air is to be felt only by holding the hand several inches above what it was originally pointed at.

The African desert wind is this blowpipe current; at first all heat and fury, rushing in a horizontal position out to the sea. But it rises gradually in its course to the west, picking up moisture rapidly as it goes by reason of

its high temperature, and extreme capacity in that state for absorbing watery vapour; and it is probably never fully saturated, so long as its primitive high temperature is kept up by continued reinforcements of hot wind from the desert. But when that wind has blown itself out, say in three or four days, the temperature at a distance from Africa falls; and the great quantity of water-vapour brought there into the higher strata of the atmosphere, by the temporary warm current from below and eastward, can hardly do anything else than precipitate itself as rain or dew. Wherefore we find Dr. Mason recounting, on his p. 48, in these words:

"I may also state that rain generally falls within twenty-four hours after the Leste has altogether ceased; and that I have seen a very strong precipitation of dew three hours afterwards, the atmosphere being reduced from 17° to 7° of dryness on my hygrometer; and at seven o'clock the following morning to 2°; while the plants and shrubs were covered with dew."

But from our low, almost sea-side, station at Quinta de Corvalho, where we felt neither the heat, nor the dryness, nor the force of a true Madeiran Leste, we observed as follows on June 26, 1881; the account being extracted from my observing ledger, in which it was entered the next day:—

Sunday, June 26.

Sky unusually clear this day; but no instrumental work took place in the spectroscope room, on principle.

Every one, however, in the house and neighbourhood, noted, from 1 P.M. and onwards, the formation in the deep blue of the sky, and then remaining centrically stationary, of an enormous cloud to the west, of most peculiar physiognomy; mainly so smooth-edged and regularly curved in an elliptical, a double elliptical, manner, thus—

and pretty evidently at some exceeding height in the atmosphere, far above the highest mountain tops. But the customary trade-wind seemed to have entirely died away, both above and below, and on the sea far and near.

Towards sunset the above cloud had an outer fringe of cirro-cumuli, but still preserved the smooth outline of the original mass within that fringe, and apparently in a level below it; besides adding, within that first outline, several others equally smooth, concentric and apparently at successively lower levels.

After sunset the red and crimson illuminations of the cloud were most brilliant, almost bewildering. Nothing approaching to its chromatic glory had been seen during all our previous experience of Madeiran sunsets, and even the native population was immensely excited, and somewhat awed as to what it might portend. At that time, too, the differences of colour between the outer and inner boundary lines became still more striking, the latter passing from brown into gray, while the former were still gorgeously red; and even up to 9 P.M., when twilight had ceased, the northern border of the cloud was lit up with a faint moon-like radiance,[1] and still the central vertical axis of the whole seemed immovable in the sky, anchored and moored fast, like the mountains themselves, but far higher and without visible base.[2]

[1] Although it looked like light "proper" to the cloud itself, yet I do not think it was more than the faint twilight reflected from clouds at an unusually high elevation.

[2] A drawing was recently prepared to illustrate the cirro-cumulus fringe, and concentric interior rings of this remarkable cloud; but on comparing it when finished, after a lapse of nine months from the event, with a drawing made within three days of the same, the latter,—though intended only as a subsidiary sky to a picture of an isolated lava rock, or rocky islet, off the southern coast of Madeira,—proved itself so far more satisfactory to the assisted memory, that it has been adopted for the Frontispiece, and, by the extra care of the engraver, represents the island's volcanic material as well as her occasional cloud phenonema.

The said volcanic material may often be traced from the interior heights as an ancient lava stream, with scoriæ on the surface, and denser, basaltic, dark material below; but the sea makes great havoc with it, in spite of its hardness, at low levels; and the isolated island in the picture is merely what was once a part of the lava stream just visible in the foreground.

During the night, this cloud died away, *in loco.* The next morning, June 27, was fine beyond precedent, with pure blue sky and bright sunshine from sunrise to sunset. The following day, June 28, was not only cloudy, but the trade-wind was, visibly to us at our station 270 feet high, re-established in force on the seas east and south of Madeira; and the day after that, or June 29, besides being also densely clouded, was marked by a heavy, almost tropical, downpour of rain all day long.

Again and again during that week, we were assured on all sides, by Portuguese as well as English, and both upper and lower classes, that they had never seen such a cloud as that of Sunday, June 26th, before. Yet on July 26th, after we had packed up our instruments and were waiting for the homeward-bound steamer, another cloud of the same kind did form, though not to so pronounced a degree; and we have since then heard of a resident declaring that such clouds are not seldom seen in Madeira, and are a sign of Leste wind prevailing at upper stations. On the grand occasion of June 26th and the two days following there may have been a Leste blowing aloft, because the re-establishment, to our eyes, of the trade-wind over the seas to the eastward on the 28th was so signally followed by the downpour of rain through the whole of the 29th. But the Leste itself is a three days' affair, while the peculiar cloud lasted only half a day; and, wherever extraordinary quantities of visible vapour are formed, concentrated, and arrayed in peculiar shapes,

electricity is usually concerned as an addition to mere mechanical and chemical changes.

There was nothing, indeed, of an ordinary electrical character visible to the simple senses; no lightning, no thunder, and no "proper" luminosity of the cloud after dark; while I had no atmospheric electrical instruments with me, and do not prosecute that kind of meteorology. Yet I could not but be struck with a certain degree of resemblance between those elliptical strata of cloud one under or above another, and the well-known stratified arrangement of the illuminated particles of gas, in a so-called gas-vacuum tube when electric induction sparks are passed through it. While at the same time I had not forgotten the remarkable views enunciated by M. Gaston Plantè on the Earth's Cosmical Electricity before the Academy of Sciences in Paris, and in his work of 1879, entitled *Recherches sur l'Electricité.*

Perhaps even he, with all his ability as an electrical scientist, might not have hazarded to publish his theoretical views on the electricity of Cosmos, but for a growing feeling just now in all countries that, however well the electricity of small apparatus in a chamber may be described for educational purposes, there is something further seriously wanted when rules thence derived are applied to nature on an astronomical scale.

Thus with regard to one of the three admitted kinds of theoretical electrical manifestations,—viz. not the electricity of thunderstorms, nor that of the Aurora, but

"the continual slight electrification of the air," usually called atmospheric electricity, — Professor Silvanus Thompson, in his recently published work on Electricity and Magnetism, writes at p. 262, "Our knowledge of this important subject is still very imperfect. We do not even know whether all the changes of the earth's electrification, relatively to the air, are due to causes operating above or below the earth's surface." And in his preface, p. ix., where he is strong on the principle that electricity is *one* not *two*, he also sets forth that the only true and philosophical mode of regarding electricity— viz. as something which can neither be created nor destroyed by man, only altered in its distribution, and to which the grand doctrine of "Conservation of Energy" is fully applicable—had never been published in this country until last year, and is in fact only now taking shape among the leading natural philosophers of the time.

Again the eminent Professor Stokes, lecturing last summer on Aurora at South Kensington in the celebrated series of solar physic lectures, dismisses its origination from either terrestrial magnetism or "earth currents" as impossible on account of their feebleness. But let him assume a supply of atmospheric electricity, such as often is found there, to be at hand in the neighbourhood of any auroral display, and he considers he has therein what is abundantly powerful to account for all the visible phenomena. In fact he goes on to consider that the

aurora is positively an electrical phenomenon, notwithstanding these two grievous difficulties; viz. first, he cannot explain how, why, or whence so much electricity got into that part of the earth's atmosphere; and second, the aurora's light invariably shows in the spectroscope a certain citron-coloured line, which has never yet been seen in any electrical spark or discharge in any natural-philosophy-electrical apparatus throughout all the lecture rooms of all the universities in existence.

Now M. Gaston Plantè's theory supplies the first of these two difficulties, though not the second. And in supplying the first it seems to suggest a process of nature in the tropical belt of our earth, somewhat of a comparable but complementary kind to auroral evolution near the poles; and only too much alike at the present epoch of scientific history in this,—viz. that some of the greatest men of the day have each suggested that electricity has the chief part of the work to perform, and yet they cannot quite prove, by experiments with their chamber apparatus, that there is any electricity there at all, of that instrumental kind.

M. Plantè's theory, but which each person interested in the matter should read for himself in the French volume already named, is shortly, that the earth-ball at Creation received a full charge of cosmical electricity, and became an "electrical storage" of the grandest kind, sufficient to last myriad ages, even with a large annual leakage. This leakage he considers to be in a manner

assisted or stimulated by the sun warming up the tropical seas; but to be prevented from escaping thence by the aërial atmosphere pressing upon its surface, and forming one of the worst of conductors, whenever its state is verging on the dry. But transfuse those dry gases of which the atmosphere is mainly composed, with watery vapour, and its molecules immediately become means for conducting the electricity from the ocean surface up to the cloud level. The vesicles, of which clouds are composed, then become a further carriage for such earth-central derived electricity; which, after supplying the thunder and lightning, or disruptive discharges, of the tropics, then travels with the anti-trades spirally over the temperate regions of the earth, and reaching at last the circumpolar air, full of frozen particles of moisture, gives out there silent "brush discharges," or in fact auroræ—the auroral spectroscope line alone excepted.

Arrived at that point, M. Plantè seems nearly at one with Professor Stokes. But many persons may ask, has even M. Plantè any practical proof of this escape existing and going on actively in the tropics, of his supposed original charge of the earth's interior electricity? He does not dogmatise on the point; but rather invites inquiry and observation. Wherefore it would be rather culpable in me, who had the privilege of witnessing that remarkable series of Madeiran clouds anchored above the island for twelve hours, not to try how far his hypothesis suits the case. Madeira is certainly not within the

tropics; but on the 26th of June in the northern hemisphere there is even still greater solar heat experienced in Madeira's general parallel than under the equator itself. Again, if the ocean becomes electrically charged and desires to find a discharging point, an island in its midst, high enough, as Madeira is, to reach the great environing cloud stratum of the earth, might be most suitable; in fact a real conductor, if there be plenty of watery vapour in the air round about it. But that, as we have already seen, is Madeira's grand and continual characteristic; so that neither Lisbon on the Atlantic's eastern coast, nor Malta in the Mediterranean, nor the Azore Islands farther to the north-west, nor yet the Canaries to the south, can compare with Madeira for its nearly perennial current of ascending ocean vapour.

This is so far, in a general way, in favour of M. Plantè's idea; but for the particular date of occurrence of a special manifestation of it we must look elsewhere. Now when I visited Palermo in the spring of 1872, the astronomers in the Observatorio Reale there, were comparing the occurrence of their later siroccos from the African coast with special outbreaks of the solar red-prominences; and were imagining too that the latter had been the agents to pull, as it were, the meteorologic trigger and let the desert climate at that instant explode its long-confined and pent-up breath, at each of such and such particular epochs. Did any such solar manifestation then take place at the time of the peculiar Madeiran

cloud? for even if that cloud was a Leste accompaniment or production, that does not explain why a Leste wind began at that particular time rather than at any other.

The answer I have to make is, that while my apparatus did not enable me to observe solar red-prominences in Madeira, it did, with a little alteration, suffice for taking pictures of the spots on the sun; and I had done so once a day as a rule, with this among other results,—viz. that the sun in and about the middle of June was in a very languid condition, showing only small spots, and these soon dying out. But on the 24th and 25th an increased size of spots and vigour of formation began to manifest themselves. On the 26th, as already remarked, no observations were taken; but on the 27th (the day after the cloud) an immense bound forward was recognised to have been accomplished in the formation of new, or rapid growth of old, spots, not far, too, from the middle of the solar disc.

Now there may probably be some individuals in society who still ridicule the notion that sun-spots, or rather the solar energies they represent, can have any influence upon anything that goes on upon this earth. It may therefore be instructive to give additional currency here to a very new result of observation, elicited by the Smithsonian Institution, Washington, U.S., from the Observatory of Willet's Point, New York. The observers there, who are numerous enough to take watch

and watch all the night through, and night after night, set themselves steadily to note the number of auroras that occurred; until after ten years, their records were found both to give a fairly regular retrocession in 7 years from 100 down to 4; and the dates of these extremes to coincide, the first with the maximum, and the second with the minimum, of the sun-spot cycle for the time, as determined by other observers chiefly in Europe; since which period the auroras have begun to increase again; thus, and the sun-spots too :—

Year	Total Auroras observed and concluded.	
1870	108	Sun-spot max.
1871	104	
1872	94	
1873	92	
1874	35	
1875	27	
1876	17	
1877	13	
1878	4	Sun-spot min.
1879	16	
1880	22	

The recent researches of Baron Nordjenskiöld, in his famous *Vega* voyage, have shown more than ever that the aurora is a pre-eminently terrestrial phenomenon, having its seat actually half in and half out of the solid earth. And yet the above numbers, so independently observed in America, can be explained by nothing but the frequency and intensity of the earth's auroral displays,

being dependent on what causes the far grander manifestations in the sun, which we, at our distance of 92 millions of miles, simply call "spots."

But there is still another and a very recent cosmical instance of very widely admitted electric influences from one body of the solar system to another, which has a singular claim for being mentioned on the present occasion. For on the very night of the cloud, or June 26, it so chanced that a few of the inhabitants of Madeira first caught sight of Tebbutt's great comet of 1881 coming up from the south, and proving itself presently to be one of the grandest comets of very recent times. As, moreover, it soon became circumpolar to northern observers, it was more closely studied at all the large European and American observatories, by both telescopic and spectroscopic scrutiny, than had ever been the case with any former comet. And the general conclusion seems to be, that the chief phenomena then witnessed can only be explained by electrical influences reaching the comet from the sun, though the distance between the two bodies might be even greater than that between the sun and our earth.

On this subject Dr. Huggins, in his lecture of January 20, 1882, before the Royal Institution, London, says at his tenth page: "There seems to be a rapidly-growing feeling among physicists that both the self-light of comets and the phenomena of their tails belong to the order of electrical phenomena." And again, on his page 11,

of the various suggested modes of operation for the electricity conceived, he writes: "Broadly they group themselves about the common idea that great electrical disturbances are set up by the sun's action in connection with the vaporisation of some of the matter of the nucleus (of the comet), and that the tail is matter carried away, possibly in connection with electric discharges."

Dr. C. W. Siemens also,—in a very late paper read before the Royal Society, London, on "The Conservation of Energy in the Sun,"—remarks in the matter of the zodiacal light and of comets, that each particle composing them "would have its electric tension vastly increased in its forcible removal (from the solar neighbourhood) in the same way as the fine dust of the desert has been observed by Werner Siemens to be in a state of high electrification on the apex of the Cheops Pyramid. Would not the zodiacal light also," he asks, "find explanation by slow electric discharge backward from the dust (cosmical, of which it is composed) towards the sun? and would the same cause not account for a great difference of potential between the sun and earth, which latter may be supposed to be washed by the solar radial current? May not the presence of the current also furnish us with an explanation of the fact, that hydrogen, while abounding apparently in space, is practically absent in our atmosphere, where aqueous vapour, which may be partly derived from the sun, takes its place? An action analogous to this, though on a much smaller scale, may

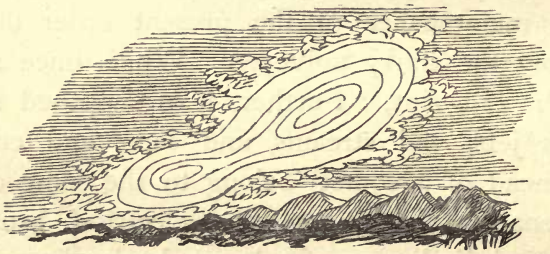
be set up also by terrestrial rotation, giving rise to an electrical discharge from the outgoing equatorial stream to the Polar regions, where the atmosphere to be pierced by the return flood is of least resistance."

In short, Dr. Siemens shows that the production of an extra quantity of invisible watery vapour at any time, on any one of the globes of the solar planetary system, produces in time an effect upon them all through means of the medium, exceedingly rare but still a gaseous medium, in which they move and have their existence; and wherein the association at one time, and disassociation at another, of the gases forming watery vapour through the many agencies of light, heat, electricity, rarefaction, and condensation, is one of the most moving importance to the preservation of all the life we know of, and the maintenance of the present order of things throughout the starry universe. While, once more to quote Dr. Huggins, "Further, it is supposed that the luminous jets, and streams, and caps, and envelopes (of the head of a comet) belong to the same order of phenomena as the aurora, the electrical brush, and the stratified discharges of exhausted tubes."

This last order of artificial phenomena is precisely what the Madeiran cloud of June 26 reminded me of in its general appearance, which is all that I can speak to. So that, for more precise ideas of its nature, we can only hope that the permanent island residents will themselves prosecute the instrumental observation of their extraor-

dinary phenomenon at every opportunity they may enjoy of seeing it repeat itself in the skies above their heads; they neglecting at the same time nothing in the contemporary physics of the sun, and of the earth as a whole.

At present, therefore, I will only seek to conclude this paper with a very few words on the more general and practical results, both to plants and man, flowing from the island's ordinary, but most peculiar, meteorological conditions; and chiefly from the large quantity of invisible watery vapour it holds in suspension, without being saturated thereby.



Evening appearance of the remarkable cloud of June 26, 1881.

PART V.

GENERAL RESULTS FOR VEGETABLE AND ANIMAL LIFE IN MADEIRA.

For any average country near latitude 32° or 33°, and in proximity to either the Mediterranean or North Africa, what is there usually considered more characteristic of its vegetation, than to speak of it as a land where, under good government, every poor man lives under his own vine and his own fig-tree? The phrase has applied to Palestine for 3000 years, but fails at once in Madeira; where we should rather say, that every happy cottager lives under his own banana, and his own pumpkin, trellised after vine-fashion.

Grape vines do of course grow in Madeira, and the wine made therefrom has had a great name for a couple of centuries; but not from the time of the island's earliest history, as testified by her heraldic shield of arms, wherein her first and best agriculture is typified by five sugar loaves; and the sugar-cane, with its wealth of sedgy, bright green leaves, is evidently a far more appropriate production for her moisture-laden atmosphere than

a fruit whose full perfection demands cold winters to precede hot, dry, and sunshiny summers. Under abnormal circumstances of European wars and "most favoured nation" custom-duties, several past generations of Madeirese grew rich by making wine in abundance for artificially promoted markets. But during the last thirty years melancholy retribution has overtaken them all. For their vines have almost entirely perished of diseases rendered fatal to them by overtaxed Nature; the palatial homes of the grandee planters have either fallen into ruin or become the possession of strangers, while the sugar-cane is once more being looked to as the island's best friend.[1]

Or take another case of two plants still more widely opposed to each other. There, where the plains of Palestine descend from their usual high level to join with the lowlands of Arabia, what an essential source of food to the sons of Ishmael is not the fruit of the date palm (*Phœnix dactylifera*)? "I weep (with joy) when I remember Feiran," was the song of a grand old Sheikh of the Sinaitic Peninsula; for that valley amongst rocky mountains is full of date palms, which go on producing their gorgeous fruit through the hot summer and hotter and drier autumn, when everything else is burnt up around them. But in Madeira such a man would find

[1] A little grape-growing and wine-making also, chiefly under British auspices, has begun once again; and the quality of the produce, as testified by the exports of the house of Henry Dru Drury, is said to be very good.

no sustenance. Some date palms are there to be seen, but only as curiosities in rich men's gardens, for they seldom or never bear any fruit,—the summer being neither hot enough, nor dry and stimulating enough, for them. In place however of dates, and precisely because the Madeiran summers are cool, the winters warm, and the air nearly saturated with moisture the whole twelve months through, therefore the custard-apple tree (*Annona squamosa*) of more decidedly tropic lands goes on with its greener growth all the spring, summer, and autumn, and presents its perfected fruit at Christmas.[1]

Still better do some of the native trees of steamy regions in South America, and more especially in Madagascar, suit Madeira: and there is a grand form of tree Strelitzia from there (a *Urania*), forming patriarchal clumps of grandest foliage, with plantain-like leaves, but longer stalks, shaggy contorted stems of all ages, and weird flowers like jackals' faces looking straight out at you with pricked-up ears; without which plant apparently no gentleman's garden in and around Funchal would now be deemed complete. While if, like Madagascar with her chameleons, Madeira is overrun with little lizards, blue, green, yellow,—darting about here, there, and everywhere,—she has none of the serpents of Syria, the cobras of Egypt, or the deadly vipers of the African desert.

Arums, sweet-potatoes, bamboos, of course abound;

[1] The market price quoted by Robert White is 10d. to 2s. 6d. per dozen.

and as to its timber trees Madeira is the country of laurels grown enormous;[1] a happy situation where the magnolia thrives better than the oak; where the oak keeps its old leaves till the new ones appear; where the oleander, the bougainvillea, and the camellia make gor-

[1] The representative tree of the island, the Til, is one of these; the biggest tree with the shortest name, or a not very pleasing one if we go to the botanists and learn to call it *Laurus fœtens;* but the disagreeable smell which the wood is infected with soon after it is felled, gradually evaporates; and, like the "Stink-hout" of the Cape Colony, leaves the happy owner who has employed it, in possession of furniture almost indestructible, and always quotable in the market at an extra price. The poet, as a matter of course, enters into none of these things; but has some grand words to say for all that of

THE GIANT TIL.

Of forest trees there's none, there's none
  Can match the mighty Til;
Like rubies that sparkle in the sun,
  His leaves the horizon fill.
His girth it is a giant's,
  And his shade a host might hide;
    A forest is he,
    That single tree,
  So stately and so wide!

When Zargo lighted on our Isle
  A monster Til he found,
Whose branches measured—nay, do not smile—
  A thousand paces round!
Cold-blooded Northern sceptics,
  Behold what our Sun can do;
    Of stalwart men
    Hand-linked were ten
  To embrace that Til too few!

geous red masses in the landscape half the size of a house; where roses white and roses pink clamber over everything, and are flowering more or less all the year through. And so with the myrtle, jasmine, fuchsia, honeysuckle. Still more with the flaming scarlet geranium, the grand datura, the heliotrope grown to an enormous bush; and, spreading farther and farther every day are passion-flowers, which cover verandahs with their leaves and blossoms, and drop their large purple fruits every evening.

In short, Madeira,—with its gentle breezes, its avoidance of both summer heat and winter cold, its large

'Twas in the Cadéa Velh' he stood
Till Spain usurped the crown,
When Philip for his Armada-wood
The noble tree cut down.
Its beauteous veins, dark-polished,
Shone in many a gay saloon;
But a storm arose,
And his English foes
That Armada finished soon!

Of forest trees there's none, there's none
Can match the mighty Til;
Like rubies that sparkle in the sun,
His leaves the horizon fill.
His girth it is a giant's,
And his shade a host might hide;
A forest is he,
That single tree,
So stately and so wide!

T. M. Hughes, 1845.

amount of subdued, secondary light from thin, fleeting, solar-illumined clouds, rather than from the burning sun direct; and its air, always well charged with the invisible water-vapour which delicate plants love so well, has been called "The Ocean Flower," and still more endearingly "The Paradise of Flowers,"—

> "The paradise of flowers, their native land is here,
> Where laugh the rosy hours, and sunlight robes the year;
> Soft breathing eve and morn their cups with nectar fill,
> New buds each instant born, drink sun and dew at will;"

and so the island poet proceeds almost *ad infinitum.*

But now it is time to put in a word of plain prose, touching the practical use of this most flowery island, both to the world in general, and Great Britain in particular. For as to its first and chief duty of contributing to the exchequer of its *suzerain* country, Portugal,[1] and furnishing Lisbon with never-ending supplies of bananas and wicker-work easy chairs,—all that of course goes on in the most exemplary manner, and is no business of mine to inquire into.

As a coaling-station, then, for ocean steamers of all peoples, Madeira is pre-eminent; safer of approach than the other more numerously-grouped East Atlantic Isles of either Canaria, Cape Verde, or the Azores; and happy

[1] To whom, we feel sure, it owes its admirable system of Levadas, or watercourses, which flood every garden once a fortnight through the summer; and its coat-of-mail method of paving with little stones every street, road, and garden path, either in or around the chief city, and thereby keeping them free from dust, and immediately dry after the heaviest rains.

in possessing so courteous and able a mercantile house as that of Messrs. Blandy Brothers, the chosen agents of seven steamship companies; while Consuls of no less than thirteen nations reside here.

But chiefly, and above everything else, is Madeira a health station for consumptive patients. In and around Funchal, more especially, it might almost be said that attendance on the sick is the profession, or calling, or occupation, of most of the living; and how well they perform their parts! The Portuguese mind or nature lends itself beautifully to the employment. More faithful and more naïvely sympathetic attendants are nowhere to be found; they seem all to step softly, and speak low; to be kindly affectioned one to another; at the same time that they vie in devotion by night and by day to gratify the least wish of the poor sick one, fading gradually away; or, it may be, steadily reviving. For the climate is largely favourable; and where, out of 100 cases sent to the Brompton Consumption Hospital at home, 78 have died within thirty months,—of the same number sent to Madeira, only 34 have proved fatal.

Yet are not by any means all consumptive patients to be shipped off indiscriminately to Madeira. For, as the so-early-cut-off Dr. Mason admirably indicated in his day, there *are* cases of consumption requiring a dry, just as much as others do a humid, atmosphere. So that for the former, Madeira is as decidedly the wrong, as for the latter, it is the right, place; and he has left behind him

the following utilisation of the island's chief climatic anomaly, as a plain and simple rule that every one may judge by.

"If," says he, "a visitation of the arid Leste wind, with its accompanying extreme depression of the wet, below the dry, bulb thermometer, disagrees with any patient—annoys, oppresses, wearies him, producing pains in the head, great thirst, general languor, faintness, loss of appetite, and inability to take exercise, either within or without doors, together with an unusually irritable state of mind—then let that patient remain in Madeira, where the Leste condition of atmosphere occurs so seldom and departs so quickly.

"But if," as with Dr. Mason himself, though he was then so near the end of his career, "the Leste wind's commencement shall instantly cause a patient to feel cheerful, to be extremely exhilarated in spirit, to enter joyfully, as it were, into a new phase of existence, enabling him to take three times as much exercise as before, without any feeling of languor or oppression, or any of his accustomed trouble, when moving about at all, from profuse sensible perspiration—then let such a patient hasten away from lovely Madeira, how beauteous soever; and let him seek out a new sanitarium, as nearly like Madeira in mean summer temperature as may be, but totally opposite as to watery vapour." Such, however, is not easy to find as a *permanent* residence; for the winters of dry countries are usually severe. But by changing

about from north to south of the equator, in these days of quick and luxurious steam-voyaging, much may be done. Trying the North African desert, or, better still, the Peak of Teneriffe above the clouds, at one season of the year; and at another, the rainless West Coast of either South Africa or Australia. Anywhere about there, in British possessions, within a wide limit of latitude, will answer; if, for the time that the region is to be occupied, a Mason's hygrometer shall show a dry temperature between 68° and 90°, and a depression of the wet bulb from 15° to 33°.[1]

[1] The high temperatures implied between 68° and 90°, when further accompanied by clear skies, bright sunshine, and the large hygrometric depressions indicated above, are so provocative of cracked lips, sunburned skin, frizzled hair, etc. etc., as to demand some special protection for the head, its contained "sea of priceless medullary matter," and the face as well. And they always have demanded it. So that all nations, living and working in anything approaching to a natural, open-air manner, have long ago become easily distinguishable by the several kinds of head-dress they have invented and perfected through the ages, to meet the respective amounts of solar radiation and dryness of air, which their countries may be accustomed to, or afflicted with.

Thus the Bedouin Arab's bulky headgear, thickly padded above, and drawing closely round the face and over the back of the neck and shoulders, bespeaks a bright zenithal sun and its burning radiations—both direct from the sky, and reflected from the bright, barren sand,—as well as a parched, arid, skin-drying-up air.

The Indian Mussulman turban, composed of thirty yards of muslin in length, wound round and round the head, but allowing the last turn or two to be taken about the face when the man is on a journey, speaks much of solar radiations chiefly, and rather less both of reflections from the ground, and of arid air. While there is a still decreasing proportion of these latter features in the rice-fields and sugar plantations of the Southern States of

Both of those western lines of coast in the southern hemisphere have been the ruination of all attempts to colonise and farm them for commercial profit, or to support permanently more than a handful of wretched

North America; where shade from above seems alone sought for, and is effectually obtained by their huge sombrero hats, with brims as broad as many umbrellas, and without a vestige of cloth to be wrapped around the face.

But on these principles how fares it with the very opposite extreme of both climate and country,—viz. with Madeira, where the sun is so generally clouded; and, when it does shine, has the sting taken out of the red, or heat, end of its spectrum, by the unequalled amount of invisible watery vapour in the island air?

The answer is given at once, by Madeira having evolved for herself through three centuries a headgear unknown to all the rest of the world; and in the construction of which, both solar radiations, parching air, and unruly winds must have been the last things thought of. It is called in the island a "carapusa." But that word is merely the Portuguese for "a cloth cap;" and is equally used in the Azores for what the men there cover their heads with, but which is a something most widely different; for it has a formidable peak in front, nearly a foot long, to shade the eyes, and a curtain at the back to protect the nape of the neck, from wind as well as sun. (See the picture thereof in Sir Wyville Thomson's *Voyage of the Challenger*, vol. ii.)

But the Madeiran "carapusa" is a ridiculous little skull cap, ending in a tube above, so that it is very much in the shape of an apothecary's glass funnel inverted; and gives no protection whatever to the face from any solar radiations, whether coming from above, or below, or anywhere around. And, further, while the women of the Azores are remarkable for protecting their heads and faces with enormous hoods,—coming out so far and so long drawn out to the front, that an old-fashioned English cottage poke-bonnet is nothing to them,—the equally Portuguese-descended women of Madeira have for *their* head-dress merely another Madeiran carapusa, just like that of the men; so exactly indeed, that, when a youth and a maiden become engaged, they exchange carapusas in token thereof, and no one need know the fact but themselves.

natives, roaming over wide, burnt-up plains, and dying for want of the smallest rain-shower, which refuses for months together to fall through the parching air, and from "clouds without water." All this occurring, because with both of those western coast-lines of great southern continents, their general wind blows off the land behind them, while a cold ocean current from the Antarctic Pole flows continually in their front, giving off no sensible amount of watery vapour, even under a blazing zenithal sun.[1]

[1] This may be the proper place at which to introduce some further remarks which I have been requested to make on Mr. Milne-Home's excellent Memoir, in part alluded to in the note on p. 28. The object of that Memoir was useful, generous, philanthropic—viz. to make an island, Malta, with which the promoter had no interested connection, and which is now nearly barren of everything except fortifications and war's alarms,—a garden of vegetation like Madeira. The method by which this was to be brought about was by planting trees over all the hilly open country throughout Malta,—and an immense number of extracts from authors of repute were collected and methodised, combining to show that trees did possess in themselves some real power for increasing rainfall, humidity, and vegetation, wherever they were made to grow on a large scale. But was that power sufficient for the particular case in question?

On inquiry from Mr. Milne-Home as to the results of his experiment in practice, I regretted to find that, although the Maltese Government had taken up the subject on the first appearance of his paper with the utmost zeal, and appropriated £800 a year to carry out the scheme, they dropped it again in two or three years; and were then found to have been more engaged in making ornamental shrubberies near the towns, than clothing the open hills with trees. So of course no perceptible effect has yet been produced in altering the Maltese climate.

The general question is, however, one which I used to hear much discussed forty-five years ago in the hot, dry climate of the Cape of Good Hope, by such men as Sir John Herschel, Sir T. Maclear, Dr. Adamson, Charles

But the watery vapour so wanting there is found in even superabundance on the very same continent's eastern coasts, where the prevailing winds blow from the sea upon the land, and the former is recruited by a warm current from the equator. There, then, amongst the forest trees of Queensland, or the grassy plains of the Zulu country and the Transvaal, let agriculture, and gardening, and populous settlements be carried to any extent, in an almost steamy atmosphere, wherein plants

D. Bell, and other good members of the South African Literary and Scientific Institution. And the general resulting opinion seemed to be this,—Man *can* do a little in modifying the aridity of a climate and soil by growing trees, and ought to be doing it much oftener and more extensively than he does; —but on the whole, whenever, at least in the southern hemisphere, we see an island or a coast-line eminently umbrageous with trees, in an atmosphere superabundantly moist and rainy,—the trees are the consequence, rather than the cause, of that moisture. So that no tree-planting by all mankind would ever make the coast of Peru (where the only plant found by Darwin, along a length of 300 miles of it, was a lichen growing on the carcase of a dead mule) to show a rainfall and a vegetation like that of the opposite side of South America in the dense and damp forests of Rio de Janeiro.

But the South African "Cape" was one of the dry countries to be improved; so with juvenile ardour I experimented myself, at my own cost, on part of the Royal Observatory hill there, during ten years. Finding, *first*, that transplanting, as at home, would not answer; and that sowing seeds of trees in the places where they were intended to stand, was the only plan for success. Sowing them, too, in such abundance, that Nature had an opportunity of producing *varieties* suitable to the untoward situation, and they only eventually survived. *Second*, complete success, on the very small scale on which I worked, was only secured at last by putting up a windmill-pump and lead pipes, and thereby raising water from a shallow marsh below, to the top of the hill, whereon the experiments were conducted: though that may perhaps be considered to be a begging of the original question.

of every kind grow rapidly, and the food of a stalwart people is rapidly raised. But let the hitherto intractable western coasts, such as the Swan River Settlement of one, or Walvisch Bay and Namaqualand of the other, be rather utilised as grand *sanitaria* for the Masonian variety of consumptive patients; and if it be true that 70,000 lives are lost every year in Great Britain from her dread disease consumption, what a field is presented to the statesman to plan for, and to the philanthropist to work in.

For remember that nineteen out of every twenty of those consumptive victims are cut off in the very prime of their lives, just as their full education for fitting them to play a useful part to the community they had been brought up in, is finished; and when their returns of gratitude, genius, and patriotism with excusable ambition, were about to begin; and each one of the poor young fellows, now so prematurely doomed to die, and of whom I saw so many in Madeira, did invariably appear the most high-souled, most intellectual, almost saintly, martyr-like, and most beautifully idealled existency I had ever come across.

We have already, in Madeira's science walks, seen Dr. Mason nobly sacrificing himself, at twenty-seven years of age, for the prospective meteorologic and medical benefit of others; and in the paths of literature in the same place the early deceased Terence M. Hughes was an equally meritorious though peaceful hero, laboriously

spending his very latest days of life in versifying whatever of the great, or good, or true had been recorded in the history of the little isle.[1] He could rejoice, too, in truest sympathy with those around him who did rejoice in their recovered health, and sing for them, after all the other delights of the "Ocean Flower" residence had been expatiated on—

"And sweetest far, when fell disease *hath* mocked
At youthful toils for glory, fame, or wealth,
To feel new life, in gentlest cradle rocked,
And o'er the cheek steal ruddier hues of health."

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[1] The following is perhaps one of his happiest examples, in its decided reproduction, of the chivalric sentiments of the best days of that noble little nation living nearer to the west than all the rest of Continental Europe:

"When great Camóens, warrior-bard,
Beneath his gallant father's eye
Fought his first battle, straining hard
To earn the knightly spurs or die;
Flashing sword 'neath plume high-tossing
With the Moor's alfangé crossing:
'Where,' he said, 'paternal valour
Bids a son to victory rush,
Filial face o'erspread with pallor
Ne'er could make a father's blush!'

"'Twas in Gibraltar's glorious strait,
King John's engaged the Moorish fleet,
Camóens' father spurned at fate,
His galley and the amiral's meet.
O'er the deck where death rained quickest,
Moorish marksman at the father
Treacherous aimed a deadly ball;
Rushed the son to perish, rather
Then that honoured sire should fall!

While for himself, at the very same time, he could only add—

"But I, whom God hath summoned, here i' the core
Feel life ebb gently, ere first manhood flee,
And walk, deep musing, on the solemn shore
That girds the Ocean of Eternity."

"His filial arm its shield advanced
In time to save a father's life;
But to his eye the missile glanced,
And left Camóens maimed for life.
'Oh my son! my grief is tender,'
Sighed Hesperia's brave defender.
'What! an eye to save from dying
Him from whom my life I drew?'
Said the warrior-bard replying:
'Bounteous Nature gave me two!'"

And again, as illustrative of his philosophy, and his own sad experiences taken improvingly to his soul—

"A bubble on the topmost wave is Man,
A moment shining 'mid tumultuous strife,
And bursting when his little course is ran
Upon the tear-replenished sea of life.

"'Tis sickness wakes him from complacent dreams
To thoughts repelled with smiles by haughty health;
'Tis sickness prompts to higher, holier themes,
And weans from the absorbing world by stealth."

Is there something in the Madeiran climate inclining to poetry, or does some higher impulse successively lead poetical souls by nature, to dwell for a while in those halcyon gardens of flowers? For now we have another little book of verse presented to us from thence. By a lady on this occasion; and so eminently taking up the religious vein,—and carrying it forward, from the vague generalities which it so seldom passes in ordinary poetry, up to its precise applications in God's own history through Revealed Scripture, of

man's past and future Divinely purposed state both upon earth and in heaven, —that it were almost a sin to leave the work (published by R. Banks, London) altogether unnoticed on the present occasion. Its title is *Faithful for Ever*, viz. the love of God for man through all the ages; in itself the grandest epic ever composed; and concludes, of that love divine, thus:—

"O mighty love! true, deep, unfathomable,
From Abram's time till now unchangeable,
And culminating in the Lord's anointed,
Whose mind with God's is interchangeable,
Art Thou not ever faithful? Bid us trust
Thee perfectly. The times are looming dark,
And Armageddon soon may be upon us:
The gathering foes but need the kindling spark,
And one vast conflagration must ensue,
Evolving mighty issues. Euphrates' vale
Will soon be bridged as pathway for the East;
Already unclean spirits tell a tale
Of faithless superstition, wielding power
O'er those without an anchor for their soul;
Earthquakes in divers places shake the ground,
And signs in heaven illuminate the scroll.
But they, Thine own, whether they wing their way—
Suddenly drawn from earth by loving look
Of precious Saviour, cleaving air like doves,
Casting no glance on what they just forsook—
Or whether die, and rise as "dead in Christ,"
It matters not, so as they are with Thee;
For Thou wilt wipe all tears from every eye;
All pain and sorrow then shall cease to be.
They will not stand before the Great White Throne
Expecting judgment; that for them is past,
Since they are Thine, the Alpha and Omega,
Beginning and the end, the first and last."

APPENDICES.

I. Observations of Days and Succession of Days at Madeira, in June and July 1881; and at Lisbon in the same Months of 1878.

II. Condensed Tables of Means of Years at Madeira (lat. 32° 38′), Lisbon (lat. 38° 43′), Jerusalem (lat. 31° 47′), and Scotland (lat. 56° 3′); also at Madrid (lat. 40° 24′).

APPENDIX

OBSERVATION OF DAYS, AT

(A.) METEOROLOGICAL JOURNAL kept by Mrs. PIAZZI SMYTH at QUINTA DO CORVALHO, Long. = 1 h. 8 m. west, during Solar Spectroscopic

MADEIRA.

DATE, JUNE 1881.			Barometer aneroid, corrected to mercurial at sea-level and 68° F.	Barometer of French bulletin at sea-level and 68° F.	THERMOMETERS.					HYGROMETER.		HYGROMETRICAL		
Day of Month	Day of Week	Hour.			Last night's minimum.	This day's maximum at or after 3 h. P.M.	Mean temp. by mean of min. and max.	Daily Range.	French bulletin, temp. at 7 h. A.M. reduced to mean of 24 hrs.	Dry Bulb.	Wet Bulb.	Depression of Wet Bulb.	Temperature of dew point.	Elastic force of vapour.
		A.M.	Ins.	Ins.	Deg.	Deg.	Deg.	Deg.	Deg.	Deg.	Deg.	Deg.	Deg.	In.
8	☿	9 h.	30.32	30.32	65.0	69.0	67.0	4.0	66.5	69.8	63.0	6.8	57.7	.477
9	♃	,,	30.28	30.29	65.0	68.9	67.0	3.9	67.9	69.5	65.3	4.2	62.0	.555
10	♀	,,	30.31	30.31	63.0	69.5	66.2	6.5	68.3	69.3	65.2	4.1	62.0	.554
11	♄	,,	30.34	30.32	63.8	70.1	67.0	6.3	66.3	69.8	64.0	5.8	59.5	.507
12	☉	,,	30.32	30.32	64.8	70.6	67.7	5.8	67.0	70.2	65.0	5.2	61.0	.538
13	☾	,,	30.26	30.23	64.7	70.8	67.7	6.1	66.6	70.0	65.0	5.0	61.1	.541
14	♂	,,	30.21	30.18	66.0	70.9	68.4	4.9	67.5	71.0	66.3	4.7	62.7	.571
15	☿	,,	30.29	30.26	66.2	68.5	67.4	2.3	67.5	69.5	64.0	5.5	59.7	.511
16	♃	,,	30.31	30.19	66.0	69.0	67.5	3.0	68.6	69.8	64.0	5.8	59.5	.507

I.

BOTH MADEIRA (A) AND LISBON (B).

270 feet nearly above Sea-level, distance 0.25 mile, MADEIRA, Lat. = 32° 38′ north, Observations there in June and July 1881.

COMPUTED RESULTS.			CLOUDS.		WIND.		SPECTRUM.			
Weight of vapour in a cubic foot of air.	Weight of vapour required to saturate a cubic foot of air.	Relative Humidity, Sat. = 100.	General 0 to 10.	On Mountain.	Miles per hour.	Direction.	Rain Band 0 to 10.	Low Sun Band 0 to 10.	Rain.	REMARKS.
Grs.	Grs.									
5.22	2.74	65	9	Heavy.	6	N.E.	3	2		☿. Clear early morning.
6.12	1.78	77	10	Heavy.	5	N.N.E.	5	2		♃. Cloudy on hills and sky from early hour.
6.12	1.74	77	8	Heavy.	2	N.E.	4	2		
5.54	2.42	70	0	None.	0	0	4	2		♄. No clouds all day long.
5.86	2.20	72	2	Light.	1	N.E.	4	2		
5.90	2.10	73	5	None.	0	0	3	2		☾. No N.E. clouds on either mountain or sky;
6.22	2.08	75	2	None.	2	N.E.	4	2		but a great spread there of cirri and cirro-cumuli moving over the face of the sun from W.N.W.
5.60	2.30	71	10	Heavy.	0	0	5	2		☿. Sky cloudy, but atmosphere wonderfully clear, the sea a deep blue, and the horizon line sharp. The Desertas standing out in colour a deep purple !
5.54	2.42	70	10	Heavy.	0	0	5	2		♃. Sky again cloudy, but atmosphere clear; sea of a gray colour. The Desertas, a sweet soft blue; at sunset they became of a copper crimson hue, changing into a deep, dark purple !

Date, June 1881.			Barometer aneroid, corrected to mercurial at sea-level and 68° F.	Barometer of French bulletin at sea-level and 68° F.	Thermometers.					Hygrometer.		Hygrometrical		
Day of		Hour.			Last night's minimum.	This day's maximum at or after 3 h. P.M.	Mean temp. by mean of min. and max.	Daily Range.	French bulletin, temp. at 7 h. A.M. reduced to mean of 24 hrs.	Dry Bulb.	Wet Bulb.	Depression of Wet Bulb.	Temperature of dew point.	Elastic force of vapour.
Month	Week.													
		A.M.	Ins.	Ins.	Deg.	Deg.	Deg.	Deg.	Deg.	Deg.	Deg.	Deg.	Deg.	In.
17	♀	9 h.	30.30	30.29	64.7	70.0	67.3	5.3	66.1	69.8	64.2	5.6	59.9	.514
18	♄	,,	30.30	30.29	65.7	70.7	68.2	5.0	66.8	70.5	65.8	4.7	62.2	.562
19	☉	,,	30.34	30.32	67.2	73.0	70.1	5.8	69.0	71.4	66.5	4.9	62.8	.573
20	☾	,,	30.23	30.21	64.5	74.8	69.6	10.3	70.2	73.3	68.2	5.1	64.4	.607
21	♂	,,	30.14	30.10	65.7	76.0	70.8	10.3	70.8	74.7	69.8	4.9	66.2	.646
22	☿	,,	30.16	30.12	68.0	74.3	71.1	6.3	72.0	72.2	69.5	2.7	67.5	.672
23	♃	,,	30.25	30.22	64.7	74.5	69.6	9.8	70.4	73.8	66.3	7.5	60.8	.534
24	♀	,,	30.29	30.30	65.2	72.6	68.9	7.4	69.0	73.2	64.8	8.4	58.6	.494
25	♄	,,	30.39	30.38	61.7	73.9	67.8	12.2	68.8	73.0	66.0	7.0	60.8	.534
26	☉	,,	30.34	...	63.2	74.2	68.7	11.0	...	73.4	67.8	5.6	63.7	.591
27	☾	,,	30.21	30.19	67.3	77.5	72.4	10.2	71.7	75.3	69.2	6.1	64.8	.615
28	♂	,,	30.15	30.10	69.0	73.0	71.0	4.0	71.5	72.6	68.0	4.6	64.6	.609
29	☿	,,	30.18	...	67.2	70.3	68.7	3.1	...	71.3	67.4	3.9	64.4	.606
30	♃	,,	30.28	30.23	65.7	72.4	69.0	6.7	69.0	71.8	69.0	2.8	66.9	.658

COMPUTED RESULTS.			CLOUDS.		WIND.			SPECTRUM.			REMARKS.
Weight of vapour in a cubic foot of air.	Weight of vapour required to saturate a cubic foot of air.	Relative Humidity, Sat. = 100.	General 0 to 10.	On Mountain.	Miles per hour.	Direction. Lower.	Direction. Upper.	Rain Band 0 to 10.	Low Sun Band 0 to 10.	Rain.	
Grs.	Grs.										
5.62	2.34	71	2	None.	1	?	?	5	3		♀. Clouds at 11.15 A.M.
6.12	2.03	75	3	Dense.	1	S.W.	N.E.	5	2		♄. No clouds at 5.30 A.M. either on mountains or sky.
6.22	2.16	74	9	Light.	1	S.W.	?	3	2		
6.62	2.27	74	4	Heavy.	1	S.W.	?	4	2		☾. About noon a strong westerly breeze sprang up, and continued until evening.
6.98	2.33	75	5	Heavy.	4	N.W.	S.W. / N.E.	5	3	×	♂. At 5.30 A.M., sky and mts. perfectly clear! W. wind strong from 9 A.M. No observing. Clouds—clouds most aggravating. Damp and slight rain fell occasionally.
7.31	1.25	85	10	Low down and heavy.	1	N.W.	S.E.	5	2	※	☿. At 4 A.M. it rained heavily; air steaming hot.
5.76	3.28	64	4	Light.	1	W.	E. / S.W.	4	2	※	
5.32	3.54	61	7	Heavy but high.	1	S.W.	N.E.	3	2		♀. Clouds, some drops of rain falling; wind strong from the E.N.E. at noon.
5.80	3.00	66	3	Light.	1	N.E.	S.W.	4	2		
6.44	2.48	72	1	None.	0	0	0	3	1		☉. Remarkable cloud; see special account of it in 4th part of paper.
6.62	2.87	70	0	None.	0	0	0	3	1		☾. Finest day we have had; not a cloud, and warm. First sight of the Comet about 9 P.M.
6.58	2.10	77	10	Heavy.	1	S.W.	?	4	2		♂. Clouds, clouds again! a few drops of rain. In the eastern distance wind strong from N.E.
6.60	1.76	78	10	Heavy.	0	0	0	3	1	X	☿. Heavy, straight down, rain fell all day. The heaviest by far yet.
7.14	1.32	84	10	Heavy.	0	0	0	4	1		

Date, July 1881.			Barometer aneroid, corrected to mercurial at sea-level and 68° F.	Barometer of French bulletin at sea-level and 68° F.	Thermometers.					Hygrometer.		Hygrometrical		
Day of Month	Week.	Hour.			Last night's minimum.	This day's maximum at or after 3 h. P.M.	Mean temp. by mean of min. and max.	Daily Range.	French bulletin, temp. at 7 h. A.M. reduced to mean of 24 hrs.	Dry Bulb.	Wet Bulb.	Depression of Wet Bulb.	Temperature of dew point.	Elastic force of vapour.
		A.M.	Ins.	Ins.	Deg.	Deg.	Deg.	Deg.	Deg.	Deg.	Deg.	Deg.	Deg.	In.
1	♀	9 h.	30.32	30.30	67.0	72.0	69.5	5.0	69.2	70.7	66.5	4.2	63.3	.583
2	♄	,,	30.32	...	64.3	72.3	68.3	8.0	...	72.2	67.5	4.7	64.0	.596
3	☉	,,	30.31	30.30	63.0	72.2	67.6	9.2	67.0	71.3	63.5	7.8	57.6	.476
4	☾	,,	30.34	30.34	64.7	71.0	67.8	6.3	68.8	72.5	65.0	7.5	59.3	.508
5	♂	,,	30.41	30.45	63.5	71.6	67.5	8.1	67.9	71.0	65.5	5.5	61.3	.543
		P.M.												
6	☿	1 h.	30.39	30.46	64.0	73.7	68.8	9.7	68.6	(75.0	69.2)	5.8	65.0	.620
		A.M.												
7	♃	9 h.	30.34	30.34	65.5	72.8	69.2	7.3	69.3	72.3	68.5	3.8	65.6	.632
8	♀	,,	30.34	30.34	63.3	71.3	67.3	8.0	67.9	71.8	64.5	7.3	59.0	.501
9	♄	,,	30.36	...	62.5	73.2	67.8	10.7	...	72.0	65.8	6.2	61.1	.540
10	☉	,,	30.32	30.29	65.7	72.5	69.1	6.8	69.0	72.8	68.5	4.3	65.3	.625
11	☾	,,	30.27	30.25	65.0	74.0	69.5	9.0	69.3	72.6	68.8	3.8	65.9	.639
12	♂	,,	30.30	30.30	62.5	74.0	68.2	11.5	68.8	73.3	68.7	4.6	65.3	.625
13	☿	,,	30.36	30.35	64.0	75.0	69.5	11.0	70.6	73.3	70.2	3.1	67.9	.684
14	♃	,,	30.28	...	67.3	72.0	69.6	4.7	...	71.2	66.0	5.2	62.1	.557
15	♀	,,	30.30	30.26	64.8	74.3	69.6	9.5	69.7	73.0	63.0	10.0	55.6	.443
16	♄	,,	30.33	30.32	63.0	74.2	68.6	11.2	69.0	73.5	69.2	4.3	66.0	.641
17	☉	,,	30.23	30.22	63.0	77.0	70.0	14.0	71.0	74.4	69.3	5.1	65.6	.631
18	☾	,,	30.12	...	66.0	75.0	70.5	9.0	...	74.8	71.3	3.5	68.7	.704
19	♂	,,	30.18	30.14	68.0	74.2	71.1	6.2	73.8	75.8	71.0	4.8	67.5	.676
20	☿	,,	30.22	...	67.3	74.5	70.9	7.2	...	73.3	69.0	4.3	65.8	.636
21	♃	,,	30.27	...	65.7	75.8	70.7	10.1	...	74.5	68.2	6.3	63.6	.588
22	♀	,,	30.30	...	62.2	75.2	68.7	13.0	...	70.0	66.7	3.3	64.2	.602
23	♄	,,	30.25	...	62.0	75.0	68.5	13.0	...	73.6	67.5	6.1	63.1	.578
24	☉	,,	30.20	...	63.3	79.3	71.3	16.0	...	74.7	69.8	4.9	66.2	.646

COMPUTED RESULTS.			CLOUDS.		WIND.		SPECTRUM.		Rain.	REMARKS.
Weight of vapour in a cubic foot of air.	Weight of vapour required to saturate a cubic foot of air.	Relative Humidity, Sat. = 100.	General 0 to 10.	On Mountain.	Miles per hour.	Direction.	Rain Band 0 to 10.	Low Sun Band 0 to 10.		
Grs.	Grs.									
6.36	1.85	77	10	Heavy.	0	0	3	1		
6.46	2.10	76	4	Heavy.	0	0	2	1		♄. Fine view of the comet a little past 9 P.M.; sky clear, and stars brilliant.
5.22	3.14	62	2	None.	1	S.W.	2	1		
5.50	3.15	63	7	None.	0	0	3	1		
5.90	2.40	71	9	Heavy.	0	0	3	2		♂. *No* clouds in the early morning. Upper wind N.E.
6.68	2.72	71	6	Light.	1	S.W.	4	2		
6.84	1.75	80	9	Heavy.	0	0	3	1		
5.47	2.99	64	8	Light.	0	0	3	1		
5.84	2.66	68	3	Very light.	0	0	3	2		♄. Good observing day.
6.74	2.00	78	9	Heavy.	1	S.W.	3	1		
6.90	1.78	81	8	Light.	0	0	4	2		
6.82	2.07	76	5	Light.	0	0	4	2		
7.42	1.47	84	7	Heavy.	2	S.W.	3	1		☿. Clouds above from N.E.
6.06	2.28	72	10	Heavy.	0	0	2	1		
4.80	4.00	54	3	Light.	0	0	3	1		♀. Cleared up, a splendid day.
6.98	1.97	78	0	None.	0	0	4	2		♄. Fine all day; taken up by visitors.
6.84	2.38	74	3	Very light.	0	0	5	2		
7.59	1.75	81	4	Heavy.	0	0	5	2		☾. Clouds passing over the Sun from S.W. and N.E.
7.24	2.40	76	5	Heavy.	1	S.W.	5	2		
6.94	1.95	78	10	Heavy.	0	0	5	2		
6.38	2.87	69	3	Very light.	1	S.W.	4	2		
6.58	1.42	82	3	None.	2	N.E.	4	2		
6.28	2.70	70	3	None.	0	0	3	1		
6.98	2.33	75	1	None.	1	S.W.	4	2		

Date, July 1881.			Barometer aneroid, corrected to mercurial at sea-level and 68° F.	Barometer of French bulletin at sea-level and 68° F.	Thermometers.					Hygrometer.		Hygrometrical		
Day of Month	Day of Week.	Hour.			Last night's minimum.	This day's maximum at or after 3 h. P.M.	Mean temp. by mean of min. and max.	Daily Range.	French bulletin, temp. at 7 h. A.M. reduced to mean of 24 hrs.	Dry Bulb.	Wet Bulb.	Depression of Wet Bulb.	Temperature of dew point.	Elastic force of vapour.
		A.M.	Ins.	Ins.	Deg.	Deg.	Deg.	Deg.	Deg.	Deg.	Deg.	Deg.	Deg.	In.
25	☾	9 h.	30.22	30.17	63.0	...	...	...	72.0	73.8	70.2	3.6	67.6	.676
June Means...			30.27	30.25	64.8	71.3	68.1	6.5	68.0	71.5	66.3	5.2	62.3	.564
July Means....			30.29	30.30	64.9	74.3	69.6	9.4	70.0	72.9	67.7	5.2	63.9	.598

To the above Madeira daily observations, some necessary corrections have been applied for each day, viz.—

To the Aneroid Barometer a final balance of + and — corrections, or + 0.04 inch has been added to make it show the height of a Mercurial Barometer at the sea-level, and at a constant temperature of 68° F.; the reference for the corrections being the Funchal Barometer, for the same days as published in the daily bulletins of M. Ed. Mascart, Director of the Central Office of Meteorology of France, in Paris, and obligingly presented by him, perpetually, to the Royal Observatory, Edinburgh. These very important French-published Funchal Barometer readings are also given in a column of their own, after being reduced from millimetres to British inches; and from freezing to 68° F.; the reduction to sea-level having been already performed.

To the minimum thermometer, after having added 4° daily for deficient column, a contrary correction of 2° has been subtracted on account of its over-sheltered position, too far *within* the dwelling-house, rather than *outside* it.

To the Maximum Thermometer a correction of — 2° has also been made, to eliminate

COMPUTED RESULTS.			CLOUDS.		WIND.		SPECTRUM.		Rain.	REMARKS.
Weight of vapour in a cubic foot of air.	Weight of vapour required to saturate a cubic foot of air.	Relative Humidity, Sat. = 100.	General 0 to 10.	On Mountain.	Miles per hour.	Direction.	Rain Band 0 to 10.	Low Sun Band 0 to 10.		
Grs. 7.32	Grs. 1.72	81	7	Veryheavy	0	0	3	1		
6.14	2.28	73	5.8	...	1.3	...	4.0	1.9		Means for June, Madeira.
6.49	2.31	74	5.6	...	0.4	...	3.5	1.5		Means for July, Madeira.

the heating effect of the forenoon sun on the too thin Venetian blinds of the open window within which said thermometer was suspended.

Lastly, the Thermometer observations of the French bulletins from Funchal have been first reduced from Centigrade to Fahrenheit; and then, having been taken at 7 h. A.M. each day, have had a correction of $+0.8°$ F. applied to them to reduce them to the mean of the 24 hours; that quantity being $\frac{1}{6}$th of the mean daily range of temperature in Madeira for the period of observation.

When monthly means are to be found from the above daily observations, which do not, in case of either of the two months included, cover their whole extent, a correction is required wherever the meteorological quantity concerned is largely and regularly progressive with the time. Probably this is only practically necessary with the mean temperature; but for *its* average rate of progression through the months May, June, July, and August, viz. of $2.5°$ for 30 days, our observations in June deficient by the first 7 days need a correction of $-0.6°$ F.; and those of July, deficient by the last 6 days, a correction of $+0.5°$ F. These corrections have accordingly been applied to the mean temperatures entered above.

APPENDIX

(B.) METEOROLOGICAL JOURNAL kept by Mrs. PIAZZI SMYTH at CAMPOLIDE DE BAIXO, Sea-level = 355 feet nearly; and distance from the sea, several miles; to

LISBON.

DATE, JUNE 1878.			Barometer aneroid, corrected to mercurial at sea-level and 68° F.	French Bar. pressure for Lisbon at sea-level and 68° F.	THERMOMETERS.					HYGROMETER.		HYGROMETRICAL		
Day of Month	Week.	Hour.			Last night's minimum.	This day's maximum at or after 2 h. P.M.	Mean temp. by mean of min. and max.	Daily Range.	French Lisbon temp. at 7 h. A.M. reduced to mean of 24 hrs.	Dry Bulb.	Wet Bulb.	Depression of Wet Bulb.	Temperature of dew point.	Elastic force of vapour.
		A.M.	Ins.	Ins.	Deg.	Deg.	Deg.	Deg.	Deg.	Deg.	Deg.	Deg.	Deg.	In.
8	♄	8.30	30.33	30.33	63.0	77.3	70.1	14.3	67.4	67.3	63.5	3.8	60.5	.528
9	☉	„	30.23	30.21	53.5	78.0	65.7	24.5	67.8	71.0	63.0	8.0	56.9	.464
10	☾	„	30.23	30.15	51.8	77.8	64.8	26.0	65.8	69.5	60.2	9.3	53.0	.403
11	♂	„	30.18	30.25	51.7	72.8	62.2	21.1	66.7	69.2	61.9	7.3	56.2	.452
12	☿	„	30.28	30.27	58.6	71.5	65.0	12.9	66.4	71.2	63.8	7.4	58.2	.486
13	♃	„	30.25	...	54.5	72.3	63.4	17.8	65.5	66.3	60.3	6.0	55.5	.440
14	♀	„	30.16	30.19	61.8	75.2	68.5	13.4	66.1	69.0	62.1	6.9	56.7	.460
15	♄	„	30.33	30.26	55.5	71.4	63.5	15.9	66.7	67.8	60.0	7.8	53.8	.415
16	☉	„	30.24	...	57.5	71.3	64.4	13.8	66.5	68.7	60.8	7.9	54.6	.428
17	☾	„	30.21	30.23	59.5	76.0	67.7	16.5	69.2	71.8	60.1	11.7	51.2	.378
18	♂	„	30.15	30.18	60.0	74.7	67.3	14.7	67.0	71.1	65.0	6.1	60.3	.525
19	☿	„	30.22	30.23	54.8	72.3	63.5	17.5	66.5	69.5	61.7	7.8	55.6	.444
20	♃	„	30.11	30.15	55.2	77.0	66.1	21.8	68.3	72.0	63.3	8.7	56.7	.463
21	♀	„	30.20	30.23	58.5	75.5	67.0	17.0	69.4	70.6	62.0	8.6	55.4	.439
22	♄	„	30.28	30.30	60.2	76.0	68.1	15.8	69.5	72.3	64.9	7.4	59.3	.508

I.—*Continued.*

Lat. = 38° 43′ north, and Long. = 0 h. 36 m. west, near LISBON, height above
accompany Solar Spectrum Observations made there in June and July 1878.

COMPUTED RESULTS.			CLOUDS	WIND.		SPECTRUM.		Rain.	REMARKS.
Weight of vapour in a cubic foot of air.	Weight of vapour required to saturate a cubic foot of air.	Relative Humidity, Sat. = 100.	0 to 10.	Miles per hour.	Direction.	Rain Band 0 to 10.	Low Sun Band 0 to 10.		
Grs.	Grs.								
5·74	1.62	79	9	4	S.W.	4	2	×	♄. A little rain and fog. Earthquake at 11 P.M. on the night of the 7th.
5.10	3.20	61	7	8	N.	3	2		
4·41	3·49	55	2	3	N.E.	2	2		
4·95	2.89	63	6	2	S.W.	4	2		♂. Wind blew strong for some hours.
5·32	3.02	64	5	1	N.	3	2		
4.86	2.23	68	5	12	N.	4	3		♃. Wind westerly, blowing almost a gale at 11 A.M. Barometer fell slowly from 1.30 P.M. until about 5 P.M.
5·03	2.77	64	8	7	N.W.	3	2	×	♀. Some rain fell last night.
4·54	2.92	61	4	8	N.	3	2		♄. Strong northerly wind during the day.
4.67	3.04	60	0	6	N.E.	4	2		☉. Wind blew strong all day from the N.E.
4.14	4.32	49	9	4	N.W.	4	2		
5.69	2.63	69	10	2	W.N.W.	4	1	×	♂. Clouds. A heavy shower of rain fell about 9 A.M.
4.86	3.04	61	0	1	N.	2	2		
5.09	3.41	58	10	1	S.W.	4	2		♃. South-west wind brings up black smoke from the suburbs of Lisbon.
4.84	3.34	59	0	2	N.W.	3	2		
5.51	3.08	63	0	1	N.W.	3	2		

Date, June and July 1878.			Barometer aneroid, corrected to mercurial at sea-level and 68° F.	French Bar. pressure for Lisbon at sea-level and 68° F.	Thermometers.					Hygrometer.		Hygrometrical		
Day of Month	Week.	Hour.			Last night's minimum.	This day's maximum at or after 2 h. P.M.	Mean temp. by mean of min. and max.	Daily Range.	French Lisbon temp. at 7 h. A.M. reduced to mean of 24 hrs.	Dry Bulb.	Wet Bulb.	Depression of Wet Bulb.	Temperature of dew point.	Elastic force of vapour.
		A.M.	Ins.	Ins.	Deg.	Deg.	Deg.	Deg.	Deg.	Deg.	Deg.	Deg.	Deg.	In.
23	☉	8.30	30.19	...	60.5	80.0	70.2	19.5	...	73.5	65.0	8.5	58.8	.496
24	☾	,,	30.21	30.23	60.0	77.7	68.8	17.7	72.0	73.7	65.5	8.2	59.5	.510
25	♂	,,	30.18	30.20	61.8	78.2	70.0	16.4	73.0	75.2	65.5	9.7	58.5	.492
26	☿	,,	30.13	...	61.8	81.0	71.4	19.2	...	71.1	67.0	4.1	63.9	.594
27	♃	,,	30.14	30.16	61.5	77.0	69.2	15.5	70.0	73.7	67.0	6.7	62.1	.558
28	♀	,,	30.09	30.11	59.5	72.8	66.1	13.3	66.2	69.0	61.8	7.2	56.2	.451
29	♄	,,	30.13	...	58.2	71.3	64.7	13.1	66.0	68.0	59.4	8.6	52.6	.397
30	☉	,,	30.22	...	55.3	74.8	65.0	19.5	65.5	70.0	60.1	9.9	52.5	.395
July.														
1	☾	,,	30.22	30.23	57.5	72.8	65.1	15.3	68.7	71.6	64.0	7.6	58.3	.487
2	♂	,,	30.30	30.24	55.8	73.5	64.6	17.7	67.4	71.2	63.9	7.3	58.4	.489
3	☿	,,	30.33	30.35	59.8	77.5	68.6	17.7	69.2	72.6	65.0	7.6	59.3	.507
4	♃	,,	30.22	30.25	62.0	87.0	74.5	25.0	73.0	75.0	65.2	9.8	58.1	.485
5	♀	,,	30.18	30.20	68.0	87.0	77.5	19.0	77.9	77.8	66.0	11.8	57.8	.480
6	♄	,,	30.23	...	68.8	91.3	80.0	22.5	81.3	80.1	65.6	14.5	55.7	.444
7	☉	,,	30.25	30.28	65.8	83.0	74.4	17.2	73.4	75.6	65.8	9.8	58.8	.497
8	☾	,,	30.18	...	61.5	79.0	70.2	17.5	67.7	72.2	63.0	9.2	56.1	.452
9	♂	,,	30.17	30.20	62.0	82.2	72.1	20.2	74.7	75.2	63.2	12.0	54.6	.427
10	☿	,,	30.20	30.22	67.2	88.6	77.9	21.4	77.7	78.0	65.8	12.2	57.4	.472
11	♃	,,	30.16	30.18	65.5	90.4	77.9	24.9	...	78.0	68.0	10.0	61.1	.539
12	♀	,,	30.14	30.15	65.0	90.7	77.8	25.7	77.1	78.8	69.0	9.8	62.2	.561
13	♄	,,	30.13	30.17	62.1	80.0	71.0	17.9	68.0	74.5	66.5	8.0	60.7	.532
14	☉	,,	30.08	30.02	60.0	79.0	69.5	19.0	64.2	70.5	65.8	4.7	62.2	.562
15	☾	,,	30.04	30.05	62.2	78.2	70.2	16.0	66.7	73.5	65.9	7.6	60.3	.525
16	♂	,,	30.16	30.06	60.5	76.0	68.2	15.5	68.2	67.7	64.0	3.7	61.0	.538
17	☿	,,	30.20	30.20	63.0	75.7	69.3	12.7	68.5	68.5	63.5	5.0	59.6	.510

COMPUTED RESULTS.			CLOUDS	WIND.		SPECTRUM.		Rain.	REMARKS.
Weight of vapour in a cubic foot of air.	Weight of vapour required to saturate a cubic foot of air.	Relative Humidity, Sat.=100.	0 to 10.	Miles per hour.	Direction.	Rain Band 0 to 10.	Low Sun Band 0 to 10.		
Grs.	Grs.								
5·35	3·60	60	0	3	N.	4	2		
5·53	3·48	62	0	5	N.	4	2		
5·33	4·13	56	0	8	N.	3	2		
6.48	1.84	78	0	7	N.	3	1		
6.06	2.95	67	1	7	N.W.	2	2		♃. Wind at night rose to a gale.
4.94	2.86	63	1	18	N.W.	2	2		♀. Observed all day without any interruption from clouds.
4·32	3·18	58	2	12	N.W.	3	2		
4·33	3·67	53	4	7	N.	2	2		
5·34	3·08	63	9	4	N.W.	3	2		
5·35	2·99	64	6	2	N.W.	3	2		
5·48	3·20	62	3	2	N.W.	3	1		
5·26	4·14	55	0	1	N.W.	2	1		
5·22	5·02	50	0	1	N.W.	3	2		
4·77	6.26	42	0	1	N.W.	3	2		♄. Wind rose during the day, and at night blew strongly from N.W. Clouds over the sky at 7 P.M.
5·38	4.20	55	0	12	N.	3	2		
4.98	3·58	56.4	3	15	N.	3	2		☾. Early part of the night, the wind blew almost a gale.
4.64	4.82	49.0	0	5	N.	2	2		
5.04	5.26	49.4	0	2	N.	4	2		
5.80	4.50	56.0	0	1	N.	4	2		
6.12	4.42	56.6	0	1	S.W.	3	2		
5·75	3·55	62.0	8	5	N.	3	1		
6.12	2.03	75.0	9	12	W.	3	1	×	☉. Rain at 9.20 A.M.; occasional heavy showers until noon, when it cleared up, and in half an hour everything looked quite dry again.
5·71	3·24	64.1	8	2	S.W.	4	1		
5.86	1.58	79.5	9	2	W.	3	1		
5.60	2.05	73.0	10	1	W.	2	1		☿. Clouds cleared off soon after 8 A.M.

Date, July 1878.			Barometer aneroid, corrected to mercurial at sea-level and 68° F.	French Bar. pressure for Lisbon at sea-level and 68° F.	Thermometers.					Hygrometer.		Hygrometrical		
Day of Month	Week.	Hour.			Last night's minimum.	This day's maximum at or after 2 h. P.M.	Mean temp. by mean of min. and max.	Daily Range.	French Lisbon temp. at 7 h. A.M. reduced to mean of 24 hrs.	Dry Bulb.	Wet Bulb.	Depression of Wet Bulb.	Temperature of dew point.	Elastic force of vapour.
		A.M.	Ins.	Ins.	Deg.	Deg.	Deg.	Deg.	Deg.	Deg.	Deg.	Deg.	Deg.	In.
18	♃	8.30	30.31	...	58.0	83.8	70.9	25.8	...	72.0	64.8	7.2	59.4	.508
19	♀	„	30.33	30.34	62.5	82.0	72.2	19.5	71.5	74.8	66.0	8.8	59.6	.512
20	♄	„	30.25	30.28	63.5	80.0	71.7	16.5	70.3	74.9	66.2	8.7	59.9	.517
21	☉	„	30.19	30.21	61.6	83.2	72.4	21.6	70.0	73.3	65.0	8.3	58.9	.499
22	☾	„	30.25	30.25	65.0	80.5	72.7	15.5	69.8	73.2	66.8	6.4	62.1	.559
23	♂	„	30.36	...	64.3	79.3	71.8	15.0	...	74.0	67.0	7.0	61.9	.554
24	☿	„	30.24	...	63.1	75.0	69.1	11.9	...	73.5	68.0	5.5	64.0	.596
25	♃	„	30.16	30.15	61.9	79.3	70.6	17.4	69.3	71.1	63.0	8.1	56.8	.463
26	♀	„	30.21	30.18	64.0	90.0	77.0	26.0	75.3	75.6	66.5	9.1	60.0	.519
27	♄	„	30.16	29.90	69.5	97.8	83.6	28.3	85.0	81.2	68.0	13.2	59.1	.501
28	☉	„	30.03	30.03	69.2	98.3	83.7	29.1	88.0	81.2	67.2	14.0	57.7	.477
29	☾	„	29.96	29.96	64.0	82.0	73.0	18.0	87.0	74.1	65.8	8.3	59.8	.515
30	♂	„	30.01	29.99	64.5	83.4	74.0	18.9	85.5	75.0	67.2	7.8	61.6	.549
31	☿	„	30.03	30.04	68.0	78.3	73.2	10.3	88.3	71.5	66.2	5.3	62.2	.561
June Means...			30.20	30.22	56.4	73.7	65.0	17.3	66.1	70.5	62.8	7.7	56.9	.466
July Means....			30.18	30.16	63.4	82.7	73.1	19.3	74.2	74.4	65.7	8.7	59.5	.511

To the above daily observations, similarly to what is explained at the end of the Madeira series, a balance of corrections amounting to + 0.13 inch, has been applied to the Aneroid Barometer at the station to reduce it to the Mercurial at the sea-level, and at a temperature of 68° F.; while the French temperature, having been observed at 7 A.M., has had $\frac{1}{6}$th the daily range added to it, viz. 3°, to reduce it to the mean of 24 hours.

COMPUTED RESULTS.			CLOUDS	WIND.		SPECTRUM.		Rain.	REMARKS.
Weight of vapour in a cubic foot of air.	Weight of vapour required to saturate a cubic foot of air.	Relative Humidity, Sat.=100.	0 to 10.	Miles per hour.	Direction.	Rain Band 0 to 10.	Low Sun Band 0 to 10.		
Grs.	Grs.								
5·54	2.96	64.2	0	1	W.	3	2		
5·52	3.82	58.8	0	1	W.	2	1		
5·59	3.78	59.2	7	3	N.W.	3	1		
5·37	3.52	61.1	4	5	N.	3	1		☉. A cloudless sky all day, except towards Cintra, the hills there being heavily clouded. At 11 P.M. clouds over all the sky.
6.08	2.78	68.4	10	8	N.W.	4	1		☾. Sunshine at 10 A.M., but not a clear sky.
6.00	3.10	66.0	8	6	N.W.	3	1		♂. Sunshine. White clouds; not a good observing day.
6.50	2.45	72.0	9	5	N.	4	1		☿. No observing to-day; clouds until after 1 P.M.; strong wind from north all day.
5.09	3.23	60.7	0	10	N.	3	1		
5·59	3·99	58.2	0	4	N.	4	1		
5.38	6.00	46.6	0	6	N.	3	1		♄. *Open air shade* at 4 P.M. Dry Bulb=97.8°; Wet Bulb=72.8°.
5·14	6.24	44.2	0	10	N.	4	2		☉. At 12.23 P.M., Dry Bulb 100.0°; Wet Bulb 72·5°; at 4 h. P.M., max. and Dry Bulb still 98.3°; at 6 h. P.M., a cool breeze sprang up, and thermometer went down to 85.1°.
5·53	3.60	60.9	0	10	N.	5	2		
5.88	3·52	62.8	5	2	N.	5	2		
6.08	2.32	72.0	10	2	N.W.	4	1		
5.09	3.07	62.0	3.6	5.6	...	3.2	2.0		Means for June at Lisbon.
5·54	3·72	60.2	3.8	4.6	...	3·3	1.5		Means for July at Lisbon.

In deducing the monthly means above, the maximum and minimum, the mean temperature, and also the French Thermometers for the month of June, have had −1.6° applied to them to reduce them from the mean of the days observed (viz. 8 to 30) to the mean of the whole month. The July observations need no correction of the kind.

APPENDIX II.

MADEIRA (FUNCHAL), Lat. = 32° 38′ north; Long. = 1 h. 8 m. west; mean height of Stations = 150 feet.

Cycle of a year, compiled from various authorities between 1830 and 1881.

Months.	Barometer.		Thermometer.		Hygrometer.			Clouds 0 to 10.	Wind, days of, Direction of.				Wind velocity, miles per hour.	Rainfall.		Spectrum of low sky.	
	Reduced to sea-level and 68° F.	Extreme Monthly Range.	Mean Temperature by max. and min.	Mean Daily Range.	Depression of Wet, below Dry, Bulb.	Weight of vapour in a cubic foot of air.	Vapour wanting to saturate.		N.	E.	S.	W.		Days.	Depth in Ins.	Rain Band 0 to 10.	Low Sun Band 0 to 10.
	Ins.	Ins.	° F.	° F.	° F.	Gr.	Gr.										
JANUARY	30.26	0.71	60.4	7.9	3.8	4.4	1.4	6	9	12	1	3	6	9	4.0		
FEBRUARY	30.07	0.67	61.2	9.9	4.3	4.6	1.4	5	2	15	1	0	7	8	3.1		
MARCH	30.13	0.60	62.3	10.8	5.4	4.4	1.8	3	14	2	1	9	8	8	2.3		
APRIL	30.14	0.57	64.0	11.4	4.4	5.1	1.5	5	10	5	1	9	8	8	2.9		
MAY	30.24	0.33	65.0	11.0	4.7	4.9	1.9	4	9	5	1	9	7	5	1.4		
JUNE	30.30	0.25	67.2	8.3	4.8	5.3	2.0	6	19	6	0	1	7	4	0.4	4.0	1.9
JULY	30.40	0.29	71.1	8.6	5.1	6.1	2.2	5	15	9	0	3	8	3	0	3.5	1.5
AUGUST	30.34	0.21	72.6	8.5	6.0	6.1	2.6	4	15	7	0	0	8	2	0		
SEPTEMBER	30.33	0.36	72.1	8.6	4.4	6.5	2.0	4	14	4	0	2	7	3	0		
OCTOBER	30.28	0.52	69.0	9.2	4.4	5.9	1.9	5	14	4	1	3	8	10	5.1		
NOVEMBER	30.21	0.40	65.8	8.4	3.9	5.5	1.5	6	13	10	2	0	7	9	2.0		
DECEMBER	30.19	0.71	63.2	7.8	3.5	5.1	1.3	7	14	7	3	3	10	10	7.8		
YEAR'S MEANS	30.23	0.47	66.2	9.2	4.6	5.3	1.8	5					7.6				
YEAR'S RANGE OF MONTHLY MEANS	0.33		12.2		2.5	2.1	1.3	4									
YEAR'S SUMS									148	86	11	42		79	29.0		
									287~365 = 78 days calm								

LISBON, Lat. = 38° 43′ north; Long. = 0 h. 36 m. west; height of Station = 350 feet above sea-level.

Cycle of a year, between 1856 and 1863; as published by the Meteorological Observatory of the Infant R. Dom Louis.

MONTHS.	BAROMETER.		THERMOMETER.		HYGROMETER.			CLOUDS	WIND, days of, Direction of.				WIND velocity, miles per hour.	RAINFALL.		SPECTRUM OF LOW SKY.	
	Reduced to sea-level and 68° F.	Extreme Monthly Range.	Mean Temperature by max. and min.	Mean Daily Range.	Depression of Wet, below Dry, Bulb.	Weight of vapour in a cubic foot of air.	Vapour wanting to saturate.	0 to 10.	N.	E.	S.	W.		Days.	Depth in Ins.	Rain Band 0 to 10.	Low Sun Band 0 to 10.
	Ins.	Ins.	° F.	° F.	° F.	Gr.	Gr.										
JANUARY	30.28	0.82	49.5	11.1	3.0	3.1	0.9	5	18	2	3	7	10	16	4.0		
FEBRUARY	30.22	0.75	50.6	12.5	4.0	3.1	1.1	5	15	2	3	5	10	15	4.2		
MARCH	30.20	0.90	54.8	13.5	5.2	3.3	1.6	5	16	2	3	8	11	14	3.4		
APRIL	30.15	0.66	58.2	14.3	6.0	3.6	1.8	5	12	3	2	1	10	14	2.2		
MAY	30.15	0.58	61.3	15.0	6.7	3.8	2.2	5	17	1	3	2	11	13	2.0		
JUNE	30.19	0.48	66.6	16.1	8.0	4.3	2.8	3	19	1	2	2	11	9	0.8	3.2	2.0
JULY	30.20	0.30	71.1	19.1	10.0	4.4	3.9	2	23	1	1	2	12	3	0.1	3.3	1.5
AUGUST	30.16	0.42	70.8	18.5	9.6	4.5	3.8	2	24	1	1	2	12	4	0.5		
SEPTEMBER	30.20	0.54	67.4	15.5	7.5	4.5	2.8	4	16	1	3	2	10	10	1.0		
OCTOBER	30.16	0.68	62.8	13.3	6.0	4.3	2.1	5	15	2	5	2	9	14	3.7		
NOVEMBER	30.14	0.91	56.2	11.2	4.0	3.8	1.2	6	15	4	4	2	9	16	5.4		
DECEMBER	30.27	0.86	50.7	10.7	3.0	3.4	0.8	5	19	2	3	2	10	14	3.6		
YEAR'S MEANS	30.19	0.66	60.0	14.2	6.1	3.9	2.1	4.3					10.4				
YEAR'S RANGE OF MONTHLY MEANS	0.14		21.6		7.0	1.4	3.1	4									
YEAR'S SUMS									209	22	33	37		142	30.9		
									301~365 = 64 days calm.								

JERUSALEM, SYRIA, Lat. = 31° 46′ 50″ north ; Long. = 2 h. 20 m. 52 s. east ; height above sea-level = 2500 feet.

Cycle of a year, from Observations of three years and four months, ending February 1867 ; by Scottish Meteorological Society.

Months.	Barometer.		Thermometer.		Hygrometer.			Clouds 0 to 10.	Wind, days of, Direction of.				Wind velocity, miles per hour.	Rainfall.		Spectrum of low sky.	
	Reduced to sea-level and 68° F.	Extreme Monthly Range.	Mean Temperature by max. and min.	Mean Daily Range.	Depression of Wet, below Dry, Bulb.	Weight of vapour in a cubic foot of air.	Vapour wanting to saturate.		N.	E.	S.	W.		Days.	Depth in Ins.	Rain Band 0 to 10.	Low Sun Band 0 to 10.
	Ins.	Ins.	° F.	° F.	° F.	Gr.	Gr.										
JANUARY	30.32	0.42	47.2	12.5	4.0	2.7	1.0	5.6	6	9	6	9	11	10	5.18		
FEBRUARY	30.29	0.48	48.8	13.1	4.3	2.8	1.3	3.8	5	7	4	11	13	8	3.57		
MARCH	30.21	0.29	58.4	18.1	8.4	3.3	2.5	4.7	7	10	4	9	13	6	1.53		
APRIL	30.16	0.32	59.8	19.6	9.8	3.3	3.1	4.2	6	5	7	10	11	4	0.86		
MAY	30.15	0.26	67.8	22.7	13.0	3.7	4.6	2.4	8	5	4	15	12	1	0.12		
JUNE	30.08	0.26	73.0	20.0	13.1	4 5	5.2	0.8	8	3	3	15	17	1	...	?	?
JULY	29.98	0.15	74.8	22.4	11.4	5.5	5.1	0.9	11	0	1	18	12	0	...	?	?
AUGUST	29.98	0.18	76.2	22.5	14.8	4.6	6.0	1.1	12	1	1	16	11	0	...		
SEPTEMBER	30.10	0.21	72.2	22.7	10.2	5.0	4.1	1.8	14	1	1	13	10	0	...		
OCTOBER	30.18	0.20	71.8	22.5	13.1	4.1	5.0	2.3	11	10	3	7	9	3	0.52		
NOVEMBER	30.24	0.28	61.0	15.8	7.5	3.6	2.4	3.8	6	14	2	7	10	6	1.50		
DECEMBER	30.29	0.35	49.9	12.7	4.5	2.9	1.3	5.0	6	8	6	11	10	11	3.00		
YEAR'S MEANS	30.16	0.28	63.4	18.7	9.5	3.8	3.5	3.0					11.6				
YEAR'S RANGE OF MONTHLY MEANS	0.34		29.0		10.8	2.8	5.0	4.8									
YEAR'S SUMS									100	73	42	141		50	16.28		
									356~365 = 9 days calm.								

SCOTLAND generally, reduced to its Mean Central Position of Lat. = 56° 3′ north ; Long. = 0 h. 14 m. 36 s. west ; height = 256 feet. Cycle of a year, from returns by the Registrar-General from 1856 to 1881 ; the Spectroscopic Columns by Mrs. C. P. S. excepted.

MONTHS.	BAROMETER.		THERMOMETER.		HYGROMETER.			CLOUDS 0 to 10.	WIND, days of, Direction of.				WIND velocity, miles per hour.	RAINFALL.		SPECTRUM OF LOW SKY.	
	Reduced to sea-level and 68° F.	Extreme Monthly Range.	Mean Temperature by max. and min.	Mean Daily Range.	Depression of Wet, below Dry, Bulb.	Weight of vapour in a cubic foot of air.	Vapour wanting to saturate.		N.	E.	S.	W.		Days.	Depth in Ins.	Rain Band 0 to 10.	Low Sun Band 0 to 10.
	Ins.	Ins.	° F.	° F.	° F.	Gr.	Gr.										
JANUARY	29.86	1.62	36.8	9.1	1.5	2.2	0.4	6.7	5	5	9	11	19	16	4.03	0.5	1.8
FEBRUARY	29.93	1.47	38.3	9.7	1.5	2.3	0.4	6.5	4	5	7	10	20	14	3.11	1.1	1.4
MARCH	29.93	1.44	39.6	11.6	1.7	2.4	0.5	6.4	6	7	6	10	20	15	2.82	0.6	1.1
APRIL	29.99	1.25	44.4	14.0	2.0	2.8	0.5	6.3	6	8	7	8	18	13	2.26	1.6	1.1
MAY	30.05	1.05	49.0	15.3	3.0	3.1	0.9	6.2	6	8	7	8	16	13	2.21	1.4	1.2
JUNE	30.03	0.92	54.9	15.4	3.0	3.9	1.0	6.2	4	6	8	10	15	14	2.69	1.8	1.7
JULY	29.99	0.87	57.5	14.8	3.0	4.4	1.0	6.5	5	5	8	12	15	15	3.01	2.2	1.3
AUGUST	29.96	0.96	56.8	14.3	2.5	4.4	0.8	6.5	5	6	8	11	15	16	3.53	1.4	1.1
SEPTEMBER	29.94	1.17	52.5	13.4	2.0	3.8	0.6	6.3	4	5	8	11	17	16	3.73	1.4	1.0
OCTOBER	29.91	1.44	46.7	11.9	1.7	3.3	0.4	6.4	5	6	8	10	19	16	4.16	1.2	1.2
NOVEMBER	29.94	1.53	40.4	10.2	1.5	2.5	0.4	6.4	6	5	7	10	18	15	3.68	1.0	1.5
DECEMBER	29.89	1.54	38.1	9.3	1.3	2.3	0.4	6.5	6	4	8	11	19	16	4.10	0.9	2.2
YEAR'S MEANS	29.95	1.27	46.3	12.4	2.1	3.1	0.6	6.4					17.6			1.3	1.4
YEAR'S RANGE OF MONTHLY MEANS	0.19		20.7		1.7	2.2	0.6	0.5								1.7	1.2
YEAR'S SUMS									62	70	91	122		179	39.33		
									345~365 = 20 days calm.								

MADRID, Lat. = 40° 24′ north; Long. = 0 h. 14 m. 45 s. west; height above sea-level = 2180 feet.

Cycle of a year, by Observations extending from 1860 to 1869; published by the Astronomer-Royal of Spain.

MONTHS.	BAROMETER.		THERMOMETER.		HYGROMETER.			CLOUDS	WIND, days of, Direction of.				WIND velocity, miles per hour.	RAINFALL.		SPECTRUM OF LOW SKY.	
	Reduced to sea-level and 68° F.	Extreme Monthly Range.	Mean Temperature by max. and min.	Mean Daily Range.	Depression of Wet, below Dry, Bulb.	Weight of vapour in a cubic foot of air.	Vapour wanting to saturate.	0 to 10.	N.	E.	S.	W.		Days.	Depth in Ins.	Rain Band 0 to 10.	Low Sun Band 0 to 10.
	Ins.	Ins.	° F.	° F.	° F.	Gr.	Gr.										
JANUARY	30.24	1.19	40.8	16.6	2.2	2.5	0.5	5	8	9	7	7	10	9	1.3		
FEBRUARY	30.27	1.31	42.4	21.1	3.2	2.4	0.7	4	8	8	6	6	9	6	0.8		
MARCH	30.09	1.09	46.8	22.0	4.9	2.5	1.2	4	9	5	7	10	15	9	1.5		
APRIL	30.15	0.95	54.9	25.7	6.7	2.9	2.0	5	8	7	8	7	12	8	1.3		
MAY	30.13	0.70	61.0	25.4	6.5	3.8	2.2	5	6	6	9	10	11	10	2.1		
JUNE	30.20	0.65	69.1	29.0	10.1	4.1	3.7	4	8	7	6	8	12	6	1.5		
JULY	30.20	0.50	76.1	30.8	14.0	4.2	5.5	2	7	6	7	11	10	1	0.2		
AUGUST	30.20	0.52	74.8	30.6	13.5	4.0	5.4	2	7	7	7	9	10	3	0.4		
SEPTEMBER	30.22	0.74	66.0	26.5	9.0	3.9	3.1	4	6	6	9	8	11	7	1.3		
OCTOBER	30.27	0.91	56.5	21.8	5.0	3.6	1.5	4	8	8	8	7	9	8	1.6		
NOVEMBER	30.19	1.21	46.8	18.9	3.1	2.9	0.8	5	8	9	7	7	11	9	1.5		
DECEMBER	30.24	1.18	41.0	15.8	1.8	2.5	0.5	5	9	9	7	6	12	10	1.7		
YEAR'S MEANS	30.20	0.91	56.4	23.7	6.7	3.3	2.3	4.1					11				
YEAR'S RANGE OF MONTHLY MEANS.	0.18		35.3		12.2	1.8	5.0	3									
YEAR'S SUMS									92	87	88	96		86	15.2		
									363~365 = 2 days calm.								

APPENDIX III.

TERENCE M. HUGHES, whose poetical work *The Ocean Flower* has been so largely quoted from in the preceding pages, was born of gentle parents in the then stirring town of Newry, in Ireland, about 1814. His father, Philip Hughes, a leading merchant there, was in intimate relation with several fine old aristocratic Catholic families. Intended, parentally, for the Roman Catholic priesthood in his native country, the young Terence was early sent to Maynooth College. There his exceptionally high literary talents secured him the attention due to a first-rate student who might reflect credit on his teachers; but the innate tendency of his soul assured him meanwhile, and with more and more distinctness as the years rolled on, that he was born for greater freedom than the rules of that Church allowed.

Breaking away, therefore, from Maynooth soon after 1834, he entered the wide world of London as a friendless youth, but vigorously determined to trust to his own literary abilities for carving out his own way to liberty and light. At first as a reporter to, next as writer in, and subsequently a special correspondent of, the *Times* newspaper, he both supported himself, and indulged his almost hereditary desires to visit Spain and Portugal. In the former country all men's intolerance in matters of religion, and the unspeakable pride of a people who "are historians of nothing but themselves," were repellent to his refined and sympathetic nature; but in the latter, though so much smaller a, country, he met with far more that he could thoroughly admire. Indeed, before long, he was happy in marrying a daughter of the land, and entered with her so truly *con amore* into its historic glories, its literary excellences, and all its present better aspirations, that he seemed likely to become a permanent resident, and a more than native enthusiastic worker there;

but that scourge of so much of the early genius of mankind, consumption, had already marked him for her own, and he died in London, it is believed soon after returning from Madeira, in 1848; at an age when most men are only beginning to settle down to their professional life, or to the ideal subjects by which they hope to make their claims to the world's regard.

The following is a list of the chief of the purely original and rapidly following works of Terence M. Hughes, outside the circle of his, through many years, almost daily multitudinous writings, and some of them truly eloquent, in the service of the newspaper press :—

1. The Ocean Flower (Madeira) ; a Poem. Published by Longman & Co. in 1845.
2. Revelations of Spain. Published by H. Colborn in 1845.
3. The Biliad ; or how to criticise. Published by Longman & Co. in 1846.
4. Iberia Won ; a Poem. Published by Longman & Co. in 1847.
5. Revelations of Portugal. Published by H. Colborn in 1847.

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[1] *Madeira: its Scenery and how to see it*, by Miss Ellen M. Taylor—published by E. Stanford, London: 1882—demands both notice and commendation, though it has only reached me while these last pages are going through the press.

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