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Sheldrake.

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THE
C A U S E S
O F
H E A T AND C O L D

I N T H E
Several CLIMATES and SITUATIONS of
this GLOBE, so far as they depend
upon the Rays of the SUN,

C O N S I D E R E D

In Order to shew that the Difference of HEAT
and COLD in other COUNTRIES may be
nearly ascertained by a Thermometer.

As it was Read to the ROYAL SOCIETY

By T. S H E L D R A K E.
Author of the HERBAL.

Printed for and sold by the Author at the *Black-boy* in the
Strand near *St. Martins-Lane*; and by M. Cooper in
Pater-noster-Row.

M D C C L V I.

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T O

The Right Honorable

G E O R G E

E A R L O F *MAGGLESFIELD*,

V I S C O U N T *PARKER*,

P R E S I D E N T

O F T H E

R O Y A L S O C I E T Y .

M Y L O R D,

I SHOULD not have presumed to
have approached your Lordship
with this small Tract, if it had not
been honored with a hearing before
the Members of the ROYAL SOCIETY,
and,

DEDICATION.

and, as the late Doctor *Mortimer* assured me, approved by them.

Whatever may be the Merit of the Performance, I hope the Candor of the Public will excuse its Defects, and your Lordship from your known Goodness and Humanity forgive the Presumption of its Author, in addressing it to your Lordship,

being,

MY LORD,

YOUR LORDSHIPS

most obedient and

most humble Servant,

T. SHELDRAKE.

(1)

THE
C A U S E S
OF
HEAT AND COLD
IN THE
SEVERAL CLIMATES AND SITUATIONS
OF THIS GLOBE.

THE Senses of Men are wonderfully adapted to their several corresponding Objects in Nature: the Ear to Sounds, the Palate to Tastes, Feeling to every Touch, Smelling to Odours, and the Eye to Colours. Almost infinite is the Variety

B riety

riety of Objects that employ the Sense of Vision, and among these the Flowers that rise spontaneously to adorn and beautify the Face of Nature, are not the least engaging. They have Charms to allure and gratify the Organs of Vision and of Smelling; they have Wisdom and Contrivance in their Forms and Structure to engage the Study of the Philosopher, and to excite Meditation in the Divine: and as their Beauty charms our Eye, their Virtues administer to the Relief of every Animal in the Cure of various Maladies. It is not therefore Curiosity, or Ornament alone, that induces us to wish we could teach the vegetable Productions of other Countries, to grow in English Ground, but Health and Piety join our Ideas of Beauty, and all persuade the Culture of every fair and useful Flower, Herb, Vegetable and Tree, whether it be the Growth of this or the remotest Clime.

As we have no certain Rule for determining the Heat, that exotic Plants may require in Summer, nor unless by dear-bought Experience what Degree of Cold they could with Safety bear in Winter, I was led to consider, whether it might not be possible to discover some Method for determining how much less the Cold of the Winter in more Southern Climates might be, than in ours, and in what Proportion their Heat also might probably exceed that of our Summers, by adjusting a Thermometer so as to ascertain the Difference; that if it were possible we might, by the Assistance of good Green-houses, Thermometers and Stoves, have the Pleasure of seeing Exotics here in almost the same Beauty and Perfection as in their native Countries.

With this View I attentively and constantly regarded the Changes of Seasons, and the Rise and Fall of the Spirits in the Thermometer,

knowing that the Difference of Seasons, as well as the different Degrees of Heat or Cold of Seasons in other Countries, depend upon the Changes of the Position of this Globe, with respect to the Sun, the only visible Fountain of Warmth and Life: I also collected from Books such Observations as might assist me in this Undertaking. And when I had proceeded thus far, I believed it was possible to determine very nearly the Degree of Heat and of Cold in most, if not all Countries with such Exactness at least, as that, with the Assistance of a Thermometer well graduated, foreign Plants might be preserved in Health and Vigour.

The natural State of this Globe seems, from repeated Observations, to be what we call Temperate, or an intermediate Degree between Hot and Cold, as appears from the Warmth of deep Wells in Winter, and the Coldness of them

them in Summer, compared with the external Air, though, by a Thermometer, little, if any Variation is discoverable in the same Places, in opposite Seasons. The ingenious Dr. HALES, in his *Vegetable Statics* pag. 62. from the honourable Mr. BOYLE, tells us, that the Spirits both Summer and Winter stood at Temperate in a Cave 130 Feet from the Mouth of it, and 80 Feet below the Surface of the Earth; which natural Warmth of the Earth is what secures Springs and all other Bodies from being frozen, few Winters proving so cold as to penetrate the Earth to more than twelve or fourteen Inches below the Surface.

The Transitions from the greatest Heat to the greatest Cold that we feel, in the Air embracing our Globe, is chiefly owing to the Elevation and Depression of the Poles, which causes so great a Change in the Situation of the Earth, that the Obliquity and Perpendicularity,

cularity, in which the Rays of the Sun fall, are continually in a State of Variation: and as the Face of the Earth forms Angles of Incidence by which they are reflected in direct or oblique Angles, back again under a vertical Sun in right Lines and dispersedly, according to the Angle of the Plane on which they fall, so is Warmth increased or diminished.

So far as Action and Reaction, occasioned by Reflection, conduces to the Production of Heat, so far also will the Continuance of the Sun's Presence, with the Slowness of his Motion be found to increase that Heat: and on the contrary, Cold will be increased by the Obliquity of his Rays, the Swiftmess of his Motion, and the Time of his Absence below the Horizon, which is much longer than is his Presence above.

Upon these Principles it will appear, that a regular Increase of Heat should always follow
the

the Approach of the Sun, and as gradual a Decrease of Warmth, or Increase of Cold, always attend his Departure; but this is not so either on the Continent or the Islands.

There are many Accidents that occasion very great Variations from such regular Changes, from Heat to Cold and from Cold to Heat. Such as the Situation of Hills, Mountains, and the Declivity of Land from a true Plane: if the Descent be towards the South it will be warmer than it would be if towards the North,

Clouds will sometimes propagate Heat by Reflection, and Water - clouds will make the Air cool.

Winds from the South, if without Rain, and from the South-west, always increase Warmth; as on the contrary, Winds from the East, North-east, North and North-west, always bring a colder Air with them, than was felt before they

they began to blow. By all these Changes Fermentation and Vegetation is greatly promoted.

Whenever Water becomes a reflecting Plain, the Smoothness of its Surface increases very much the Heat of the Sun's Rays, but much more so when united, they then produce almost double the Heat the Sun would do without such Reflection.

Certain it is, that all Bodies, whose Surfaces being polished reflect Light, reflect Heat also along with it; the Degree of which will bear a just Proportion to the Closeness of the Pores, the Size of the Diameter and Degree of Convexity or Concavity of the Surface. How bright is the Central-point of Light, and how strong must the Heat of such a concave Burning-glass, as Mr. Vilette's be which soon dissolves Metals &c. ? On the contrary, the Moon, which is a spherical Body, reflects a faint
Light,

Light, compared with that of the Sun; but no Heat is to be raised from any Collection of its Rays. For the same Reason that the Moon reflects no Heat, the Tops of Mountains in hot Countries are seldom free from Snow, because the Whiteness of the Snow reflects the Heat back again in such a Divergency as to prevent any Heat from being generated. And therefore the Plants that grow upon Mountains in hot Countries, will also grow upon Plains in colder Countries; this is evident from the Cedars which flourish in the Botanic Garden at Chelsea. But as the greatest Dimension of Mountains is towards their Base they gradually acquire Warmth, till it becomes nearly uniform with the Plain on which they stand.

Heat is always increased or diminished, as the Colour of the Body, on which the Rays of the Sun fall, is light or dark, or admits of different Shades from white to black; and as
the

the Surface of the Body is ragged or smooth. Black absorbs Light, and if the Surface be rough, it will grow warm much sooner than if it were smooth : White, on the contrary, reflects Light and Heat, and that more vigorously from a polished Surface. This is the Reason why white Bodies are slower in taking Fire than those that are black. The same holds true of all intermediate Degrees of Colour, in Proportion as they recede from the grand Opposites, black and white. If we walk on a black Sand, or dark dry Soil, our Feet will grow very warm from the Heat that the Sand or Soil has imbibed from the Sun, but our Faces will feel little, if any Warmth reflected from the same Soil : whereas if we walk on dry Chalk, white Sand, &c. our Feet will not acquire any considerable Degree of Heat from them, but our Faces will feel, by a strong Reflection of Light and Heat from such white

Ground

Ground or Sand, a very sensible Alteration, which will be aggravated, if the Sun shine upon us at the same Time.

All Increase of Heat above Temperate is owing to the Rays of the Sun becoming daily more and more perpendicular, for the Reflection becomes stronger as the Rays descend in more direct Lines, are prest closer, and continue longer above the Horizon. Cold, on the contrary, increases in Proportion as the Sun's Rays become more oblique, for by this Obliquity they are thinner, more dispersed and fainter, which must daily diminish and abate the Force of Reflection. Not that we have our greatest Heat when the Sun is in Cancer, and nearest vertical on the 21 of June, nor our greatest Cold when the Rays of the Sun, at his Entrance into Capricorn, are most oblique, and thin, being extended to their greatest Length, when Days are shortest and the Sun's Stay longest below
our

our Horizon. But our greatest Summer's Heat is commonly in July, and our greatest Cold in January: from which Observation it appears that Heat increases by the Continuance of Action, notwithstanding what caused it grows weaker; and Cold increases, notwithstanding the Sun's Approach, till his thinly dispersed Rays become closer collected together, and his Presence is longer with us. Thus we often experience in clear Days, that our greatest Heat is not till the Sun is gone several Degrees westward, nor the greatest Cold of the Night till the Sun has left the Nadir, and is gone many Degrees towards the East. Common Experience proves that, when a Body is hot, a less Degree of Heat will preserve that Heat, than was required to generate it; and so on the contrary with respect to Bodies that are cold, more Heat is required to put the Parts in Motion again, than will keep them so when once agitated.

From

From what has been said it is evident, that Heat and Cold are caused by the Rays of the Sun being more or less vertical, from whence proceed not only the different Degrees of Heat and Cold in different Climates, but also the Variety of Seasons in one and the same Climate; so necessary for the Production and Growth of all the various Tribes and Species of Animals, Insects, Vegetables, which require different Degrees of Heat and Moisture.

I tryed with a Thermometer Tube, which was not fixed to a Board, how much the Heat of the Sun would raise the Spirits in the Tube higher than they were at in a Room of a South Aspect, in which I keep my Standard Thermometer, the Windows being open, and I found the Sun's Rays assisted by the Reflection of them from a red Brick-wall at about three Foot Distance raise the Spirits, in the hottest Part of an Afternoon in July, 20 Degrees

grees above the Height they were at in the Chamber at about ten Feet from the Window.

By this Experiment we see how the Rays of the Sun on one Side and the Reflection of them on the other Side of a Thermometer Tube raised the Spirits to a Heat somuch superior to what they were in the Chamber, as above mentioned.

As the Earth, like all the other Planets, moves in an elliptic Orb round the Sun, we on the North-side of the Equator enjoy thereby eight Days more of Summer, reckoning from the vernal to the autumnal Equinox, than the Inhabitants on the Southern Side of the Equator, whose Winter is eight Days longer than ours. This together with their greater Distance from the Sun, makes it reasonable to suppose that their Cold also continues longer, and is more intense. Which Providence has provided as a Counter-balance for the Good of his Creatures,

tures, that by the Earth's nearer Approach to the Sun in their shorter Summer than ours, it might receive a Degree of Warmth, as much superior to what we have, as the Cold of the Southern Winter may exceed that of the Northern.

I am induced to think, as the Rays of the Sun, darting through the Atmosphere in our Winter's Solstice, are, by their Obliquity, nearly fourtimes the Length they are in Summer, which is evident from the different Length of Shadows at those opposite Seasons, that this greatly helps to vary the real Action and to abate the full Force of the Sun's Rays, which, if it did not, any thing in a true Plane to the Sun in Winter would be heated nearly, if not equal to, a Plane under the Sun in Summer. This plain Appearance of the Sun through the Atmosphere is probably the true Reason why the Sun appears of a larger Diameter in December

cember than in June. If it has not already been tryed, it would be well done to make a Trial with proper Instruments in the Month of June in a Morning, or in an Evening, when the Sun is of a Height above the Horizon equal to what it is in December. If this Experiment for meafuring the Sun were made, and the Sun fhould appear of the fame Magnitude as in Winter, it would then be certain that the apparent Magnitude is owing to the great Tract of Atmosphere through which we fee it : which alfo makes the other Planets, particularly Venus and Jupiter, appear fo much bigger foon after their Rifing, or before their Setting, than they do when in their Meridian Altitude ; at which Time they are nearer to us by almost one Semidiameter of the Earth, than they are at their Rifing or Setting.

From what has already been faid, I hope, it will be allowed, that all the Variety of Heat
and

and Cold that we feel in the Air, as well as the Changes that are produced on the Surface of the Earth and Waters, &c. are owing to the diverging or converging of the Sun's Rays, their Obliquity or Perpendicularity. By the latter Motion is increased, and thereby Warmth or Heat in equal Proportion; and by the former Motion is abated, and therefore Cold will increase continually as Action decreases and Bodies come nearer to a State of Rest. Here we must not forget that the Changes of the Wind will also influence and prevent the regular Alterations of the Air, &c. I have seen the Spirits in the Thermometer at the 4th Degree when the Sky has been clear, very little Motion in the Air, the Heat almost insupportable, and the Flesh in the Market began to be offensive before 3 in the Afternoon; and the next Week the Spirits rose one Degree higher, the Sun not obscured but a brisk Wind then blowing, no

such Effects were produced. Hence the Necessity of Air as well as Warmth for the Preservation of animal and vegetable Substances.

It is certain that all Parts of this Globe enjoy the same Quantity, or nearly so, of the Sun's Presence in the Space of a Year, and it is certain that all Places do not enjoy the same Quantity of Heat from his Presence.

As the Sun's Motion from North to South, and from South to North is confined between the Tropics, so is his Motion swifter there, than in any other Part of the Globe: and the nearer vertical to the Equator, so much the swifter is his Motion from East to West, and from North to South, and South to North. This will appear from the following Observation.

First, The Sun passes from 3 Degrees 30 Minutes South Latitude, to 3°. 30'. North Latitude, being together seven Degrees, in about eighteen Days, whereas, when the Sun enters

Gemini

Gemini on the 21 Day of May, at twenty Degrees North Latitude, the Sun spends one intire Month in going three Degrees and thirty Minutes, or till he enters cancer and touches the Northern Tropic, and another Month in returning back from the Tropic till he arrives at Leo, on the 23 of July: in all which Time, being Sixty Seven Days, the Sun is as near the Tropic, as he is to the Equator for eighteen Days. Hence it appears reasonable to suppose, notwithstanding the Sun passes the Equator twice in the Space of Twelve Months, as spending only Thirty-six Days in these two Transits, that the Heat under either of the Tropics may be as great, if not greater than under the Line.

Secondly, For a further Proof of the Probability that the Heat under the Tropic is as great, if not greater, than under the Line, I shall just observe the Difference of the Time of the Sun's

Motion in the abovementioned different Places on the Surface of the Globe, *viz.* As the Sun moves Fifteen Degrees of 60 Miles each (common Computation) in one Hour under the Equator which are Nine Hundred Miles, and as the same longitudinal Degree under the Tropic contains only Fifty-five such geographical Miles, which amount to no more than Eight Hundred and Twenty-five Miles, *i. e.* the Sun travels Seventy-five Miles less in one Hour under one of the Tropics than under the Equator. The Motion of the Sun then being slower, may we not with Reason suppose that the Heat may thereby be raised to a more intense Degree by the Sun's being nearly so long vertical, and withal his Motion so much slower under the Tropic than it is under the equinoctial Line? It is also to be remembered in this Place, that the Sun in our Summer half Year remains about 140 Hours longer above the Horizon under

der the Tropic than under the Equator; which must certainly conduce to the increasing of the tropical Heat to a greater Degree than of that under the Equator.

Having proceeded thus far, I shall now describe the Method I used for making the Scale.

Having attentively and duly considered the foregoing Causes of Heat and Cold, I took a Thermometer, and keeping it in one constant Place, I carefully observed, and marked the greatest Variation of the Spirits, by which I obtained their Height in the Heat of a kind, good Summer, and their Descent in a hard Frost. I then described a large Circle of several Foot diameter, and, according to the common Rules of Geometry, divided it into Degrees, &c. and according to the known Rules of Geography laid down the Tropics, Circles, Paralels, &c. Having done this I drew a Line in a true Plan from North to South, supposing

the Sun vertical in cancer, by which it appeared, that the Rays of the Sun at Forty-seven Degrees Northern Latitude, were as closely connected as under the Equator; that the Sun was at an equal Distance from the Equator, as he was from Forty-seven Degrees North Latitude; that the Northern Part of Italy might with great Probability, in its nearest approach to the Sun and greatest Heat, have a Degree of Heat equal, or nearly the same, with that under the Equator in the greatest Cold and greatest Recess from the Sun: and that Fifty-two Degrees and Forty-two Minutes Northern Latitude were further from the Sun, when vertical in cancer, than the Tropic by seven Degrees and Forty Minutes, or nearly so. In this Position of the Globe, I formed the first Table under the Name or Title of, Difference of the Sun's Distance, in which Tables the Difference of the Sun's Distance at every five
 Degrees

Degrees of Northern Latitude, is laid down by Mensuration*.

This being finished, I proceeded in like manner for making the second Table under the same Title as the first, the Sun being vertical under the Equator, as in Libra and Aries; and the third also under the same Name, the Sun being in Capricorn; which shews how much these Northern Countries are removed further from a true Plan, under a vertical Sun, in December, than they are in June. In these two last Tables, the Difference is laid down at every five Degrees, and may be of the same Use on the South as on the North Side of the Equator.

These Tables being thus adjusted, I fixed the Point of greatest Height, to which the Spirits rise with us, in the greatest Heat of our

* These so nearly answer Computation, that where there is any Difference 'tis inconsiderable.

Summer, at that Point of our Distance in Degrees and Minutes as according to the first Table we at 52 Degrees and 42 Minutes here are, from a Plan under the Sun, when vertical in cancer, than the Tropic itself, or 23 Degrees 30 Minutes is. And when the Spirits were by a very hard Frost sunk down, I marked the lowest Point they fell to at the Number of Degrees and Minutes of our Recess from the Sun when vertical in Capricorn, according to the third Table of the Sun's Distance, which gives the Difference of about Thirty-eight Degrees. This very considerable Increase of Cold (from our greatest Heat) in Summer we can and do feel by the Rays of the Sun being so very Oblique in Winter, as to bear little more than the Proportion of seven to one, so that the same Quantity of the Rays of the Sun that on the 21 of June falls upon a level Piece of Ground, suppose of one hundred Yards square,

square, will on the 21 of December be so dispersed by this very great Obliquity and thinness as to describe a true plain piece of Ground in the same Latitude of one hundred Yards in Breadth and full if not more than seven hundred in Length when the Sun is at its Meridian Altitude.

Having divided the Space in which the Spirits move into the above-mentioned Thirty-eight Degrees; and finding, by the First Table, that the Inhabitants under the Tropic of Cancer are nearer the Sun upon the 21 of June, than we at 52° . and $42'$. North Latitude are by seven Degrees and Forty Minutes, I then fixed the Point of greatest Heat, as many Degrees and Minutes above our greatest Heat as the Tropic is nearer the Sun than we are. This increase of Heat is very great and as hereafter will be shewn, is very just and afford the most exact Point.

Upon

Upon these Principles and Observations, all the different Degrees of Heat and Cold, in all Countries and Latitudes are determined, whether Northern or Southern, and are by the Tables for the Thermometer shewn. For I believe a City which lays nearer the Sun by two Degrees perpendicular Measure has the Rays of the Sun so much denser or closer contracted, as to raise the Spirits two Degrees higher in their greatest Heat than at London: so on the contrary, a City whose approach towards the Sun is not by ten Degrees perpendicular Measure, so near as London, cannot by the Angle of Incidence dispersing the Sun's Rays more than at London, have the Spirits in the Thermometer so high by Ten Degrees as marked in the above-mentioned Tables.

Having thus briefly set forth the Reasons on which I founded the Scale for shewing by a Thermometer the Heat and Cold of any Country

try

try in any Part of the Globe, how much fo-
 ever it exceeds or falls short of what we do
 or may feel here in England, I shall endeavour
 to prove the certainty of this Scheme from the
 best Authorities.

First as to the Coldness of the polar Parts
 of the Globe which is very great, though not
 every Winter alike, no more than with us.

The honourable Mr. BOYLE in his History
 of Cold has several quotations from the Dutch
 Voyage to Nova Zembla, *viz.* page 16—161.
 “ That the Ground was frozen in the begin-
 “ ning of June”, in the same page, he says,
 “ On the Twenty-third of June Sun-shiny
 “ Weather, yet the Heat not strong enough
 “ to melt Snow”,---again in the same page,
 “ that in July and August, their Heat is not
 “ sufficient to melt Ice in less than Eight or
 “ Ten Days”, and page 187, Mr. BOYLE
 further says, “ That in 74 and 75 Degrees
 “ North

“ North Latitude July the Fourteenth Wind
“ Northerly both Snow and Frost, and on the
“ Twenty-fourth Day of the same July, the
“ Wind. N. E. the Frost was so hard, as to
“ freeze their Cloaths.

These Winds undoubtedly made the Cold greater than it would have been with a South or South-west Wind.

The Cold of the Northern Circle in Winter is described as follows by the Members of the Academy of Sciences at Paris in the Year 1737. *viz.*

“ December the 21, that whenever they
“ would Taste a little Brandy, the only thing
“ that could be kept Liquid, their Tongues
“ and Lips froze to the Glafs, and the Cup
“ came away Bloody. See Page 78, 79, and
“ Page 82. Snow that was melted with Fire
“ was froze immediately, forming a Hearth of
“ Ice all round the Fire. That on the Thir-
“ tieth

“ tieth of December the Mercury in the Ther-
“ mometer fell down to Thirty-seven Degrees
“ below the freezing Point, which was
“ Twenty-three Degrees lower than they fell
“ at Paris in the great Frost, 1709. The
“ Spirits of Wine were frozen in the other
“ Thermometers”.

This Cold is nearly equal to the Cold in my Tables, according to the Distance of the Sun and great Obliquity of his Rays. The Cold, when the Spirits are so low as Fifty Degrees from the greatest Heat, is so intensely severe as to congeal Drops of Water in Half a Minute into hard Ice: and I have seen a Glass of Brandy drank, the Spirit by the severity of the Cold fly from what remained, when the Water on the Sides of the Glass has immediately freezed into a feathered Ice.

The very learned Dr. BOOERHAAVE says that the Cold of Ice-land was at 1 Degree above O,
that

that is the First Degree, measuring from the greatest Cold upward. Which as near as I can find by comparing one Scale with another, and one Observation with another, is nearly as Cold as what the Members of the Academy of Sciences above-mentioned describe the Cold of the Northern Circle to be. Their Winter might be Colder than that in which Professor BOORHAAVE sent his Thermometer to Ice-land. The Doctor says he observed in Leyden Garden in 1709, the Spirits to be Four Degrees above the Cold of Ice-land, that is at Fifty Degrees without Doors, or Forty-five Degrees within Doors; which is the greatest Cold of Amsterdam as is laid down in my Tables of Heat and Cold. Thus nearly in Cold, does my Calculations and Scale of Cold answer to the above Observations.

Having by the foregoing Observations shewn how near my Scale for Cold comes to the
 Truth

Truth of the Cold near the Poles, I shall now shew their nearness to Truth with respect to the Heat and Cold of some Countries, whose situation is nearer to the Equator.

The Ingenious Mr. RAY in a Collection of Travels which he Published says in Page 182. “ The Winter is not very severe (at Bagdat) “ in these Countries, which you may conclude, “ for, that our March Flowers, as Hyacinths, “ Narcissus, Violets, &c. were in full Flower “ in December, and that the Farmers went “ to Plough at that Time”, wherefore I judge their Winter is like our Spring. It is to be observed that their Winter was not come to its greatest Cold, January being generally the coldest Month. These were the Observations of Dr. ROWALF, a Native of Augsburg in Germany between the Forty-eight and Forty-nine Degrees of North Latitude.

Monfr.

Monfr. ROLLINS in his Ancient History of the Egyptians, Page 21 speaking of the Weather says, “ The Egyptians begin to turn them
 “ out to Grafs in November, and they Graze
 “ till the end of March. Words could never
 “ exprefs how rich their Pastures are; and how
 “ fat the Flocks and Herds (which, by reason
 “ of the Mildnefs of the Air, are out Night
 “ and Day) grow in a little Time.

As to the December Flowers at Bagdat blowing at the latter end of March or beginning of April, with us, allowing their Weather to vary in Proportion to ours here in England, which is not always, nor may I fay at any Time the fame, in different Countries of the fame Latitude, but to allow it fo, and upon observing our Weather in March the mean Motion of the Spirits is between Thirty or Cool, and Thirty-five or Cold. On the Thermometer Table in which Table the greateft Cold of Bagdat is at
 Twenty-

Twenty-six Degrees and Forty Minutes, the greatest Cold of Augsburg being at Forty-one Degrees, the Cold of March there, according to my Tables will be at about Twenty-seven Degrees and Thirty Minutes, something below Temperate, which is within less than one Degree of the greatest Cold at Bagdat in the same Scale: upon comparing them together, it plainly appears that what Flowers blow with us in the beginning of April, may Blossom in the middle of March at Paris, Vienna, Augsburg, &c. being at an equal Distance from the Sun, and at Bagdat or any other Place under the same Latitude in December.

As to Egypt the greatest Cold at Grand Cairo in these Tables is very near what we call Temperate: take the mean Height of the Spirits with us in November, it is generally about Cold, in all probability, the same Spirits in November, at Grand Cairo, would

be found at a Medium, at Sixteen, or Seventeen Degrees, or nearly as High as very Warm according to the Scale in the Tables, and at the latter end of March to be at about eleven Degrees or nearly what we call Hot, or such Weather as, (if the Summer proves kind,) we have in July, in a seasonable kind Year.

These Quotations from Mr. RAY, and Mr. ROLLIN, as also those of the Northern Countries are what offered since I formed my Tables of Heat and Cold, which upon strict Examination, finding them answer so nearly to what I had there laid down for the Heat and Cold of those Countries, was I confess no small Satisfaction to me to find my Tables for the Thermometer so very near Truth.

The greatest Heat in my Scale for the Thermometer is upon Trial found equal to that of a healthy Man in Summer, which is the usual Height of the best Thermometers, neither of
which

which I had recourse to for fixing the Point of Heat in my Tables, nor to the aforementioned Observations on the Cold of the inhabited Parts of this Globe: but the excess of Heat, more than what we Feel, necessarily arises from the nearer Situation to the Sun by contracting the Rays, &c. and the exactness in the Point of Cold being greater than with us is the natural Consequence of a further recess from and greater dispersion of the Suns Rays.

I can from Experiments made on several Exotics, since I formed the abovementioned Tables, assert that any foreign Plants will perfectly well indure the changes of our Air, till the Spirits fall to the Cold, assigned to the Country from which they are brought, in the Scale for the Thermometer: by these Tables the growth of Exotic Plants is brought to a greater certainty than ever, and that curious Instrument

the Thermometer is found much more entertaining and usefull than it has heretofore been.

I shall now inform the Reader what the Particulars contained in the so often mentioned Tables are.

First, a Table of Countries with their Latitudes in Degrees and Minutes, from the latest Observations, whether North or South, or both, and what Quarter of the World each Country lays in.

Secondly, three Tables in which the first Column shews the Degree of Latitude ; the second the Height of the Spirits in the Thermometer : the Numbers expressing which, being as the versed Lines of the Distances from the Vertical Sun, may be found from these Tables to all Times and Places.

Thirdly, a Table of the Suns Motion in the Ecliptic, by which is shewn, not only how
Swift

Swift his Tranfit is crofs the Equator, but alfo how flow his Motion when he either approaches to, or departs from either Tropic.

Fourthly, a Table of Climates for finding the Length of the Day or Night in any Country or Latitude.

Fifthly, a Scale for a Thermometer by which is shewn how much the Heat of Summer, or the Cold of Winter, exceeds or falls short of what is, or may be the Heat or Cold of England, alfo how much the Spirits are Higher abroad, if rifing, or lower in the Air if falling, than in the Houfe. Likewise what Cities or Countries lay Parallel to each other, and what is the difference of Distance in perpendicular Measure in Degrees and Minutes, (when the Sun is Vertical in either Tropics) of each Country and moft Cities.

Sixthly, a large Catalogue of Exotic Plants with the Countries where naturally Produced, curiously,

curiously Engraved on a very large Copper-Plate, and Printed on Imperial Paper, inscribed to Sir Hans SLOAN, Bart. and approved of and recommended by Mr. PHIL. MILLER, F. R. S. and Gardiner at the Botanic Garden at Chelsea.



Explana-

Explanation of the FIGURE.

A, Represents the Globe of the Earth, in its Position on the 21 of June, when the Sun is Vertical in Cancer: it is divided by the Equinoctial Line on which the Hours are marked, and by the Tropics and polar Circle. Again, it is divided from Pole to Pole at every Fifteen Degrees or every Hours Transit of the Sun. This will give a tolerable Idea of the Rising and Setting of the Sun in the different Latitudes and Seasons of the Year. The Line FF. describes how much the Velocity of the Sun in his diurnal Motion is greater in one Latitude than another.

There is also a Circle that incloses the Globe, divided at every Fifteen Degrees, representing the Atmosphere.

B.B.B.B.

B.B.B.B. These Lines represent the Rays of the Sun falling Perpendicularly upon the Earth; from a due Observation of which it will appear that the Surface of the Globe at a very few Degrees distance from the middle Rays which fall on the Tropic, reflects the Rays not Perpendicularly but Obliquely, and thereby abate the force of Re-action till that Power, which so much increases Heat, continually lessens till entirely lost; and the Rays of Light pass by the Globe, without affording any Warmth.

C.C. The Point of this Angle shews nearly the Place upon the Globe on which London is situated, with the Angle of Reflexion, and also how much farther five Degrees of Rays diverge here than under Capricorn. In this Position of the Globe by this Angle of Reflexion, it appears, that as the Rays are reflected back in Lines more and more Oblique, Motion or Action, being thereby lessened, Heat must for the same Reason

Reason be also lessened. D. D. Shews that 47° . Latitude is as near the Sun as the Equator, the Angle of Incidence being equal in both, the Velocity of the Sun less, and thereby the Heat at 47° . Latitude may be equal to the Cold under the Equinoctial Line.

C2. C2. Shews the extream Obliquity of the Suns reflected Rays at London, and how vastly wide the Angle of Incidence disperses the Rays of the Sun in Winter, or when the Sun is in Capricorn. The taking this point for the situation of London in Winter on the South-side the Globe could not easily be avoided without drawing another Diagram, to avoid which as well as the placing London in Winter so far North, as not to be Inhabitable, I thought it would be pardonable if I reversed its Situation.

E. E. A pricked Line drawn parallel under a Vertical Sun in Cancer and touching the Globe in that Point to shew how the Distance
from

from the Sun is increased in different Latitudes in Summer and Winter.

F. F. Another Line drawn cross the Globe, and extended to shew by the horary Circles which intersect the Equator from Pole to Pole, the different length of Days and Nights, by exhibiting the Time the Sun Rises and Sets in any Latitude, as also the different Spaces the Sun passes over in the same Period of Time.

F I N I S.

E R R A T A.

- Page 18 line 11 *read* than.
20 l. 3 *r.* common Computation.
l. 17 *r.* than equinoctial.
21 last l. p. 23 l. 10 p. 24. l. 4 *r.* Plane.
22 l. 12 *r.* Fifty.
25 last l. *r.* affords.
19 29 p. 30 l. 9 *r.* BOERHAAVE.

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