

I. *The History of the Great Frost in the last Winter 1703 and 170^s. By the Reverend Mr. W. Derham, Rector of Upminster, F. R. S.*

THIS Famous Society having done me the Honour to put into my Hands their Papers relating to the late *Great Frost*, and having also my self received divers Relations thereof from my Friends at Home and Abroad, as well as made Observations my self, I shall endeavour to give an Account of Two Things; *The Degree, and Effects of this Remarkable Frost.*

The Degree of the Frost in England.

As to this Matter, I believe this Frost was greater (if not more universal also) than any other within the Memory of Man. The greatest that hath happen'd within our Memo y, was the *Long Frost* in 1683; but the late Frost, although of shorter continuance, was more intense than that. Of which I have already given some Account in a former Paper (which I find in the *Transactions*, No. 321.) and must be forced to Recapitulate it here; *viz.* That my Thermometer was much lower on *December 30.* than it had ever been since 1697. when I first began my Thermometrical Observations; That the self-same Thermometer in our Repository in *Gresham-College* was lower than ever it was before: [The Particulars of its greatest Descents are these; *January 26. 1696. 41 Gr. January 5. 1683. 40 Gr. and January 3. 170^s. 43 Gr.*] And lastly, that in another self-same Glass in
London

London [Mr. J. Patrick's] the Spirits were four or five degrees lower than in 1683.

In *London* the greatest Contraction of the Spirits was on *January 3.* which was an excessive cold Day at *Upminster* also: But the far greatest Contraction with us was on *December 30.* before. The reason of the Difference is, because my Thermometer is always abroad in the open Air, where no Sun-shine toucheth; but those two *London-Glasses* are within Doors, in Rooms where no Fires are made. And it is easie to observe, that the Frost doth not presently exert its greatest force within Doors: And when it doth, neither doth it so soon abate its force within Doors, as without. The reason whereof is plain enough, and needs not be mention'd.

These Observations of the Intenseness of the Cold with us, I have received Confirmations of from other Places in the Southern Parts of our Island; particularly I find them to agree with some Observations made at *Streatham* in *Surrey* by Mr. *Cressener*, an Ingenious Member of our Society.

I had like to have forgotten to Note, That the Descent of the Spirits in my Thermometer on *December 30.* was within One tenth of an Inch as great as the Descent effected at another time (and that in a cold Day too) with Artificial Freezings perform'd both with Snow and Salt, and also Snow and Spirits. Both which Mixtures I have several times made use of, and find them nearly of equal Power: If any difference be, I have sometimes thought the preference due to the Mixture of Spirit of Wine with the Snow. I said also the Contraction of the Spirits in a cold Day, because an Artificial Freezing is less vigorous in a warm Day than in a cold one. It is well known that we can in Summer freeze with Ice and Salt, and the same may be then done with *Sal Armoniack* dissolv'd in Water; but we cannot produce so intense a Frost

then by these means, as in Winter, and especially in a very cold Day. But these Things by the by.

The Degree of the Frost in Scotland and Ireland.

But notwithstanding the Frost was so extremely rigorous in the Southern Parts of our Isle, yet the Northern felt little thereof; as I have been certified by Persons that have come from thence, as well as by several Letters my Friends have received from thence. My Ingenious and Learned Friend Dr. *Sloane* writes to me in general, That he hath received many Informations from those Parts, which do all agree that the Winter was no way extremely Cold there, but as other Winters. And as to Particulars, the two following Letters from two eminent Persons in those Parts, to my Ingenious and Learned Friend Dr. *Woodward*, will give an Account. One is from the Right Reverend and very Learn'd Lord Bishop of *Carlisle*, dated from *Rose*, November 5. 1709. " In *January* last
 " (saith he) I had a sufficient occasion to take notice of
 " the Frost and Colds being more intense in the Southern
 " Parts than here, and the Snow much thicker. I be-
 " gan my *London*-Journey on the 26th of that Month,
 " three days before the Thaw, and can assure you that
 " for several Miles (near the Banks of the River *Eden*,
 " in both the Counties of *Cumberland* and *Westmorland*)
 " my Horses hardly ever trod upon Snow. When we
 " came to *Stanemoor*, on the Confines of *Yorkshire*, we
 " found the Ground covered pretty thick, and the deep-
 " er still the farther we came to the South. None of our
 " Rivers or Lakes were frozen over; and the extraordi-
 " nary Flocks of Swans that resorted hither (nothing of
 " the like having been seen by the eldest Man living) was
 " a sure Argument that the Temperature of Climates
 " was strangely inverted. Thus far that Right Reverend Member of this Illustrious Society.

The

The other Letter is from *Edenburgh*, *November 5. 1709.* from a very Curious and Ingenious Person, Sir *Robert Sibbald*; who saith, " I can learn no extraordinary Effects of the cold Season here. It was a long Winter: " The Cold came early in *October*, and continued till " near *May*. There was much Snow, which lay long " upon our South Hills near this Place. We had not " much Frost to speak of, and it lasted not long. There " was but little Sport at *Curling* upon the Ice [A Sport in *Scotland*, usual in hard Frosts, when the Ice can bear a great Company of People.]

And as in *Scotland*, so in *Ireland* the Frost was very favourable: Of which among other things, I have this Account in a Letter from *Dublin*, from Mr. *S. Molyneaux*, a very curious and ingenious Gentleman there; who saith, " They had there an harder Winter than usual, but judg- " eth they suffered not so much as their Neighbours: " They had two or three pretty hard Frosts, and some " Snow, but not of any remarkable continuance, as he re- " members.

The Degree of the Frost in other Parts of Europe.

Having thus related how the Case was near Home, let us next look farther Abroad, and first into the more *Southerly Parts of Europe*.

And in the Comparison I have already given the Society between Dr. *Schenckzer's* Observations at *Zurich* and mine here, I said, That he noted the Cold to have been excessive there; but whether more than usual, he saith not. But by a Letter I have lately seen from his Brother (of which more by and by) it appears to have been in as great and unusual Excess there, as here it was with us.

In that Paper also I have foretall'd my self, and said to what Excess the Frost arrived in *Italy*, viz. " That the Cold there was so great, that for 20 Years past they had not been sensible of greater, and on *Twelfth-Day* it wanted but half a Degree of the Extremity.

As to the *Northern Parts*, the before commended *Dr. Woodward* tells me, that in a Letter he received from the Learned *Mr. Otho Sperling*, from *Copenhagen* dated *April 6. 1709.* he calleth it *Hyems Atrocissima.* And I find it noted in the Minutes of the *Royal Society* of *May 4. 1709.* " That *Dr. Judichar* said the Ice was frozen in the Harbour of *Copenhagen* 27 Inches; and that *April 9. N. S.* People had gone over between *Schone* and *Denmark* on the Ice. Which Accounts give me a better Opinion of some Papers I have by me, which were shew'd to the Society, concerning the Frost at *Copenhagen*, pretended to be taken from the Observations of *Mr. Romer.* I should not entertain any the least distrust of the Accuracy either of the Instruments, or Observations of that Eminent Person, were I sure they were his. But there are some Passages and Hints in those Papers that lessened others, as well as my Opinion about them. 'Tis said there, " That such a Frost hath not been known in the Memory of Man in these Countries, and that the Frost on *January 7.* and *February 23. 1709.* did very nearly approach the Point of Artificial Freezing.

In the *Northern Parts* of *Germany* also I find they had the same fare with their Neighbours of *Denmark.* Of which I have an Ingenious printed Account put into my Hands by the foremention'd *Dr. Woodward.* The Title of the Book is, *Consideratio Physico-Mathematica Hyemis proxime Praterlapsæ, &c.* being an Academical Exercise performed in the University of *Hall,* *June 13. 1709.* by *G. Remus a Dantzicker,* and Printed at the same Place [*Hale & Magdeburgica.*] This Dissertation relating directly

to our Subject, and being I suppose in but few Hands with us, a short Account thereof may not be unacceptable.

The Ingenious Author having complained of the Defects of Meteorology, and Meteorological Instruments, and given some Directions concerning observing the Winds, &c. tells us, he had the help of the Observations of three Eminent Persons in his Dissertation about the Winter, namely, of *Dr. Wolfius*, Mathematical Professor of *Hall*; *Dr. Hamberger*, Mathematical and Natural Philosophy Professor of the University of *Jena*; and of the Reverend Mr. *Teuber*, an excellent Mathematician at *Ciza*. The Winter he distributes into five Periods. The first of which he begins at *October 19. 1708.* at which time he saith the cold Weather began with them, the Northerly Winds then blowing, and frosty Weather accompanying it. But with us at *Upminster*, it began something sooner: For all the latter end of *September* the Winds were Northerly, and an Hoar-frost on *Michaelmas*, and the following Days. After which, a great part of *October* to the 23th Day, my Register shews the Weather to have been for the most part Hoar frosty, or Frosty, very agreeably to Mr. *Remus's* Observations. The end of this first Period he placeth on *November 3.* the same with our *October 23. O. S.* their Style I perceive by divers Comparisons, and Hints in his Paper, being the New Style.

As to his next Period, which with its Interval takes in *November* and *December*, I find a pretty deal of Agreement between his Observations and mine, the Weather often being Warm, or Cold here, as it was there, and the Winds also not very different. Only I observe the Cold in one Place commonly to precede the other. Also the furious Wind, that he saith blew the Night before *December 13.* was not perceivable here 'till the second

Day after, viz. *December* $\left\{ \begin{array}{l} 14 \text{ N. S.} \\ 3 \text{ O. S.} \end{array} \right.$ about Noon: At
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which time it had much spent it self, and was only a brisk Easterly Wind, but no Storm.

The third Period he begins on *January 5*. Of which he saith, “ *Scena subito mutabatur, & cum universæ Europæ admiratione cœpit Periodus, insolito profusè frigore notabilis.* The very same { *January 5* } the { *Decemb. 25* } the Wind and Weather began here to change, as there he saith it did, and the Cold also to encrease. The most remarkable Depressions of the Spirits he hath put into a Table, which may be seen with mine in this following little Table, fitted to our Old Style.

<i>Day of the Month</i>	<i>Degree of the Thermometer at Hall, at 10^h p. m.</i>	<i>Degree of the Thermometer at Upminster, at 9^h p. m.</i>
<i>Dec.</i> 27	84 $\frac{1}{2}$	65
28	84 $\frac{1}{2}$	75
29	92 $\frac{1}{2}$	58
30	100	45
31	Totus intra Sphæram.	52
<i>Jan.</i> 1		63
2		54

For the right Understanding these Observations, it is to be observed that the Scale of their Thermometer runs downwards from some Point above, down towards the Ball. But the Ball, or Bottom of the Stalk, being a certain Place that all Thermometers agree in, and every one is acquainted with, I therefore make the Degrees of the Scale of my Thermometers to begin at the Top of the

the Ball, or (which is all one) at the Bottom of the little Tube, or Stalk; and so reckon upwards; every Degree being One Tenth of an *English* Inch; the *Freezing-Point* in my old Thermometer (here noted) at 82 gr. equal to 8 Inches Two Tenths from the Ball; and the most *Intense Cold* at 44 gr. But in my later Thermometers (which I now use, and are much nicer than my old one) the *Freezing-point* is at 100 gr. ten *English* Inches from the Ball, and the most *Intense Frost* near to, or just in the Ball. Which things I thought convenient to note, as being necessary for the right understanding the little Table above, and also any of my Thermometrical Observations, that shall be mentioned here or elsewhere.

It may from the foregoing Table be perceived, that the Frost kept a pretty equal Pace in both Places at its beginning. And my Notes give me reason to think it did the same the greatest part of its duration: But I cannot be very sure thereof, my old Thermometer (the only one I then had) happening to be unfortunately broken on *January 11*. For which reason I am unable to give such another Thermometrical Table of his next Period as I have done in this.

This third Period he makes to end *January* $\left\{ \begin{array}{l} 25 \text{ N. S.} \\ 14 \text{ O. S.} \end{array} \right.$ with a Westerly Wind, and a Thaw, which held for a few Days. With us the Wind was Southerly at the same time, and a Thaw accompanying it for a few Days likewise.

The fourth Period he begins *January* $\left\{ \begin{array}{l} 31 \text{ N. S.} \\ 20 \text{ O. S.} \end{array} \right.$ In which I observe there is a great Agreement between our Observations as to the Cold; and those Days on which he noteth the Westerly Winds to have been strong, it was the same here. And some Agreement also, but less, is in the Coasting and Shifting of the Winds throughout this Period.

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The fifth and last Period he placeth between *February* $\left\{ \begin{array}{l} 17 \\ 6 \end{array} \right.$ and *March* $\left\{ \begin{array}{l} 17 \\ 6 \end{array} \right.$ *N. S.* In this, he saith, the cold Weather returned, and continued long: And the same it did with us. But as to the end of this Period, I find some Difference, and some Agreement between our Observations. The Snow was more with them than us; the Winds changed with us from the Easterly Points, to the Westerly and Southerly, a Day or two sooner than with them; then agreed with them; and soon after veered about to the Easterly and Northerly as it did with them. And I observe farther also, that when the Winds agreed in both Places, my Notes shew the Wind to have been of some force here.

As to the Warmth of the Weather all this time, I find a pretty deal of Agreement; only as the Wind changed two Days sooner here, so we had the mild Weather, he mentions, two Days sooner: Then it grew colder here, as he saith it did with them. And whereas he noteth *April* $\left\{ \begin{array}{l} 13 \\ 2 \end{array} \right.$ *N. S.* to have been the first Day on which the Spirits rose to the Point of Warmth, I found by my Thermometer (then renewed) the Day before to have been as warm as that, as also were the following Days; and each of them warmer than had been all the preceding Winter; but yet that we had divers warm Days before that time, particularly *March* 12, 13, 14, 18, 19, 28. *O. S.* were warm Days, but the rest in that Month for the most part Cold.

Our curious Author having given this Relation of the State of their Winter, takes occasion to speak next of the Barometrical Heights there. Of which he hath given us a little Table: Which I shall take a more convenient Opportunity of Communicating to this Honourable Society, together with my own and some other Observations of the same Nature, made at the same time.

The Effects of the Frost.

Having thus given the History of the *Degree* to which the Frost arrived in several distant Parts of *Europe*, I shall next shew what unusual *Effects* this so unusual a Frost produced; and that on *Fluids*, *Animals*, and *Vegetables*.

The Effects of the Frost on Fluids.

The Waters we may easily imagine were the first thing that felt the dire Effects of this Frost. And these were in many Places frozen to an extraordinary depth; although I hardly believe to that depth, as in the Long-Frost in 1683. Of which Frost we have a sufficient instance in our River of *Thames*; whose Waters were so frozen, that above Bridge, 'tis well known, many Booths were erected, Fires made, and Meat dress'd; and on *January 10. 1683*. I my self saw a Coach and two Horses drive over the River into *Southwark*, and back again, a great number of People accompanying it. But this last Winter the Case was greatly different, according to this Account I received from my Learned and Ingenious Friend Mr. *Lomthorp*; who saith, " He saw several People cross
 " the *Thames* at some distance above the Bridge: But
 " that was only towards Low-water, when the great
 " Flakes of Ice that came down, stopp'd one another
 " at the Bridge, 'till they made one continued Bed of
 " Ice from thence almost to the *Temple*. But when the
 " Flood came, the Ice broke, and was all carried with
 " the Current up the River. I was told the like happen-
 " ed between *Westminster* and *Lambeth*, a little above
 " *White-hall*.

As for other Waters, they also had their share; especially where they lay exposed to the Northerly and North Easterly Winds. Nay, the Sea-waters themselves escaped not, but were covered with Ice in many Places near the Shore, in Harbours, and where they lay calm and still. Of this I have already given a pregnant Instance in the Harbour of *Copenhagen*, and the Sea between *Denmark* and *Schonen*. And in a Letter from Dr. *Newton*, Her Majesty's Illustrious and Learned Envoy at *Florence*, he tells me, " The Sea was frozen both on the Coast of "*Genoa* and *Legorne*."

As for the Northern Parts of *Germany*, the last cited Dissertation gives this Account of its Effects on Fluids: *Aqua infra solitam profunditatem in glaciem abiit, & alii liquores congelati apparuere, qui aliàs extra congelationis periculum mediâ hyeme constituuntur. Pertinet huc Fons in quodam Silesiæ pago, qui cum aliàs æstate frigidus, hyeme calidus deprehendatur, hac tamen hyeme spissa satis glacie non sine omnium admiratione obductus fuit. Certè Novellæ publicæ aliquoties Thermas in glaciem conversas nunciarunt: Id quod tamen calidioribus non accidit Halæ strias fontibus salis adherentes vidimus, id quod intra seculi ambitum non contigisse fertur. Per literas me certiozem reddidit D. Breynius, in urbe patria Medicus celeberrimus, Soc. Reg. Ang. Soc. &c. ipsum mare, quousque oculorum iacies etiam armata penetrare poterat, adhuc d. 8. Aprilis glacie tectum fuisse. Cum is Lixivium cineribus clavellatis ad saturitatem ferme imprægnatum aeri exposuisset, licet nunquam congelare ab hominibus, qui pluribus annis ad tractaverant, assereretur, brevi tamen tempore in glaciem conversum esse expertus. Addit, amicum quendam suum Tartari quoque spiritum dephlegmatum congelatum observasse. Referunt observationes Halenses Sputum ex ore vix dimissum in glaciem abiens Fluvii ter in glaciem abiere, etiam illi, quibus ob celeritatem, qui feruntur, frigus aliàs non infestum. Thus far D. Remus.*

These Effects I am apt to think the Waters felt not only in *England, Denmark, Germany, France and Italy*; but in all the *Northern World* also, excepting *Scotland, Ireland,* and probably some other Islands, or Places near the Sea; although even some of these appear from the foregoing Account to have been great Sufferers too. This Universality of the Frost, I suspect from the multitudes of divers kinds of Birds (utter Strangers to these Parts, and many of them Inhabitants of the Northern colder Countries) which were seen and killed in many Parts of *England*. In our *Essex-Marshes*, near us, we had many wild Swans, Brent Geese, many of the rarer Gull-kind, and divers other sorts of Birds, utter Strangers to these Parts. And Mr. *Bellers*, an ingenious *Gloucestershire* Gentleman, gave Dr. *Woodward* this following Catalogue of Birds killed within four or five Miles of *Coln St. Aldwins*, or *Edwins*, in *Gloucestershire*, between the beginning of *November* and the latter end of *March 1708*, which he saith are never found there in moderate Winters.

1. *Lanius cinereus major*. The Greater Butcher-Bird, or Mattagefs: Sometimes seen in *Derbyshire*, but common in *Germany*, as Mr. *Willoughby* saith.
2. *Fringilla montana*. The Brambling.
3. *Numenius, sive Arquata*. The Curlew. These Birds, though Strangers to the inland Parts, I have seen common enough on the Sea-coasts of *Essex*: And Dr. *Woodward* saith he saw them several times this last Winter at the *Poulterers* in *London*.
4. *Gallinu'a Erythropus major*. The Redshank, or Pool-Snipe
5. *Gallinula Hypoleucos Gesneri*. The Sand-piper.
6. *Schæniclos*. The Stint.

7. *Corvus aquaticus minor*, five *Graculus Palmipes*. The Shag.
8. *Merganser*. The Goosander.
9. *Mergus cirratus longiroster*. The Dun-diver.
10. *Mergus major cirratus*. The Smew, or White Nun.
11. *Colymbus major*. The Greater Loon.
12. *Larus major*. The Greater Gull.
13. *Cygnus ferus*. The Elk, or Hooper, or Wild Swan.
14. *Brenta*. The Brent-Goose.
15. *Anas niger Aldrovandi*: Seldom seen in England, but frequent in Norway.
16. *Tadorna*. The Shel-Drake, or Burrough-Duck.
17. *Anas Fuligula prima Gesneri*. The Tufted-Duck.
18. *Anas fera fusca Gesneri*, *Penelops Veterum*. The Poker.
19. *Anas Platyrhynchos mas Aldrov.* The Golden-Eye.
20. *Anas Platyrhynchos rostro nigro & plano*. The Gadwall.

The Effects of the Frost on Animals:

In the Dissertation before cited, we are told, how Animals suffered both with them, and in other Places; “ That the Fresh-water *Fish* were every where killed in “ their Parts, and that a vast Destruction befel their “ *small Birds*. Both which things he was informed hap- “ pened in his own Country also at *Dantzick*. Nay “ some did not, saith the Author, stick to affirm, that “ they saw Birds, as they flew along, to drop down out “ of the Air, their Strength failing: That the *Lusatia* “ *Letters* said many Cows were frozen to Death in their “ Stalls. And many Travellers on the Road, he tells us, “ were

“ were some quite frozen to Death, others lost their
 “ Hands, Feet, Noses or Ears; and others fainted, and
 “ were in great Danger of Life or Limb, when brought
 “ too soon near the Fire. Of these Particulars he gives
 “ divers Instances from their News Papers; of two Gen-
 “ tlemen, and a Smith in *England*, and above 60 Men,
 “ and many Cattle near *Paris*; and the like at *Venice*, and
 “ 80 *French* Soldiers near *Namur*, all killed on the Road,
 “ with the Cold. Whether any such Persons perished on
 our Roads in *England*, I have not heard. But we were
 told of some that did; particularly some Post-Boys, and
 if I misremember not, some Drovers also. Our Fresh-
 water Fish also were many of them destroy'd in Ponds
 that were shallow, and especially if long frozen over;
 some for want of Air, where the Ponds were not kept
 open; and some with the cold Air at the Holes in the
 Ice, where in great numbers they came to get Breath. On
 the *Italian* Coast some of our poor “ Mariners on board
 “ our Men of War died of the Cold; and several lost
 “ Parts of their Fingers and Toes: As the before named
 Dr. *Newton* writes to me.

But the greatest Sufferers in the Animal-Kingdom were
Birds and *Insects*. *Robin Redbreasts*, which before the
 Frost were numerous, are since that very scarce about us,
 only here and there one to be seen. Nay notwithstanding
 their Recruits in the following Summer, yet even
 still, in this succeeding Winter, their scarcity remains.
Larks also, both *Wood* and *Sky-Larks*, which used plen-
 tifully to entertain us with their pleasant Melody, became
 in a manner Rarities in our Country the following Spring
 and Summer; only one here, and another half a Mile or
 a Mile off. Neither are they as yet become so numerous
 as heretofore. But whether this was an universal Calamity
 that befel that Family of Small Birds, or whether it
 only happened to our *Essex-Larks*, or whether they were
 not driven from these Parts by the Frost, I cannot say;

because I have been told that in some other Counties of *England*, which abound in large common Plough'd Fields, and where Larks are commonly more numerous than about us, they have had large Flights of Larks this present Winter 17th. But I have lately enquired of the *London-Poulterers*; and they tell me, they have Larks from almost all Parts of *England*, and have not this following Year received a Quarter, nay, scarce a Tenth part of the Larks they used to have, by reason the Frost killed them, as the Bird-catchers say.

In the *Insect-Tribe*, I have particularly observed the *Pediculus Pulsatorius*, or *Fatidicus*, or *Death Watch*, to be great Sufferers. 'Tis that *Death-watch* I mean, which there is the History given of in *Phil. Transf.* No. 271 and 291. where I have taken notice of the great Precaution, and Art of that Insect, to secure it self against the hard Weather, in dry Places within Doors, under downy, light Dust, &c. Notwithstanding which, they seem to have been great Sufferers by the Frost. For few of them appeared the following Summer; and in places where they used in *July* to be very sonorous with their Ticking Noise, only now and then one was heard; a manifest sign of their being either killed, or rendered less fertile and venereous.

The Effects of the Frost on Vegetables.

But among all the Sufferers by the Frost, the *Vegetables* were the most universal; few of the tender Sorts escaping, to the great Dammage of the Owners. About us, *Bays*, *Rosemary*, *Cypresses*, *Myrtles*, most of the *Phillyrea's*, yea, even *Junipers*, among Shrubs; and *Artichokes*, *Colly-Flowers*, and a great many other Olitory Plants suffered greatly. In a word, so great were the Dammages done among the Gardens, that by Enquiries made on purpose among the *London Gardiners*, I have been informed some
of

of them have lost to the Value of 80*l.* 100*l.* yea
200*l.*

But the most exact Account I have met with, is from that accurate Botanist of the *Oxford* Physick-Garden, Mr. *Ja. Bobart*, in a Letter to the ingenious Mr. *J. Thorpe*, F. R. S. in which he takes notice, That the Dammmages of this Frost do not come up to those in 1683; which Frost being of longer continuance, cleft the *Oaks*, and Bodies of the *Vines*, &c. But in the last Frost there were Intervals of Relaxation, besides several considerable Snows, which proved a good Guard to many Plants. But the Snow melting, and the Cold withal continuing, proved of evil Consequence to many Bulbous and Tuberos Roots, and abundance of other Things. “ But (he saith) the sharp, dry, and cutting Winds from the North, and North-East, were most Destructive to many of the Ornaments of our Gardens, which before seem’d so good Natur’d, as to be almost naturaliz’d to our Clime; as *Cypress*, *Bays*, *Rosemary*, *Alaterni*, *Phillyrea’s*, *Arbuti*, *Laurustines*, &c. as also to most of our Frutescent Herbs, such as *Lavenders*, *Abrotonums*, *Rue*, *Tyme*, and divers others of such Race, especially such as had their Heads above the kind covering of the Snow. And not such Exoticks only, but some of our own Natives, as is visible in most of our *Furze-fields*, and divers *Hollies*, especially of the finer strip’d Race, have felt the smart of such the Vigour of the Season, by the loss of their Leaves, beautiful enough, and sometimes their Lives,

“ And what (he saith) hath been more observable this Year, than in others, is, The Sap of our finer mural Fruit-Trees, as of *Peaches*, *Nectarines*, *Apricocks*, &c. was so congealed and disorder’d, that it proved stagnated in the Limbs and Branches, and equal to Chills in Humane Bodies; which in too many Parts of the Tree, turned to so frequent Mortifications, that it is very much to be doubted whether sufficient Vigour
“ is

“ is ever to be expected from them, to be worth their
 “ standing, notwithstanding their weak Endeavours of
 “ shooting, and recovering of such their Maladies, seem-
 “ ing to make work for another Winter to compleat,
 “ what this hath so unhappily begun.

“ And it is no less observable than extraordinary, That
 “ the very Buds in these finer Trees, as well Leaf-Buds,
 “ as Blossom-Buds (which are but the Ovaries of the
 “ succeeding Fruits) were quite killed, and dry'd into a
 “ farinaceous Matter, by the too great Sharpness of the
 “ Cold, before they grew out, though Life remained in
 “ the Branch.

“ The *Plumbs*, being more hardy, produced their
 “ Blossoms well enough; but through the chilling Wets,
 “ before mentioned, which happened too plentiful about
 “ that time, and the great Defect of nutritive Warmth,
 “ they grew weak; with their little Stalks, or Pedicles
 “ languishing, and turning Yellow, generally dropt off,
 “ and came to nothing.

“ It might (he saith) reasonably have been supposed,
 “ that such conjoyn'd Cold, with repeated Wets, should
 “ have destroy'd the injurious *Insects*, which usually in-
 “ fest the first Product; but even in this Year, they have
 “ proved vivid, in too great plenty among the *Apples*
 “ and *Pears* (especially the former) whose Blossoms, as
 “ well as Leaves, have been too copious pabulum for
 “ these voracious *Erucas*, whose Eggs lay dormant all the
 “ Winter, so dry in their Bags, that there were so ma-
 “ ny escaped from being frozen, that in many Places they
 “ proved enough to destroy the whole Verdure.

“ *Fig-Trees* (he tells us) whose softer Texture was
 “ more easily penetrated, have suffered much, most of
 “ them being cut down, to begin the World again.

“ Many *Exotick Greens*, and rare Plants coming from
 “ *Africa* and other warm Regions, have mightily suffered,
 “ espe-

“ especially in such Stoves and Conservatories as were too
 “ parsimoniously defended by Fire.

What he observeth concerning the Destruction of
Wheat, was I believe a general Calamity, as also the Particulars he takes notice of much the same in other Places too, *viz.* “ Where the Land was poor, and coldly exposed, there the *Wheat* was killed; that many Lands of
 “ *Wheat* escaped tollerably well on the warm side, when
 “ the other side was quite killed with the Extremity of
 “ Cold.

By the *warm and cold Sides*, I suppose our ingenious Observer meaneth the sunny and shady Sides. But with us the *Wheat* suffered rather more on the Southern, sunny Side, than the Northern; I suppose by reason the Ground was somewhat opened by the Sunshine, and the covering of Snow melted, and way thereby made to the Severity of the Nocturnal Frost. Upon which account I have heard it said by some skilful Observers, *That Vegetables suffered more the last Winter from the Sun than the Frost.*

In *Essex* also, about us, I observed many small Fields of three or four Acres of *Wheat*, to escape pretty well, where fenced with thick high Hedges against the cold Winds, especially where they were covered long with Snow; at least they came off better than other Parcels of Land exposed to the Winds, that dislodg'd the Snow, and aggravated the Cold also. So in the Parish where I live, the best Pieces of *Wheat* were such, I observed, as lay on gentle Descents facing the West or S. W. especially when guarded on the Eastern, or N. Eastern side with a Hill, or a Wood; which fenced off the cold piercing Easterly and North Easterly Winds.

And not only *Shrubs* and *Plants*, but the *larger Trees* have in some Places had their share of Suffering too. But it was observed by some ingenious Persons at one of the Meetings of our Society, That the Calamities which befell Trees, arose not purely from their being frozen,
 but

but principally from the Winds shaking and rocking them at the same time, which rent and parted their Fibres.

These have been some of the most remarkable Effects of the Frost on the *Vegetables* of the more *Southerly* Parts of our Island, the *Northerly* (as hath been observed) escaping better; as will appear by another part of the forementioned Letter of Sir *Rob. Sibbald* in these Words: “ The Corn did not rise, and ripen so soon as wont; “ but, Blessed be God, there hath been a plentiful Harvest, well brought into the Barns and Yards. And “ the Price of Victuals (which was high) falls lower “ daily. There was no greater number of those who “ died, than was usual during the Winter formerly.

As to other Places, I find the Effects were, in the more Southerly Parts of *Europe*, much the same on their *Vegetables* as in ours. In *Italy* my forementioned Illustrious Friend, Dr. *Newton* saith, “ Almost all the *Lemon* “ and *Orange-Trees*, with those of the like kind, are destroyed in this Country by the Frost, and a great many *Olive-Trees*. The Leaves of the *Bay-Trees* have the “ same Colour now, as all others have when they are “ falling in *October*. Besides which Calamities upon *Vegetables*, there are two other Disasters he tells me of, owing probably to the Frost, which I shall mention here, for want of a more convenient Place to bring them in. One is a Disaster that happen'd at *Florence*, where “ on the “ side of a Hill were formerly many Buildings, which “ twice falling down, by the Earth giving way, a Wall “ was Erected in the time of this Great Duke's Grandfather, with an Inscription on the Wall, which separates “ the Ground from the next Street, that for the future “ no Person should build there. After the Great Frost, “ this Wall hath fallen down too. The Hill is full of “ Stones, and they will have it, that as those increase, “ the Ground is pushed forward, and thereby thrown “ down

“ down. But I am apt to think, the Frost might have a great Concern herein.

The other Accident befel at *Pifa*, where he faith, “ That upon the melting of the Snows, and the great “ Rains which fell after the Frost, although the *Arno* did “ not swell over the Banks at *Pifa*, yet the Water at “ some distance from the River; in a middle Row of “ Houses, betwixt the River and the Great Street on “ the North-side, with great Violence broke out, and “ if it had not been immediately perceived, and the “ Breach stopp’d by the throwing in of a great quanti- “ ty of Bricks and Timber, that part of the Town might “ have been in danger of being drowned, where the “ *Palace*, and the *Publick-School's*, or, as they call it, the “ *Sapienza* stand.

Dr. *Mich. Angelo Tilli*, the Learned Botanick Profefſor at *Pifa*, hath only told me in a Letter he favoured me with from thence, “ That the Frost hath destroyed a “ world of Trees both in City and Country about them. But I wish he had been as particular in his Account thereof, as our Eminent Botanist before mentioned.

In *Switzerland*, among the high *Alpine* Ridges, they felt dire Effects of the Frost, but yet some Places were so happy as to escape. Of which Dr. *Woodward*, before commended, imparted to me the following Account he received from Mr. *John Scheuchzer*, Brother to our Industrious and Ingenious Member, Dr. *John James Scheuchzer* of *Zurich*. His Words are, “ Effectus tristissimos, “ quos Hyeme præteritâ sensere Arbores nostræ, etiam “ crassissimæ, præsertim *Juglandes*, *Vites*, non prorsus “ sensere loca quædam præaltis versus Septentrionem ju- “ gis munita. *Vesene* ad *Rivarium-Lacum* salvæ man- “ sere arbores & *Vites*, ut *Vindemia* (apud nos nulla) “ ibi sit copiosa; *Juglandes* fructibus oneratæ, uti quo- “ que arbores reliquæ, ac si in diverso succrevissent a “ vicinis locis Climate. *Galandæ*, montis altissimi in con- “ finiis *Rhætorum* & *Sarunetum*, radicibus adjacet pagus “ *Vettis*.

“ *Vatis*. Hujus incolæ vix unquam mitiorem Hyemem
 “ habuisse testantur, dum interim incolæ Pagi proximi
 “ *Valentia*, supra Thermas Fabarias siti, durante summo
 “ Frigore, aditum mutuo prorsus intercluso, veriti fuere,
 “ ne *Vettienses* omnes frigore perierunt. E contra Sylva
 “ Boreæ exposita, & Arboribus etiam vivacissimis, Abie-
 “ tibus, Taxis, Laricibus consista, quasi adusta rufum in-
 “ duere colorem, foliisque nudata.

Lastly, as to the Northerly Parts of *Germany*, the Case
 was there after the manner it was with us; which
 Mr. *Remus* being very curious and particular in, I shall
 insert the particular Matters he takes notice of here.
 “ Arbores, saith he, et frutices ultra nivis superficiem
 “ prominentes magno numero Frigus destruxit. Cerasus,
 “ Malus, & Prunus risere Hyemis minas. Multa ramo-
 “ rum segmenta mense adhuc Martio Microscopio suppo-
 “ suit D. Præses [that is Dr. *Wolfius*, the Learned and
 “ Ingenious Author of the *Elem. Aeromet.* Printed at
 “ *Leipsick*] nec quicquam integritati & turgescentiæ fibra-
 “ rum deesseprehendit. Flores copiosi in
 “ Ceraso, rariores in Malo, &c. Nuces Amyg-
 “ dalæ, Mali Persicæ & Mali Armeniacæ nobiliores pa-
 “ riter ac ignobiliores, Rosarum frutices tantum non
 “ omnes interierunt, Pyri plurimum damni perpeffa.
 “ Vites sub terrâ defossas & satis tectas a frigoris savitie
 “ immunes vidimus, at reliquas contra illud non suffici-
 “ enter munitas prorsus destructas & ipsi conspeximus,
 “ & Novellæ &c. Commemoranda vero sunt
 “ quæ D. Præses annotavit. Cum statim ab æqui-
 “ noctio, nive liquefactâ, & glacie resoluta, aditus in
 “ Hortos pateret, Cortex, Lignum, & Medulla in iis
 “ arboribus, quibus Frigus infestum fuerat, e. g. in Pyro
 “ & Malo Armeniacâ, nigricabant. Unde multi
 “ extirpabant. Cum segmenta ramorum, qui præteritâ
 “ æstate adoleverant, microscopiis subjicerentur, fibril-
 “ læ

“ hæc hinc inde disruptæ, non secus ac in ligno putrido,
 “ conspiciebantur: In reliquâ autem ramorum parte
 “ nulla istiusmodi disruptio notari poterat, succus unice
 “ desiderabatur & viriditas. Enimvero cum circa medi-
 “ um Aprilis arbores calore Solis foverentur, in Malis Ar-
 “ meniacis ex ligno seniore passim novæ Gemmæ erum-
 “ pebant, in quibusdam etiam ex juniore ibi provenie-
 “ bant, ubi flores progerminare debuerant; in nonnul-
 “ lis nullus furculus protrusus. Pyri Gemmæ omnes evo-
 “ lutæ, & Flores prodire; consueto tamen vigore ple-
 “ rumque destituti, atque hinc nulla Fructuum rudimenta
 “ relinquentes. Tunc temporis viriditatem plenariam con-
 “ sequebatur Cortex, nigrior ex centro Medullæ versus
 “ peripheriam migrabat, Ligni substantia candorem recu-
 “ perabat. Fibrillæ novi anni adhuc nigricabant, per
 “ Microscopium tamen inspectæ non minus ac fibrillæ
 “ eadem in Ceraso & Malo, quas frigus intactas relique-
 “ rat, succo turgescere videbantur. Equidem medulla
 “ sub Gemmis inolitâ nigredine passim tingebatur; radi-
 “ cula tamen Gemmæ in furculum protrusæ admodum tur-
 “ gida & virens oculo armato sistebatur. Notabile
 “ vero, quod, quemadmodum Frigus Pruno, ita etiam
 “ gemmis Malorum Armeniacarum intra corticem furculo-
 “ rum Pruni immixtis pepercerit, in proceras frondes nunc
 “ excrefcentibus juxta arbores sui generis, quibus ne uni-
 “ cam Gemmam intactam reliquerat Frigus.

Having dispatched the two things proposed, the *Degree* and *Effects* of the Frost, I intended here to have put an end to my History: But upon a review of the fore-mentioned Dissertation, I cannot easily forbear saying something to

The Causes of the Great Frost.

These are to me, I confess, so very much hidden, that upon that Account I intended wholly to have passed over

this Matter; but the last commended Author having ingeniously enquired thereinto, I shall as briefly as may be shew his Opinion. The Fountain of Heat enjoy'd by the Earth, being the Sun, and that Heat being not always the same, he enquireth into the reason why it is not so. The Variation of the mutual Distance between the Earth and Sun at the Apogee and Perigee; the mutation of the Earth's place in respect of the Heavens, or its being justled at a greater distance from the Sun, and the Obstruction of the Solar Rays by the Spots on the Sun, he (after ingenious Enquiries and Calculations) rejects. And as to the true Causes, having assigned good Philosophical Reasons for the Perpendicular warming more than the Oblique Rays, for the Wind cooling the Air, and the North and East more than other Winds, &c. he then enumerates his Causes in these Words: *Ex hæcenus dictis apparet, quam ad Frigus hybernum producendum concurrere possint. Nimirum ex parte Solis requiritur ingens a vertice distantia, & exigua supra Horizonte mora: Ex parte Telluris vero, Atmosphæra exhalationibus plena, & nubibus gravida; Ventique Orientales & Septentrionales, præsertim impetuosè requiruntur. Omnium autem maximè necessarium, ut actiones Solis & diu, & tum imprimis impediatur, quando causæ Frigoris concurrunt.*

Having thus assigned his Causes, he then applies them to his five Periods, and the more remarkable Accidents that happened in them.

But after all, notwithstanding I like, for the most part, his Causes, as being those which are the common and ordinary ones, yet there are some other more hidden extraordinary Causes, that he hath not reached. For we have all his Causes very commonly concurring in other Winters, without the same Effects as in the last. Yea this present, next succeeding Winter 1776, we have had (besides what is common to all Winters, the Obliquity

quity of the Sun's Rays, &c. we have had I say) the Winds as much Northerly and Easterly, and as strong; and as much dark Weather; and all concurring too together, as happen'd during the Great Frost: And yet no more than ordinary severe Weather.

But as to misty, cloudy, dark Weather, which our ingenious Author reckons among his principal Causes, I am so far from thinking it a Cause, that I rather take it to be the reason we have not more frequent severe Frosts, at least in our Island-places, surrounded by the warm Vapours of the Sea. Clouds and Vapours do indeed intercept, and keep off the Sun-beams; and probably imbibe and retain a great deal of Warmth themselves; nay perhaps they may (as he saith) reflect back some of the Sun-Rays: But we constantly in Winter find, that the fewer the Exhalations are, and the clearer the Air, and after the Warmth of the Sun by Day, the sharper the Frost is at Night.

But now, after that I have denied the sufficiency of the ordinary Causes, it may be expected I should subjoyn others. But as I have declared my Ignorance of them, little can be expected. Only thus much seems to me reasonable: That the great Mint of Meteors being the Superior Regions of the Air, and the Source of Exhalations being the Terraqueous-Globe, in those two Places we are to seek for the farther, and more grand Causes of the late Frost. And in the fourteen and more Years Observations I have made of the Weather, &c. I have found a great deal to be attributed to the Increases and Decreases of the Cold of the Upper Regions, as also to the inner Dispositions of our Globe, at least to the greater or less Plenty of Vapours and Exhalations. But not as yet having Observations enough to clear and demonstrate my Hypothesis, I must beg leave to defer what I might have said (and may perhaps at some other time

do,

do, if God spare Life) which may give some Light to our present Phœnomenon.

Thus having given as full, but withal as brief, a Relation, as well I could, of the Great-Frost in our *European* Parts, I should have been glad to have done the same for the *Asiatick* and *American* Parts of the World. But not having any Accounts thereof, and (living in a somewhat obscure Part of the Country) not having opportunity to make Enquiry of Travellers, I must be forced to omit this material Part of the History. But if I should be so happy as to get any good Accounts thereof, this Honourable Society may expect a Supplement hereunto.
