Some Observations, Directions and Inquiries Concerning the Motion of Sap in Trees; in pursuance of what was formerly begun therein, about the latter end of 1668, and the next following spring, by Dr. Ezekiel Tonge, and Francis Willoughby Esq.;

We shall here begin, according to the order of time, with the late Communications of Dr. Tonge, which are as follows:

I now begin my Inquiries and remarks upon the last published Observations of those Ingenious persons Mr. Willoughby and Mr. Wray in your Ph. Transact. N. 48. June 21. 1669. And First, to the 2d and 4th Experiments I propose this Inquiry; at what season of the year, March, day, and in what wind and weather, Branches and young Trees (especially small Branches) are so full of Sap, that, being held perpendicularly, they will bleed at both ends, as there related; and Roots, both ways? And what gage the Barometers and Thermometers then held? And in what forwardness their Buds and Leaves, or Chats were then fust, or broken? And of what Diameter such Roots were?

The latter part of the 4th Experiment appearing to manifestly to disagree with some Observations, I have made this Year, as well as formerly in Roots and Branches of Trees, whereby I found, that not only Cold weather, but Cold Wind and Sun-setting stopped or abated the Motion of Sap in the Sycamore: Which persuadeth me, how to direct an Inquiry to find out the Cause of this singular experiment, and of the Observations also in the 4th Experiment, which highly confirms this. The best directions I can at present devise, (until the Experimenters shall please to give us an account of the Time, Season, and that not on y the Month, day, hour, but also by the winds, and the motions of the weather-glass before, after, and at the instant of those Observations;) are the ensuing, which we shall conclude with some other Inquiries.

1. What was the difference of the Seasons of that Experiment was from the foregoing? 2. Whether the Heat were so great, when the Sycamores so sensibly abated, that it consummated their Juice, and, by thickening it into Jelly, and so into wood, ended the running? And therefore 3. Whether this Experiment of Cold, promoting, and of Heat, stopping the bleeding, were not in the latter end of their running only, and not in the former? And if so, Whether the rising of Sap be not rather to be attributed to the Degree of heat, than the Abatement of Heat? 4. Whether the reasons, that the Birch increased, when the Sycamores abated, be not also to be imputed to this, that the Birch runs not ordinarily till March (unless in a forward season) and the Sycamore and leavell Maple in January; and so the season of the one Sap beginning sooner, doth also end sooner; and whether thereupon it be not observed, that the leavell of the Birches Jellying into wood will not commence till a greater heat, as that of May; whereas the Maple-Sap probably will congeal to Jelly and wood in a lesser heat, as that of March going out, or April beginning? 5. Whether this be not also probably the reason of what is observed in the 4th Experiment in the same N. 48. viz. the Sycamores running more on the North-side, contrary to my yesterdays Observation (March 1. 1669.) the Southern branches yet dropping in the afternoon when others ceased? 6. Whether the Birch also in such seasons, after the Maple and Sycamore cease running, will not bleed more in colder weather, suppose in the middle or beginning of May, or latter end of April, and so verify my Experiment of the Sycamore running in hotter, and standing in colder seasons, or in the sign Pisces, the latter end of February, and the beginning of March, and on the contrary, running in colder and staying in hotter seasons, viz. of Arius, or the latter end of March and the beginning of April: Or briefly, In what Sign, and what weather as to wet and dry chiefly, the Birch and Maple bleed in hot, and stay in cold weather, or vice versa? Which temper of weather I would have accurately observed by Weather-glasses and Barometers. 8. If this be found to verify my Conjecture, then Whether by the running and staying of these Trees, and the first rising and ceasing of their Sap, may not probably (in some measure, by diligent Observation and comparing Observations...
(1166)

(cervations of time, season, weather, &c.,) be found the difference of Climates, Land, and Situation, as also of Years forward or latter fruitful or of years unfruitful? Whether the Observations of Quality as well as Quantity of Sap by Distillation after fermentation, &c. may not also conduco to the Prognosticque of the Fruitfulness or Barrenness of a year, especially in Walnuts, and such Fruit-Bearers as yield plenty of Sap, and by analogy and observation from them to others: As (e.g.) whether a fruitful or unfruitful year of Hazel or Filbert-nuts may not probably be discovered by their Scarlet blossoms, not appearing this year till now? (March 2.) 10. Whether Ablausion (or digging about and baring the roots of Trees) will retard the rising of sap in the Walnut &c. and what other effect it will have on fruit, &c.? And whether such Baring of Roots of Pear, Plum, and Cherry-trees (which are as much forwarder than Apples, as Maples are than Birch &c.) and generally of all forwarder Trees should not be made in different seasons (accordingly) from Mulberries and such like? 11. Whether Amendment of ground, laid after the Sap ceased, be not fruitier, as to that year, or much less beneficial than what is laid before? 12. Whether the feasableness of watering may not be found and promoted by a right Inquiry, and by a due satisfaction to these Queries? 13. Whether Ablausion watering, Amendment, &c. according to these reasons, may not be so directed, as to encourage Fruit, Wood, or both; either at pleasure? 14. Whether Ablausion, which so alters the rising of Sap, that it curdles them, when it should run, doth not hurt? 15. Whether the same hath influx on the Leaves, Suckers and outward products of the Tree, or on the inward also, as fruit; or only increases their quantity, by accident hindering the growth and draught of other parts which did rob the fruit? 16. Whether the Cool seasons of the Night afford not some temperament in these cases, so that thereby, as tis in cool seasons, the Sap runs and Jellies by day, as it runs by night? 17. Whether in some warm days, in which the Sycamore runs not at Noon or in the heat of the day, or it runs in the Night, or the Cool of the day, and, on the contrary, the Birch run by day or about Noon, and reafe at Night or Sunset, in the same reasons? 18. The same Queries might also be profected in the Hop, which runs after the extreme heat of the Summer, after the Hops are ripe and gathered, or any other Plant, that runs in Summer or Autumn, if there be any such.

So far the Inquisitive Doctor for this time: To which we cannot but subjoin the Letter of that Worthy and Observing Gentleman, Mr. VVilughby, containing an Answer to such of the precedent remarks and Queries, as concerned him, and therefore improper to him. It runs thus.

Sir, I, no wonder, that Dr. Zonger Experiments concerning the Bleeding of the Sycamore do not agree with ours, they being made in a different season; his, in February, and ours towards the end of March, viz. the Cold, which caused the Intercale of the bleeding in the Sycamore and Walnut, began upon the 23, 24, 25, 26 March; and one Sycamore, which ceased to bleed from the 18th of the same Month, bled afresh copiously from wounds that had been made so long before: The Buds before the cold were just ready to open into Leaves, and the Sap had begun to coagulate above a fortnight before. This year, making incisions in the Sycamore and common Maple, in January, immediately upon the replenishing of the first Frost, we found that they both bled, and faster, as the weather grew hotter; nor did the succeeding Cold promote, but rather hinder their bleeding. So that the Learned Doctor doth most ingenuously conjecture, that the Ascensio Sap in Trees, depends up on a certain Degree of heat, sufficient to raise, but not to coagulate their respective Juices. In those Months, wherein the Heat ordinarily falls short of that Degree, an accidental heat or warmth of weather promotes the bleeding; but in those Months, wherein the ordinary temper of the Air exceeds that Degree, an extraordinary fit of colder weather makes them bleed again.

The Experiments concerning the Northern and Southern sides of Sycamores were made at the same time; and are well solved by the same Hypotheses.

In Walnut-trees, we never yet found, that Heat promoted their bleeding, but always Cold. From a wound, made in a Walnut-tree, in January, and the beginning of
of this present March, in mild weather, nothing issued; but
the weather changing and growing colder, it bled plentifully;
which seems not well to consist with that Hypothesis, and must
be better examin'd.

Last year, the 6th and 7th of March we made the Experiments
of the Bleeding of Poles (held perpendicular) at both ends, in
Willow, Birch, and Sycamore: which may so easily and certain-
ly be found to succeed, in a great latitude both as to the bignes
of the boughs and temper of the weather, in the best Bleed-
ing season, that there needs no such exact niceness in the Ob-
servation of those particulars. The 11th of March, Roots of
Birch, great and small, bled both ways; and about the same
time, Sycamore roots also. Of all which I doubt not, but Dr
Tonge is by this time fully satisfied by his own Experiments.
The same Birch, which first began to bleed the 3d of March this
Year, bled 3 weeks sooner last year.

Tryal would be made, whether Cold will dissolve the Sap al-
dready coagulated: Else it will be hard, in the Doctors Hypo-
thesis, to give an account of the Trees dropping a new in Cold
weather.

It was last Autumn observed by our ingenious Friend Mr
Martin Lister, that upon the first Frost, which hap'd in No-
ember, a Sycamore bled copiously; so that the Sap cannot be
said to rise in January, but immediately after the Fall of the
leaf, in this Tree.

Our Experiments, which you have already printed, are most
true, and according to the Doctors Hypothesis, will very well
agree with his. His Deductions and Inquiries are very rational
and well deserve to be made publick. Various interruptions
have hindred us from the diligent prosecuting of these Experi-
ments this spring, which that I may more critically make here-
after, I must procure two Sealed Thermometers and two Baro-
merers. I am &c. Dar. Middleton in Warwick-shire March
No. 1645.