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Chapter 8

Galileo's Letter to Piero Dini, Rome 21 May 1611

Translated with commentary by Michael Edwards

NB. Footnotes by Michael Edwards are in superscript in the text, endnotes by NK are in square brackets in the text.

Introduction

On the publication of *Sidereus Nuncius* the British Ambassador Sir Henry Wotton sent a letter to King James about the discovery of four 'new planets' revolving around Jupiter, enclosing a copy of the book. He added that the new little planets would affect Jupiter's perceived astrological influence: 'For the virtue of the new planets must needs vary the Judicial part'.[1] A year later, a query on this matter was put to Galileo by his friend at the Vatican, Piero Dini: if the *Stella Medici* really existed, how could one ascertain their influence? His reply is here translated into English, for the first time ever. This is the only Galileo letter which we present unabridged – not least because of its eloquent and poetic passages about the qualities of things.

Galileo's affirmation that the new stars do really exist appears here as inseparable from his averring that they must also, like Jupiter, exert an influence. The one theme moves seamlessly into the other, or rather they are for him one and the same issue. He also proposes what could be the first program for astrological research: from past case-histories, by scrutinising the configuration of the little Jupiter-moons, one should in principle be able to ascertain how they work.

He here disagreed with Kepler. In his letter to Galileo of 1610, the Imperial Mathematician had expressed the view that, because the new moons did not depart appreciably from the side of Jupiter, viewed from

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Earth, therefore they could *not* exert any 'influence' – and they must exist purely for the benefit of the inhabitants of Jupiter! For comparison, a brief citation from the Kepler letter is made at the end [2]. Galileo wanted to avoid conjecture and speculation, which could be why he never replied to Kepler.

Galileo's Text

First, that these Gentlemen can doubt there may be some trick of the glass,[1] is for me truly a thing of wonder: for I know that they will not deny that the detection of deception and faults in an instrument or other device is both a matter for and the faculty proper to one who is master of the arts on which such instruments depend, and who moreover has performed many experiments with these same instruments; now, since it is known that both the construction and the theory of this glass depends on a knowledge of refraction, which falls within the mathematical sciences, my particular field, nor is it open to doubt that I, for a full two years hitherto, have with my instrument, rather with tens of my instruments, carried out hundreds of thousands of experiments with thousands and thousands of objects, both near and far, both large and small, both bright and dark, I fail to see how it could occur to anyone that I might quite simply carry on being deceived in my observations, and that, between the perspicacity of another's genius and the stupidity of my own, could fall such wide discrepancy, that they, without ever having seen my instrument, have discovered this fault, of which I, who have performed a hundred thousand experiments with it, was not aware, rather not just I, but not one among the many who have used it with me. This would presume one so much alone, and so little in company, that I cannot believe such a conceit could ever cross the mind of any rational person.

Perhaps it might be said that I, aware unfortunately of the error in my instrument, do not deceive myself, but enjoy deceiving others. To this I reply, first declaring myself, protesting and confessing that I know nothing of such errors: so that if it should happen that some sublime genius see through and reveal such deception, I do not mean to distinguish myself from the number of those deceived, nor wish to cover my ignorance with the mantle of wisdom; rather I declare myself on this occasion so much the more ignorant than the rest, as further experiment must make me in less time the more aware. Let me add that it is not only

1. The defence of his instruments comes naturally as the first priority of the practical scientist that Gailieo was.

my instrument, or the others by me constructed, that make visible the four Jovial planets, but all others too, made in whatever place by whichever craftsmen, provided they are well worked and show other objects large and distinct; and with all these instruments, used from anywhere, can be seen their same mutations[2] changing from night to night and the same hair-like dispositions[3] of these Planets: such that those who would maintain that such phenomena are also mere illusions, will have much trouble finding what causes all these instruments, both large and small, both long and short, to so conform in showing these false images, from among all the countless objects visible, round the star of Jupiter alone. And let me further add, that if anyone else is of the firm opinion that it is possible to construct a glass of such virtue, that round any star or luminary or round any other particular object it could make appear the illusion of other lights or other magnified images, which are not in reality there, and that such would happen to appear round but one object and none other; then let him try to make such an instrument, because I vouchsafe I will pay him 10,000 scudi for it. And if my own glass had the power to make visible anything other than what is really there, not for any treasure on earth would I exchange it. Enough have I now said about this false notion of deception that has been raised, of which but a glance through the instrument would suffice to relieve each and everyone.

As for the other objection,[4] namely that if such Planets are indeed real, they must on account of their smallness remain ineffective, I cannot see how this can be held against me, since I have put forth not a word on their effectiveness or their influences; such that if anyone judge them superfluous, redundant and of no use to the world, let them take issue with nature or God, not with me, for I have naeught to do with it, claiming no more than to have shown them there in the sky, revolving by their own proper motion round the star of Jove. But if, as nature's advocate and to be of service to V.S.R.,[5] I must say something, I should

2. *mutazioni*, or 'mutations', refers to the interrelated cyclical configurations apparently formed nightly by the orbital motions of Jupiter's moons

3. *costituzioni*: literally 'constitutions', a term used in astrological/astronomical texts of earlier times to denote the particular configuration of any horoscopic figure, or 'constitution of heaven', cast for any moment in time.

4. *parte*: literally means 'part' or 'side'. Similarly, Galileo deals first with objections to and suspicions of his telescopic method of observation, secondly with astrological objections.

5. An abbreviation for 'Your Serenest Reverence', to whom this letter is addressed.

say that I, for one, would proceed only with many reservations in asserting that these Medicean Planets lack all influence, wherein the other stars abound; and it would seem to me boldness on my part, not to say temerity, were I to wish from within the narrow confines of my understanding to circumscribe the intentions and operations of nature. Thus it was in recent days when, at the house of My Lord the Most Illustrious and Most Excellent Signor Marchese Cesi,[6] were shown paintings of five hundred Indian plants, I had to declare whether they were fictitious, denying that such plants were to be found in the world, or indeed, if they were, would they be superfluous and without effect, since neither I nor anyone else present were acquainted with their qualities virtues and effects? I certainly do not believe that in ancient and ruder centuries nature forebore to produce the immense variety of plants and animals, of gems and metals and other minerals; to make for each one of those animals member, muscle and joint; furthermore, that she failed to move the celestial sphere, and in sum, to produce and work her effects; simply because these inexpert people knew not the virtues of the plants, the stones and the fossils, nor understood the uses of all the parts of the animals, nor discerned the courses of the stars: and indeed for my part what a ridiculous thing would it be to believe that the things of nature come into being only when we come to discover them and to understand them. For if then the understanding of men be required to cause the existence of things, then necessarily, either those same things are and at the same time are not (they are, for those who understand them; and they are not for those who understand them not), or indeed the understanding of the few, even of but one, sufficeth to make them be: and in this second and less exorbitant case, suffice it that one alone understand the properties of the Medicean Planets to make them exist in the sky, and that others content themselves for now simply with seeing them.[7]

But to say that they do not influence because they are so small, to then deduce (as far as I can imagine) that, being superfluous and ineffective, they be not worthy of consideration and evaluation; is said, I believe, more to excuse these objectors from the toil of observing them and of investigating their most improbable and almost inexplicable orbital periods, than because it admits to accounting works of God, works so

6. Frederico Cesi, Marquis of Monticello.

7. Having answered technological objections, Galileo now waxes somewhat legalistic in style and vocabulary in addressing possible astrological implications of his discovery of Jove's moons.

sublime, as unnecessary, useless and contentious. And which rules or observations and experiments, if you please, teach us that the efficacy, the nobility, and the excellence of these workings are, solely from the magnitude of the instruments with which nature and God operate, to be expected? Who of sane mind would measure from mass alone the virtue and perfection of things? I for one have no doubt that I could count as many things, in the university of nature, minute yet most effective in their operation, as one could attribute to the large: and if like the Arts which, for the variety of their workings, have no less need of the use of the smallest things than of the large, so for the diversity of her effects nature has need of the most diverse of mechanisms the more conveniently to produce them; and with the tiniest of mechanisms can such workings be brought into effect, that larger ones could, either not so well, or on no account bring about. And who would contend that the anchor, by being ironmongery of such huge mass, lends such great use to navigation, while on the contrary the compass, as a thing of minimal size, remains useless and unworthy of the slightest consideration? While it is true that for stopping the ship the compass is of no help whatsoever; the anchor is of no less use for trimming and navigation of her voyage: perchance even is the operation of the former finer and more admirable than that of the latter. An iron crowbar, designed to dig ditches and shift stones, does not put in the shade the delicate use of the needle with which the artful hand of a gracious lady works her prettiest embroidery. For if smallness of mass reduces or prevents efficiency and perfection of operation, how much less noble would be the heart than the lungs, and the pupils of the eyes than other very large and muscular parts of the body? And who would say that in nobility pumpkins beat pepper or cloves, or that geese take the prize over nightingales? Yet rather, were we but to cast a more acute eye at the effects of nature, we may find the most marvellous workings to derive from and be produced by the most tenuous means. Let me mention first the motive causes of our most perfect senses, that which induces the sense of hearing, and thus conveys to within us the thoughts, conceits and sentiments of others, what else is it but a bit of air subtly rippled by the motions of the tongue and lips of him who speaks? And yet there would be none who would not concede, this lightest rippling of the air by far surpasses in efficacy and nobility that great turbulence of winds that shakes the forests and propels ships across the ocean. How minute and fine are the optical means which, within the narrowest confines of the pupils of our eyes, contain one-fourth part of the universe? And what mass have the phantasms that perturb our brains, now inciting our

imagination to bring into the present all that we have seen, felt or heard in our life, now rousing our memory to recall so many things long past? I could recount thousands and thousands of the greatest affects and effects, that depend on the smallest of causes; but I believe these few indications suffice to show how sovereignty of strength must not be measured solely by magnitude of body, rather that effects are manifold, the accomplishment of which seeks and demands smallness and tenuity of efficient causes: certain of which are the most spiritual, and in consequence those that, so-to-speak, participate more in the divinity.

And should we wish to discuss inferior causes,[8] that motivate the affections, powers and virtues of our soul, there would be no lack of a thousand judicious and sure examples, as some faculties are stimulated in us by extreme and vehement causes, the which causes not only are not designed to awaken in us any other virtue, for they totally impede and destroy them, neither can these be aroused without being moved and activated by causes of an opposite nature. Thus we have boldness of heart, animosity of spirit, defiance of danger and of death itself, all engendered by wine, then wonderfully excited by the shriek of shrill trumpets and by the sound of drums amid the din of horse-drawn artillery, in the tumult of advancing armed squadrons, across open countryside, in the brightest sunshine; and on the other hand, there you are in the deepest, gloomiest night, all ardour suppressed by the mute silence of lonely solitude that inspires but fear and dread. Yet if we turn our attention to which things enlighten and which things perturb the discursive and speculative faculty of our minds, we shall find how wonderfully darkness, stillness, fasting, silence and solitude stimulate it; whereas tumult and bustle, din and the fumes of wine darken and totally impede it. If, therefore, of the inferior causes, those which arouse boldness of heart are diametrically contrary to those which inspire intellectual speculation, it is also most reasonable that the superior causes (if indeed they operate in us) be utterly different from those on which courage and the speculative faculty depend; and if the stars do operate and influence principally by their light, perchance might it be possible by some probable conjecture to deduce courage and boldness of heart from very large and vehement stars, and acuteness and perspicacity of wit from the dimmest, almost invisible lights.

8. Inferior causes are those that take place here on Earth, in the ‘Below’, that reflect the ‘Above’, the source of superior causes.

Let us therefore leave to the vastest celestial bodies the largest operations in inferior things, like changes of seasons, turbulence of seas and winds, perturbations of the air, (if they also work upon us), constitutions and dispositions of body, general qualities and complexions, and suchlike other influences; for there is no lack on earth of thousands and thousands of other particular effects to be attributed to more subtle and spiritual influences by those who would, in like-minded curiosity, busy themselves therewith. And if others too are eager to press me to say what particular influence I believe depends on these new Planets I have recently discovered; I would respond, that all the influences which they have hitherto attributed to Jupiter alone, are derived no more from Jupiter than from his satellites, and having believed that Jupiter operates alone, and not having known that he had four companions, not one authority has mastered the manner in which Jupiter might cease to have them close by and to co-operate with them. How to distinguish more particularly their effects, I would not know, unless someone were to remove his satellites from his side, and for some time make him work alone. And who would know if anger, love, hatred and other such passions reside in the brain or in the heart, lest first he try living for some time without brain or without heart?

On this matter let me not remain silent on my recent response to one of those genethliacal astrologers, who believe that God, in creating the heavens and the stars, had nothing more in mind than that which they have in theirs, so might I free myself of his tedious request that I tell him the effects of such Medicean Planets. He protested that otherwise he would have refuted them as redundant and forever denied them as superfluous (I believe that such as these, according to the doctrine of Sizii, think that astronomers know that the other seven planets exist in the world, not by having seen their bodies in the sky, but only their effects on earth; and that, in precisely this manner, not by means of sight, but from strange effects, some houses are found to be occupied by malignant spirits). I replied that he should go back and consider those hundred or thousand judgments he had noted on their particular days, and in particular he should examine well the events he had predicted by means of Jupiter; and if he found that everything had happened precisely according to his predictions, that he should merrily carry on prognosticating according to his usual old rules, because I could assure him that the new Planets would have in no way whatsoever altered things past, and that for the future he would be no less fortunate a diviner than for the past; but if, on the contrary, he saw that events dependent on

Jupiter have in the slightest detail not responded to the prognostical dogmas and aphorisms, he should try to find new calculations for investigating the constitutions of the four Jovial orbiters at each past moment, for perhaps from the diversity of these habitual motions he might, with accurate observations and multiple collations, find the changes and variety of influences dependent upon them: and I added, that never in all the centuries past had the sciences with so little effort been learned at the expense of others on the written page, but that the leading inventors will find and acquire more excellent knowledge of things natural and divine from study and contemplation of this greatest of books, which nature henceforth holds ever open to those who have eyes in their forehead and in their brain; and what more honourable and laudable enterprise than to try with one's own vigil, study and sweat, to discover some wondrous new thing from among the many which still remain undiscovered in the deepest abyss of philosophy, than to lead an idle and inert life, exhausting yourself solely in trying to overshadow the inventive labours of your neighbour, as an excuse for your own cowardice and ineptitude in speculation, exclaiming that to what has already been discovered there is nothing new to add. But this is all said by way of digression, and not as a point directly relevant to the replies of the doubters: please excuse this slip of the pen.

And returning to the point concerning the ineffectiveness attributed to the Medicean Planets on account of their small size, I would add this that also befell me with another astrologer recently in Rome. He having told me that those in the art take no account whatsoever of stars of the third magnitude and less, after a lengthy circuitous speech it fell to me to enquire as to why they make such grand capital of nebulous stars: and he replied that they are of the greatest efficacy in clouding the vision, and also in obfuscating the intellect, of those in whose nativities they were most malignantly constituted. Then I replied to him: how then can you also say that the minor stars of the third magnitude have no effect, it having lately been discovered by me that the nebulous stars are not, as was formerly believed, one single star obstructed by a somewhat denser part of the sky, which thus acts to dilate and refract its light, but are a mass of very minute stars, of less than not only the third rank, but of those of the sixth and even the tenth magnitude? He fell silent: and contrary to the custom of those who dispute, not to arrive at the truth, but to keep the upper hand in contest, he calmed down and seemed satisfied.

Now I add further, that if it is true, as these astrologers and many philosophers affirm, that the stars work their operations *lumine et motu*,

by light and motion, and if it is further true that the larger lights influence more effectively, it follows that velocity of motion and swiftness and frequency of conjunction give great advantage over the sluggish tardiness of those that wander slowly: and if this is so, the influence of the four new Planets must be most vigorous, their being endowed with such rapid orbital periods, that the slowest completes its revolution round Jupiter in little less than sixteen days, and the swiftest in less than two days. What they lack therefore, due to dimness of light, may be best compensated for by swiftness of motion; and if the light of all four together is, e.g., the equivalent of half the light of Saturn, they are, on the contrary, thousands and thousands of times swifter than him. So how much they may assist and alter the effects of Jupiter (assuming, indeed, we take him as primary among the five), may from future observations in particular be gathered, and at present be generally estimated by conjecture as to what it implies to have four stars now conjunct, now divided, now all oriental, now all occidental, now some dexter and some sinister,[9] now all or some direct, now by contrast retrograde, now full of light and now obscured and eclipsed; all the which variations alternating from day to day.

But should anyone insist on denying influences where the light of the celestial bodies which do influence does not reach, therefore saying that motion without light has no effect, I would first ask him what light have those places in the heavens where there is not a single star, nor any light of their own; as in the case of the ascendant, the midheaven, the part of fortune, and then all those other places which they, the astrologers, move by direction,[10] and which, without a single star, are of all the effects that follow, in their opinion, authors. Moreover, the stars beneath our horizon must have no effect, since their light does not reach our hemisphere; or if their potency is strong enough to penetrate the celestial globe, then the so many and so large stars of southern skies ought not to be neglected. Besides, who can say the light of the Medicean Planets does not reach the earth? Would we still make of our eyes the measure of the effusion of all the lights, so that where the image of a luminous object does not make itself sensible to us, there must we declare that its light does not reach?

9. 'Oriental' alludes to a planet or the Moon rising in the Eastern sky before sunrise, 'occidental' to their setting in the Western sky after sunset; 'dexter' alludes to an angular relationship calculated contrary to the order of the zodiacal signs; 'sinister', following that order.

10. The method of Primary Directions as described in Ptolemy's *Tetrabiblos* was based upon the 'motion' of the *Primum Mobile* or Ninth Sphere, a reflection of the Earth's daily rotation.

Perhaps eagles and wolves can see such stars, which remain hidden to our feeble vision. Whereas, since visible images are but forms of light, or at least cannot diffuse without light, wherever these images arrive, there must arrive their light: now, if the images of the four Medicean Planets in diffusing fade away and are lost before they can reach earth, all Murano's lenses put together would not suffice to make them visible, because what is not there cannot be magnified, and dilation and augmentation assume the existence of something which can dilate and augment: therefore, since the images of the four Medicean Planets can be seen so large and luminous through the telescope, it cannot be denied that their light diffuses brightly enough as far as the earth. Finally I might add, if it requires a most apparent and perceptible illumination in order to exert influence, then the effects of Mercury must truly remain null or extremely feeble, since his light remains for most of the time, indeed almost always, invisible; and Mars near the Sun, where his visual magnitude is barely one sixtieth part of that which we see at opposition, such that in size he subsides to the apparent magnitude of stars of the fourth order, must have little or no influence. Let us conclude therefore, if the other stars can influence, the Mediceans too do not cease to perform.

Lastly, regarding what these Gentleman add, that of such stars, to their belief, there is no lack, I cannot deny nor affirm anything, but merely say for my part that I have not been able to discover any other than these four around Jupiter, and the two in motionless conjunction with Saturn;[11] and I pray that if others have discovered more, they be not displeased to inform me, as I should be most particularly obliged to them. Yet I do not believe, that these Gentlemen mean stars other than the movable and wandering stars, as are the Medicean stars, since to talk about the countless fixed stars is beside the point: and I have already written, how immense is the number of fixed stars invisible to the naked eye: but since they do not induce us to establish new spheres nor to alter the universal system nor to recognize necessarily that no single orb is the centre with respect to which all the stars revolve,[12] they can with less scrupulous examination be passed over. And if, as I also esteem, it is the wandering stars these Gentlemen mean in stating their belief that of such there is no lack, whence at the same time arises their difficulty in conceding these four?

11. In 1656 the Dutch physicist Christiaan Huygens discovered that these two 'moons' of Saturn were actually its rings.

12. Galileo may be playing safe here by affirming that the multitude of fixed stars he has observed, of which he has written, pose no threat to the universal order of spheres, nor to whatever might constitute a universal centre.

Translator's Note: Galileo writes with long sentences composed of many clauses punctuated with commas, colons and semi-colons. Though his Italian appears quite modern, it is laced with words the meaning of which owes more to their Latin roots than to general modern usage, reflecting both the learned and early scientific context of the letter, as well as the fact that Italian is a direct descendant of Latin, which in his day was still to some extent a *lingua franca* for learned discourse. In both these respects I have tried to remain as faithful as possible to the original.

The first introductory and last two concluding paragraphs, 24 lines in total, of this letter have been omitted from the translation since they contain formalities, and nothing material to Galileo's arguments.

Endnotes by Nick Kollerstrom

1. Quoted in Sobel, *Galileo's Daughter*, p. 35.

2. Johannes Kepler the Imperial Mathematician at Prague wrote to Galileo soon after receiving his copy of the *Sidereus Nuncius* on 19 April 1610 (Stillman Drake, *Galileo at Work*, Chicago 1978, p.246.). This letter considered the question of whether the four new Medicean stars affected the doctrines of astrology. They would *not* affect it, Kepler explained, because the planets 'operate through aspects, and an aspect is a disposition produced by the angle formed at the centre of the earth or of the eye' and the little stars were too close to Jupiter to affect this. But, for what purpose, or for whom, were these little stars revolving, as humanity was unable to see them with the unaided eye? Kepler's reply was, 'It becomes evident that these four new planets were ordained not primarily for us who live on the earth, but undoubtedly for the Jovian beings who dwell around Jupiter'.