Mensurae Universales Magnitudinum ac Temporum
by Adam Adamandy Kochański – Latin text with annotated
English translation
translated by Henryk Fukś
Department of Mathematics and Statistics, Brock University, St. Catharines, ON, Canada
e-mail hfuks@brocku.ca

Translator’s note: The Latin text of Mensurae Universales presented here closely follows the original text published in [1] (republished in [2]). Punctuation, capitalization, and mathematical notation have been preserved. The translation is as faithful as possible, often literal, and it is mainly intended to be of help to those who wish to study the original Latin text. Footnotes and figures in the appendix have been added by the translator.

ADAMI ADAMANDI KOCHANSKI
E SOCIET. JESU
Sereniss. Poloniarum Regis Mathematici,
MENSURAE Universales Magnitudinum ac
Temporum
Ad Actorum Erud. Collectores.

Praeterlapsi anni 1685 Mense Decembri,
transmiseram Parisios meas aliquot Observa-
tiones ad Amicum quendam, rogatum impen-
se, ut eas ipsumet Ephemeridum Gallicarum
Collectori in manus traderet: sed eum trime-
stri iam elapso nihil, comperti habeam, utrum
eo pervenerint, visum mihi est e re literaria
futurum, si eas, prout a me nunc conscripta-
tae fuerant, ab interitu vindicarem. Omis-
sa itaque conjectura illa mea de Metu Diur-
no Telluris, e terra motu petita, quae Actis
Erud. Lipsiensibus Mense Julio Anni 1685
inserta est, & quam in Gallia, succussionibus
ejusmodi magis, quam nostrae regiones obno-
xia, notam reddere, & observatores exstimula-
re cupiebam, reliqua eo tunc transmissa, ver-
bis iisdem, fideliter & integre, exscribam, ut
sequitur.

Carris. & Eruditis. Viro Ephemeridum
Gallic. Collectori & c.

Non aliud paucis his, ut Tibi nunc, Cl.

ADAM ADAMANDY KOCHAŃSKI
FROM THE SOCIETY OF JESUS,
Mathematician of the most serene King¹ of
Poland,
Universal MEASURES of Magnitude and Time
To the Editors of Acta Eruditorum

In the month of December of the passing year
1686 I forwarded to Paris to a certain friend a few
of my observations, asking him zealously to de-
deliver them in person to the hands of the editor of
Ephemerides Eruditorum Gallicae²; yet since a
trimester already passed, and I do not know for
sure whether they arrived, it seems to be proper,
for the sake of the future of the scholarly cause,
to save them from perishing. Omitting, there-
fore, my conjecture regarding the daily motion
of the Earth, derived from [the observations of]
earthquakes, which was inserted in Acta Erudi-
torum in the month of July of the year 1685, and
which I desired to be noted and to stimulate ob-
servers in France, liable to stronger shakes than
our regions, I will copy the rest of what was then
submitted, with the same wording, faithfully and
wholly, as follows.

To the most illustrious and learned man³, ed-
itor of Ephemerides Eruditorum Gallicae etc.

I will cover the littleness of that which I send
Vir, adfero, praetexam patrocinium praefationemque, quam nos atque natura scienti cuipidios, ac ad ea, quas scimus alii enarranda proclives esse. Eo quoque invitant Tua, aliorumque in promovendis scientiis exempla. Quod si non omnes ad exstruenda scientiarum palatia, marmor aut gemmas adferimus, etiam sabulum, paleaque leves caemento hujus aedificii non erunt, opinor, inutiles.

I Nova mensura universalis Temporum.

Quaerit hucusque Geometria certam quandam, ac invariabilem Corporum Linearumque mensuram; quae quidem, opinione mea, in ipsius magnitudinis continuae natura delitescit, sed non prius eruenda, quam cognita sit, & aliquam mensuram revocata quantitas Angulorum Mixtilineorum, quales sunt semicircularum, segmentorumque: At quia id vicissim certam lineae rectae, arcus eos subtendentes, quantitatem measuring a certain quantity of the straight line, stretching beneath curves, and because perhaps arcus eos subtendentis, quantitatem prae- supponit, nec fortassis alia via indagari difficultatem haec abit in circulum nullo humano ingenio explicabiliem. Quocirca Problemati huic solvendo adhibita fuit a nonnullis mensura Temporis a Pendulo petita, cuius vibrationes minuta secunda primi Mobilis, vel horum partes aliquotas adequant. Et vero improbari minime debet Inventum istud, si debitis cum cautelis in eo procedatur, ac praevertim ut nobis certo constet, Pendula nec ab Athmosphaerae in diversis climatibus varietate, nec a varia centri terrae distantia sensibiliter alterari; quod an quisquam exploraverit, ignoror: quia tamen ejusmodi penduli inventio hominibus occupatis admodum operosa videtur: nam plurium vicarium opem postulat, unico tentamine non obtinetur, nubibus eluditur &c. Idcirco innuam aliud fortasse commodius, cujus ope motus omnes etiam Caelestes mensurari, ac praedictorum Pendulorum vera quantitas facilius determinari poterit. Observavi ab annis compluribus, candelas you with no other defense and introduction than this: by nature we desire knowledge, and we are inclined to pass what we know on to others. Your examples of the advancement of science, as well as the examples of others, also encourage this. Although not everybody contributes marble and precious stones to the construction of the palace of sciences, even gravel and light straw are not, I suppose, inexpedient as components of the concrete [used in construction] of this building.

I. New measure of universal Time.

Geometry searches thus far for a fixed and invariant measure of bodies and lines; this, however, in my opinion, nature conceals in its own magnitudes, and it is to be extracted not sooner then it is related and linked to a measure of quantity of mixtilinear angles, which are of the kind of semicircles and segments. And because this presupposes a certain quantity of the straight line, stretching beneath curves, and because perhaps another way cannot be found, this difficulty leads to a circular problem, not resolvable by human ingenuity.

On the account of solving this problem, many employed a measure of time derived from a pendulum, whose oscillations are equal to seconds of time of the prime motion, or some parts thereof. Indeed, this invention should not be rejected if one proceeds with due precautions, and particularly if we make sure that the pendula are not perceptibly affected by differences of the atmosphere in different climates, nor by differences in the distance from the center of the earth. I do not know if somebody explored this issue. Still, this method seems to be troublesome for the people using it: it requires the effort of several helpers, the result is not obtainable by a single attempt, it is frustrated by clouds, etc. On that account, I will hint another, perhaps more convenient method, by the power of which the motion of all, even celestial bodies, can be measured, and for which the true quantity can be determined easier than with the aforementioned pendulum. I have observed for many years com-
usitate cujusvis crassitiei, ardentes in aere libero ac tranquillo, scintillationes, sive subsultationes illas suas ab aere undulatim accurrentes ortas, vibrationibus ad sensum aequidiuturnis peragere. Inveniatur ergo Pendulum, cuius una vibratio quaternis, aut fenis ejusmodi palpitationibus sit aequalis, atque hujus Penduli longitudo simplicia vel dupla cum motu diurno fixarum, nec non solis medio, conferatur: sic enim habebimus mensuram non e Caelo, sed ex Elemento ignis nostri sublunaris deductam; quam tamen & ab aliis elementis aliter obtinebimus.

II. Nova mensura universalis Magnitudinis.

Praeter aliam indicatam, est alia quadam non inelegans huius indagandae ratio, ab elemento Aquae deducta, diversa tamen ab ea, quam T. Livius Burattini, amicus quondam meus, secatus est in suo hac de re tractatus, Italiae in Lituania edito: sed quia meam Observationem paucis hic explicare non possum, alteri tempori locoque reseravere coget. Nostrae igitur Artis Geometriae Practicae, a naturis Aereis mensuras mutuabimur hoc modo. Praetermissis itaque omnium vegetabilium seminibus, pilis animalium, fibris corporum Microscopio detectis &c. ego spem omnem collocavi in Volubribus. Aptissimas huic negotio crederem pennas ex alis passeri domestici ruralis, supposito tamen quod haec species avicularum etiam in extremo Oriente, nec non America reperierit, & quidem ejusdem staturae cum nostratibus. Refert O. Dappers in sua Africa Germanicae edita, passeres ad caput Bonae spei reperiri; sed eorum pennae cum nostratibus essent conferenda. Praaxis ad rem praesentem ita esset instiituentia. Ex alterutra ala passeris masculi & senis, sumatur certa quaedam penna, v. g. tertia & quarta, & ea primum artificio facili in directum extendatur: tum in medio calulculi, plumulis transversis convestiti, capiatur certus quidam numerus intervallorum, quibus monly used candles of any whatever thickness, burning in the unencumbered and calm air, their twinkling or flickering arising from the air rushing in a wavelike fashion, causing oscillations perceived as of equal duration. Let a pendulum be contrived, such that its period is equal to four or six such oscillations, and let its single or double length be compared to the daily motion of fixed [stars], or of the middle of the sun. In such a way we will have a measure derived not from the sky, but from the element of our sublunar fire; we will yet obtain it differently also from other elements.

II. New universal measure of magnitude

Before I point out another, there is also a certain other [measure] not inelegant by its investigation method, derived from the element of water, nevertheless separate from that which was pursued by formerly a friend of my T. Livius Boratini⁴, in the treaty on this subject, published in Lithuania in Italian; but because I cannot explain this observation of mine in a few words, I am compelled to reserve it for another time and place. From the nature of air, therefore, we will move the measures to the practice of our art of geometry. Passing over the seeds of all plants, animal hairs, fibers of materials revealed by a microscope etc., I placed all hope in flying creatures. Most suitable for this work I would believe to be feathers from the wings of domestic sparrow from the countryside. Supposedly this species of bird is found even in the far East in America, and indeed its stature is the same as the stature of our birds. O. Dappers⁵ reports in his “Africa”, published in German, that sparrows are found at the Cape of Good Hope, and its feathers are comparable [with the feathers of our sparrows]. Practice pertaining to our matter is established as follows. From one of the two wings of a masculine and aged sparrow a certain feather is taken, for example the third and the fourth one, and at first it is skillfully made straight. Then in the middle of the stem vested with transverse barbs, we take a number of in-
transversae plumulae ab invicem distant, istae enim divisiones inservient nobis per modum scaleae cujusdam artificialis, juxta nam taxari poterant partes aliquotae pollicum, aut palmarum pedis Geometricici, ac etiam aliarum Urbium, ac posteritati scripto commendari: non enim mihi credibile videtur, passerculum nostrorum proceritatem secuturis saeculis immutandam. Cautelas in operando necessarias non numero, quia perspicacibus lectores, Si quis autem subtiliore, & exactiore scala uti volet, hanc inveniet in iisdem passe- rum pennis: nam & ipsaem transversae plumulae subdivisa in aliis transversis plumulis, quae iudice rudiore Microscopio, magis æqualibus ab invicem distant intervallis. Inquirant igitur curiosi, quibus aut maria trajcere, aut a regionum peritus id intelligere commo- dum fuerit, utrum passeres & hirundines, aut alia aves communes ubique terrarum, & qui- dem (quod caput rei est) ejusdem cum nostris staturae reperiantur. Plumulas transversas struthionis, pavonis, ciconiae &c. relinquendas censeo, quod non sint adeo obviae, quales esse praestat. Habeo complures alas passe- rum e diversis Europae partibus, qua primo adspectu aequales esse videntur, sed eas per otium diligentius adinvicem conferam. Pondus universale tunc primum adferam, cum explicuero artificium illud aquam tractandi initio commemoratum. Id interim silentio mini- me praeteribo, pro pondere universali rudorium orbem sparsi sunt, & quidem ponderis delectu prius instituto, non admodum inae- qualis. His igitur utcunque taxari poterunt librae (pondo) diversarum urbium, etiam in Asia, ubi Anglica Marcarum ponduscula ad manum haberit non possunt.

III. Mensurarum facilis ad posteros, vel absentes transmissio.

Non abs re fortassis erit hoc loco comme-
morare, deceptum fuisse W. Snellium, & aliquos cum eo Auctores, qui crediderunt mensuras pedum chartae madidae impressas, certa quadam proportione post ejus siccationem contrahi. Certum enim est, chartae longitudinem magis huic contracturam subesse, quam latitudinem. *Longitudinem* autem illam voco, iuxta quam porrigruntur in longum vestigia fiorum aeneorum, e quibus cribrum aut forma papyri contexta est. *Latitudinem* ea est, quae praedicta filamenta transversim connectit geminis filis, hinc inde ad intervallum policis circiter. Occasione pedis Romani antiqui, a Villalpando in Apparatu Templi chartae impressi, & genuino pedi plerumque congruentis, exploravi diversas in Europa chartas, & inter eas, illam ipsam Hispanicam Villalpandi, quae inter omnes minimam passa est siccatone contracturam secundum latitudinem, in quam Pes ille porrigitur: fortassus autem id accidit ex eo, quod ipsa a quidem tenuis fit, licet cribro crassioribus filis contexto formata fuerit; nam in alia quadam ejusdem fortis, at nonnihil crassiore, inveni totum Pedem un centesimae breviore eo, quem Romae a Grunbergero nostro, Villalpandi, in calculandis Apparatus Tabulis, adjutore, lapidi subtiliter incisum, exactissime dimensus sum, & in aenea lamina designatum adhuc possideo. Hic tamen alter Pes impressus crassiori chartae, nec dum compactoris malleum sibierrat, quem postea passus, defectum illum liberaliter compensavit.

Experimentum illius rei sic institui: e qualibet chartarum infra positarum, sumpti duas fascias latas 130 centesimis unius unciae pedis Rhenani, longas autem Semipede Rhen. quarum fasciarum una erat resecta juxta longitudinem, altera secundum latitudinem chartae. Hae fasciae aqua fluviatili madefactae creverunt juxta numeros adjectos, qui sunt cente-

this place that W. Snellius⁷, and with him other authors, have been deceived believing that measures of foot printed on wet sheets of paper, contract proportionally after drying⁸. It is, in fact, certain that paper will contract more in longitude than in latitude. By *longitude* I mean the direction of traces of bronze filaments from which the sieve or form of the paper is made. The *latitude* is the direction of transverse twin filaments connecting the aforementioned ones, going back and forth at intervals of about the width of the thumb. Hereafter under the pretext of investigating the ancient Roman foot, printed on the page⁹ of the book “Equipment of the Temple” by Villapandus¹⁰, and mostly congruent to the genuine Roman foot, I explored various European papers, among them the the same Spanish paper of Villapandus, on which this foot is printed: among others it suffers the least contraction in the latitude while drying. Perhaps it happened because it was thinner than the others, and yet formed with sieve weaved with more coarse filaments. But in others equally strong and a bit thicker I found the foot to be one hundredth shorter from the subtly cut stone pattern of the Roman foot made in Rome by our Grunberger¹¹, helper of Villandus in the calculations of the tables for “Apparatus”; I have measured this pattern most precisely and now I have it marked on a brass plate. Nevertheless, another foot printed on thicker paper, not subjected to the mallet of the press man, which it suffered afterwards, compensated this defect graciously.

I instituted this experiment as follows: from whichever sheet of paper shown below, I took two streaks 130/100 of 1/12 of the Rhineland foot¹² wide, 1/2 foot long, of which one was cut along the longitude, the other along the latitude of the sheet. These streaks, made wet with river water, grew according to the numbers added [to the table], which are hundredths of 1/12 of the
Simae partes unius unciae Pedis Rhinlandici. Rhineland foot.

| Sequentes Chartae madefactae creverunt | In Longum | In Latum |
|----------------------------------------|-----------|----------|
| Romana di Fuligno candida & solida     | 10        | 7        |
| Hispanica Villalpandi in figura Congii Rom. | 10        | 5        |
| Eadem nonnihil crassior, de qua superius sermo | 10        | 7        |
| Florentina epistolalis, quales & septem consequentes | 13        | 8        |
| Genuensis cum tridentis insigni         | 16        | 9        |
| Italica quaedam tenuissima, cum hasta  | 17        | 10       |
| Gallica cum Corni Tabellionis          | 10        | 9        |
| Hollandica praecedentem mentita        | 11        | 8        |
| Joachimicae Vallis in Bohemia, candida, tenuis, at compacta | 20        | 13       |
| Commotiensis in Bohem. probe aluminata, tenuis tamen | 14        | 10       |
| Uratislaviens. in Silesia, tenuis, at compacta | 13        | 10       |
| Regalis crassa Bohemica                | 14        | 9        |
| Dantiscana crassa cum Carpionis insigni| 9         | 7        |
| Italica Regalis vetusta, ac solide compacta | 10        | 9        |
| Alia crassis filamentis contexta, & mediocrer crassa | 13        | 9 1/2    |

1. John III Sobieski (1629 – 1696), from 1674 until his death King of Poland and Grand Duke of Lithuania.
2. Journal des Sçavans, academic journal estab. in 1665 by Denis de Sallo, French writer and lawyer.
3. Fr. Jean-Paul de La Roque (?–1691), editor of Journal des Sçavans in the years 1674-1687.
4. Tito Livio Burattini (1617–1681), Italian nobleman, inventor, architect and diplomat, from 1641 till his death working in the service of Polish kings. Author of Universal measure (orig. Misura universale, Vilnius 1675).
5. Olfert Dapper (1636 – 1689), Dutch physician and writer, author of Description of Africa (orig. Naukeurige Beschrijvinge der Afrikaensche Gewesten, Amsterdam 1668).
6.Marca Anglicana, weight of one English pound used with balance scales.
7. Willebrord Snellius (1580-1626), Dutch astronomer and mathematician.
8. In his book Eratosthenes Batavus (Logundi Batavorum, 1617), Snellius states that forma chartae impressa sevagesimam partem ab archetypo suo deducat, “a shape printed on paper takes away 1/60 from its pattern”. He assumes it is the same in all directions.
9. See Fig. 1 in the Appendix.
10. Juan Bautista Villalpando SJ (1552 –1608), Jesuit scholar, mathematician, and architect, author of Ezechiel Emplanationes in which he reconstructed the Temple of Solomon. The third volume of this work was published as Apparatus Urbis ac Templi Hierosomitani, Romae 1604.
11. Christoph Grienberger SJ (1561 – 1636), Austrian Jesuit mathematician and astronomer, author of a catalog of fixed stars.
12. Rheinfuss, unit of length equal to 31.4cm.
Observavi praeterea, lineas ac figuras laminis aeneis incisas, & usitato praelo Cylindrico in charta expressas, magis ea parte contrahi, qua Cylindrorum violenta pressione charta fuerat in longum distenta, quod non ita contingit in transversum; unde fit, ut circuli præsertim majusculi, laminae diligenter incisi, & memorato prelo expressi, charta siccata reddantur altera parte contractiores. Sed neque Ricciolus noster in sua Geogr. Reform. errandi periculum omne sustulit, semipedem Romanum chartae siccatae imprimi curando; nam haec ipsa ad aeris alterationes nonnihil mutatur, & tractu temporis non secus ac tabularum lignearum, quin & eboris latitudo, minuitur. Securior itaque modus esset hujusmodi mensuras particulares ad posteros transmittendi, incidendo illas formae metallicae, ac tum imprimo bracteolis illis aeris coronarii, quae ab Italis Orpello, a Germanis Rauschgold appellantur. Hae enim non incommode libris a compactore inferi poterunt. Alteratio illa modica, quam subeunt a calore vel frigore, I observed thereafter that lines and figures engraved in copper plates, when they are printed on paper using cylindrical press, contract more in the direction in which the sheet was stretched along by the violent pressure of the cylinders; this does not happen so in the transversal direction. Because of this, it happens that circles, particularly larger ones, diligently engraved in the plate and printed with the aforementioned press, when the sheet dries are reproduced [on paper] as more contracted in one direction. But neither our Riccioli in his “Geography reformed” avoided all dangers of error by arranging printing of the Roman half-foot on dried sheet; for even this sheet to some extent changes with changes of atmospheric conditions; this is not much different than how the width of wooden tables or even ivory diminishes with time. A more secure method, therefore, of transmitting particular measures to posterity would be to engrave them in the metal form, and then impress on gold leafs, of the kind used by garland makers, called Orpello in Italian or Rauschgold in German. These could then be
sensibilem in semipedes non inducet errorem. Si quis tamen e solis impressis genuinas consequi volet mensuras, eas a charta prius humectata, & convenienter extensa, sat exactas poterit impetrare.

Per Epistolam vero commodissime mitti poterit Amico absenti, mensura semipedis, vel ejus quadrantis, in chorda tennii aenea, quales in Musicis instrumentis adhibentur; In ejus enim extremis ad intra reflexi fiunt per contorsionem chordae duo laquei A & B, partes vero contortae malleo nonnihil tunduntur, ut firmius cohaerant: tandem extento supra datam mensuram mediocriter filo aeneo, eius extremitates internae forficula, vel cultello, accurata manu quantum opus est, reciduntur. Inspice adjunctam Figuram.

![Diagram](image)

IV. Penduli portatilis, ac Horologiorum perfectio.

Vibrationes ejusdem penduli in archubus in aequalibus inaequalibus esse, a multo tempore experientia oculis ipsis manifesta didici. Hanc quidem inaequalitatem Cycloidis adminiculor sublatam esse non ignoro, videtur interim mihi Cycloidis usus cum pendulo et fascia appendo, in usus nauticos, ad longitudines Terrae investigandas, ob navis agitationem, nonnihil impeditus esse. Quamobrem construxi horologium, cujus rotae ad numeros Astronomicos decurrunt, in eoque duo pendula aequalia appensa sunt ex elateribus chalybeis, mediocrer latis, ac facilis flexibilibus, & breviusculis quidem, sed qui pro re nata produci easily inserted into books by a pressman. The moderate changes which they undergo subjected to heat or cold do not induce any detectable error. If somebody wants to obtain genuine measures from such imprints alone, one can reproduce them accurately enough from a sheet previously moistened and suitably extended.

Measure of half or quarter of foot can be most conveniently mailed to a friend by letter as a piece of bronze wire, of the kind used in musical instruments. On its ends two loops are made by twisting, and the twisted parts are crushed a bit with the hammer so that they better hold together. Finally, stretching the bronze wire moderately over the given measure, its internal ends are accurately trimmed with a small knife or scissors, as much as needed. Inspect the provided figure.

---

13Giovanni Battista Riccioli SJ (1598–1671), Italian astronomer, author of Geographiae et hydrographiae reformatae libri duodecim, Bologna, 1661.
14See Fig. 2 in the Appendix.
nonnihil, vel contrahi possunt, reliquae pendulorum virgae sunt rigidae. Experior autem elateres hos ad instar cycloids, digressiones & in iis moras pendulis non permittere, sed aequales ad sensum vibrationes peragere: quae quidem in horologio meo breves sunt. Nam binae compositae five quaternae simplicas unius secundo respondent: verum & in longioribus pendulis e convenienti elatere pendentibus, de felici successu dubitare non licet. Experian-
tur itaque navigantes, annon pendulum elatere hujusmodi sustentatum, altero illo suspen-so e fascia cycloidem stringente, sit in mari commodius.

Horologis rotatis in sacco portatilibus appliceram olim pendulum Magneticum, quod frustrro validi magnetis ad vibrationes incitabatur satis aequales; sed quia pondus lapidis gravat, & ferri vicinia aequalitatem vibrationum perturbat, ideo repudiato hoc invento, id tandem efficui, ut horologia parva nunc usitata, quae libri habent elatere spirali instructum, nulla inter ambulandum vel equitandum agitatione turbentur in suo motu regulari. Appendo enim totum horologii corpus intra suam thecam extimam nonnihil ampliorum, ita ut circa systematis totius axem, librilis axi parallellum, vel circa duos potius eius polos, aut cuspides, instar Rosae nauticae, libere convertatur horologium totum: quo fit, ut nulla agitatio horologii sic appensi ejus libril in suo cursu perturbet, quemadmodum sit in usitatis, quae manu velociter reciprocque agitata, vibrationes librilis enormiter praeципitant: Idipsum autem etiam in accelerata deambulatione, quando videlicet sac- cipierum pendens, una cum horologio in eo contenuto, reciprocate agitatur, contingere solut, & incautos decipere. Praxis appensionis illius varie poterit institui. Ego hanc tenui. Thecam extimam ansa & annulo appensorio, nec non crystallo instruxi: in fundo thecae defixi brevem styllum, qui pileolum in pixide horologii firmatum sustentat: alter polus of pendulums being rigid. I attest that these springs, similarly to cycloids, do not permit the pendula to run into delays but force them into perceptibly equal oscillations. Two composite or four simple [oscillations] correspond to one second: but certainly even with longer pendula, suspended from suitable springs, one should not doubt of successful outcome. Let, therefore, navigators test which one is more desirable on the sea, a pendulum supported by the spring this [described] way, or another one suspended on a ribbon restricted by the cycloid.

I once adopted to portable watches a magnetic pendulum, induced to equal enough vibrations by a strong piece of magnet; but because the weight of the stone, and because the vicinity of iron perturbs the oscillations, abandoning this invention, I finally made it so that the small watches now used, which have the balance equipped with a spiral spring, are not perturbed in their regular motion by walking or horse riding. I suspend the entire body of the watch inside of an external slightly larger case, so that the entire watch rotates freely around the axis of the entire system, parallel to the axis of the balance, or rather around two its poles or pointed ends, similar to the nautical rose. For this reason it happens that no shaking of the watch suspended this way perturbs the balance from its course, in whatever way the watch is used, and if it is violently moved back and forth with the hand, the oscillations of the balance are hugely cast down. Moreover, this happens and surprises observers even in an accelerated walk, when the hanging sack evidently shakes back and forth together with the watch kept in it. In practice this suspension can be set up in various ways. Here is how I do it. I constructed the outer case with a hook and loop handle, as well as crystal. In the bottom of the case I attached small pillar which supports a cup in the small case of the watch. Another pole is the one which carries the
est ille ipse, qui indicem horologum defert, &
in altero pileolo crystalli centrum occupante,
circumagitur.

Non ingratum fortasse Curiosis erit hac
occasione intelligere, me excogitasse ab an-
nis aliquot artificium quoddam, quo median-
te, quilibet rudis homo, puer aut foemina,
quin & caecus incidere poterit quascunque mi-
nutas horologiorum rotas, tot dentium quot
imperantur, absque praevia earum divisione,
& insuper eadem opera plures, aequales, ma-
ores, & minores. Praeterea aliud artificium
ad formandam Torno cochleam illam Horolo-
gii, quae chordam, vel catenulam colligit, dan-
do illi figuram, attemperandis viribus cuju-
scunque dati elateris chalybei convenientem;
ita ut cochlea circuitus imperatos complec-
tatur. An autem ista publicari debeant, ne
in eorum artificum, qui veteribus insistere co-
guntur, detrimentum cedant, anceps haereo.

Ausim etiam Opticis polliceri Tornum uni-
ersale, in quo lentes, & specula omnium sec-
tionum Conicarum, elaborari possunt; & qui-
dem ratione modoque inter omnes alios com-
modissimo: reddidi enim illud immune eo de-
fectu, quo omnes aliorum machinae tales la-
borant; ne videlicet inter laborandum, propo-
sitae figurae modulus deteratur.

Hucusque ea, quae a me in Galliam mis-
sa fuerant, e quibus illud posterius Num. IV
de Horologiis in sacco portatilibus, quia jam a
me in Actis Erudit. Anni 1685 Mense Septem-
bri commemoratum fuerat, ne hoc loco cram-
ben bis coctam sapiat, hoc ei condimentum ad-
jiciam. Posse videlicet, absque nova totius
horologii constructione, qualem praedicto lo-
co supposui, omnibus aliis Portatilibus, illam
circa binos axes conversionem, non difficulter
conciliari, ac praesertim iis, quae spirali, aut
etiam recto elatere vibrationes librilis uniform-
es efficere debebunt. Horologium itaque usi-
tata ratione jam constructum, thecae cuidam
extimae (rejecta vel retenta, si lubet, pristi-
na) includatur, intra quam aptata fit armil-
hand of the watch, and is rotates held in place
by another cup in the center of the crystal.

Those eager to know will perhaps not be
ungrateful to learn on this occasion that some
years ago I devised a certain method, by which
whichever simple man, boy or woman, in fact
even a blind one will be able to cut however
small clock wheels, with as many teeth as
ordered, without dividing them beforehand, and
by the same effort make many of them, equal
ones, smaller ones and bigger. In addition to
this, [I devised] another method for forming on
the lathe the clock’s snail, which holds a rope
or a little chain, giving it its appropriate shape,
with adjustable strength of a given steel string.
I am still undecided whether this should be
published, so it does not become lost, like those
skills which are restricted to be practiced by the
old only.

I would also dare to promise to opticians a
universal lathe on which one can make all lenses
and mirrors with conical surfaces; its plan and
the way of operation are most agreeable among
all others. For I rendered it immune to this
defect with which all other machines struggle:
namely, while operating, it does not wear away
the dimension of the proposed shape.

In order for the observations about portable
watches in a bag, which were sent by me to
France, mentioned in section IV and placed
on record in Acta Euruditorum in September
1685, not to taste like doubly-cooked cabbage,
I will add some condiments here. Namely,
it is possible, without difficulty, to procure
the conversion of all other portable watches,
without construcing the whole new watch with
the aforementioned method, so that they rotate
around two axes: this especially applies to
watches with balances which need to oscillate
uniformly using a spiral or even a straight
spring. Let the watch ordinarily constructed be
included in a case (original case discarded or
retained, as preferred), inside which a ring is
la quaedam latior, in Ellipsin, horologio recipiendo, & firmiter retinendo idoneam, inflexa, & in sua minore Diametro, duabus oppositis cuspidibus instructa, circa quas, tanquam Polos, totum Horologium cum armilla intra thecam extimam, armilla nonnihil ampliorem, converti circulariter possit: In Horologiis enim taliter gyrantibus, eorum librili concedi poterit elater fortior, ac praedominans elateri majori, rotas omnes impellenti, ut hoc modo vibrationes librili, inaequali rotarum dentatarum tractioni minus obnoxia sint, nec tamen primum impulsum sibi datum, & a totis incitantibus conservatum, amittant.

References

[1] Adam Adamandy Końskańi. Mensurae universales magnitudinum ac temporum. Acta Eruditorum, pages 259–266, May 1687. Available at https://books.google.ca/books?id=q7JRAAAAcAAJ.

[2] Adam Adamandy Końskańi. Mensurae universales magnitudinum ac temporum. In Opuscula omnia Actis eruditorum lipsiensibus inserta, quae ad universam mathesim, physicam, medicinam, anatomiam, chirurgiam, et philologiam pertinent: necnon epitomae si quae materia vel criticis animadversionibus celebriones, volume 1, pages 503–509. Typis J.B. Pasquali, Venetiis, 1740. Available at https://books.google.ca/books?id=2V4TAAAAYAAJ.

15 In modern terminology: a pendulum’s period of oscillations depends on the amplitude.
16 Cycloidal pendulum was already known to be isochronous, as demonstrated by Christiaan Huygens in 1673.
Appendix

Figure 1: Drawing of the Roman *congius* together with the length of the Roman foot, reproduced from J. B. Villapando, *Apparatus Urbis ac Templi Hierosomitani*, Romae 1604.
Figure 2: Length of the Roman half-foot, from G. B. Riccioli, *Geographiae et hydrographiae reformatae libri duodecim*, Bologna, 1661. The caption above says “Separately printed on this sheet previously dried.”