Incontri di filologia classica
Rivista annuale - Classe di valutazione ANVUR: A

ISSN: 2464-8752 – eISSN: 2464-8760
http://www.openstarts.units.it/dspace/handle/10077/3528

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I contributi di questo volume sono liberamente disponibili su
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Registrazione del Tribunale di Trieste n. 1218 (21.04.2010)

INCONTRI DI FILOLOGIA CLASSICA

XXII
2022-2023

EUT
Edizioni Università di Trieste
2023

INDICE

DOI: 10.13137/2464-8760/35650 *Incontri di filologia classica XXII* (*2022-2023*), *147-180*

FEDERICO DE ROMANIS

Seasonal Sailing and Nundinal Floating on the Upper Tiber. A Correction to Plin. *nat*. III 53

Abstract
The article aims to demonstrate that Plin. nat. *III 53 requires both a modification of the punctuation commonly adopted by modern editors and a correction of the manuscript text transferring* si non adiuvent imbres *immediately before* longe meabilis fertur. *The purpose and operation of the* piscinae *on the Tiber, Tinia and Clanis rivers are then illustrated.*

Keywords
Pliny the Elder, Pliny the Younger, Tiber, navigability, timber floating, hydrology

Riassunto
L'articolo intende dimostrare che a Plin. nat. *III 53 è necessaria sia una modifica della punteggiatura comunemente adottata dagli editori moderni sia una correzione del testo tràdito che trasferisca le parole* si non adiuvent imbres *immediatamente prima di* longe meabilis fertur. *Vengono quindi illustrate finalità e modalità di funzionamento delle* piscinae *sul Tevere, sul Tinia e sul Clanis.*

Parole chiave
Plinio il Vecchio, Plinio il Giovane, Tevere, navigabilità, fluitazioni di legname, idrologia

Università di Roma 'Tor Vergata' federico.de.romanis@uniroma2.it

1. *Seasonal sailing: the two Plinii and the upper Tiber*

A passage from Book III of Pliny the Elder's *Natural History* describes the course of the Tiber upstream from Rome. In Jan – Mayhoff 1906 the text is printed as follows[1]:

> Tiberis, antea Thybris appellatus et prius Albula, e media fere longitudine Appennini finibus Arretinorum profluit, tenuis primo nec nisi piscinis corrivatus emissusque navigabilis, sicuti Ti<n>ia et <C>lanis influentes in eum, novenorum ita conceptu dierum, si non adiuvent imbres. sed Tiberis propter aspera et confragosa ne sic quidem, praeterquam trabibus verius quam ratibus, longe meabilis fertur, per CL (milia) p. non procul Tiferno Perusiaque et Ocriculo Etruriam ab Umbris ac Sabinis, mox citra XVI (milia) p. urbis Veientem agrum a Crustumino, dein Fidenatem Latinumque a Vaticano dirimens.

Reproduced in all modern critical editions[2], the above text is supported by the

[1] Plin. *nat.* III 53.

[2] Same punctuation in Zehnacker 2004. While all editors agree to put a full stop after *imbres*, Sillig 1831 puts comma also after *confragosa*; Sillig 1851, Jan 1854, Detlefsen 1866 and Jan 1870 omit commas after *quidem* and *ratibus*; Detlefsen 1866 puts a comma not after *fertur*, but after *p.*

virtual consensus of the manuscripts[3]. The few variants offer no viable alternative readings[4]. The most recent translations into modern European languages are basically consistent with Rackham's Loeb, which reads as follows:

> At first it is a narrow stream, only navigable when its water is dammed by sluices and then discharged, in the same way as its tributaries, the Tinia and the Chiana, the waters of which must be so collected for nine days,[5] unless augmented by showers of rain. But the Tiber, owing to its rugged and uneven channel, is even so not navigable for a long distance, except for rafts, or rather logs of wood; in a course of 150 miles it divides Etruria from the Umbrians and Sabines, passing not far from Tifernum, Perugia, and Ocriculum[6].

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[3] **A** = *Leidensis Vossianus Latinus* F 4; **a** = *Vindobonensis ONB* 9; **Ch** = *Pierp. Morgan M* 871; **D** = *Vaticanus Latinus* 3861; **d** = *Parisinus* BN *Latinus* 6797; **F** = *Leidensis Lipsii* 7; **h** = *Paris B. N. Lat.* 6801; **L** = *Mediceus Laur. plut* 82.1; **R** = *Florentinus Riccardianus* 488; **T** = *Codex Toletanus* 47.14 = *Codex Matritensis Bibl. Nac.* 10042.

[4] Leaving aside graphic variants, *profluū* **aDd**, *profluviū* $\mathbf{R^1}$, *prope fluit* $\mathbf{R^2}$ instead *profluit*; *novorum* **aDF** instead *novenorum*. The reading *longis meatibus* for *longe meabilis*, reported by Dalechamps 1587, will be discussed below.

[5] As usual in Latin, the 'nine days' are counted inclusively. The time-lapse was actually eight days.

[6] Rackham 1942, 41. Cf. G.Ranucci in Barchiesi *et. al.* 1982, 409: «Il Tevere, chiamato anticamente Tibris e prima ancora Albula, nasce press'a poco a metà degli Appennini in senso longitudinale, nel territorio di Arezzo. È esiguo dapprima, e non navigabile, se le sue acque non sono raccolte in serbatoi e poi fatte uscire, come si fa coi suoi affluenti Tinia e Chiani; diventa navigabile solo dopo nove giorni di trattenuta delle sue acque, se non si ha l'aiuto della pioggia. Ma il Tevere, a causa del suo letto aspro e accidentato, neppure con questo sistema può essere reso navigabile per lunghi tratti, se non con zattere, o piuttosto con legni. Esso, passando non lontano da Tiferno, da Perugia e da Otricoli, per 150 miglia divide l'Etruria dall'Umbria e dalla Sabina»; Fontán 1998, 35: «El Tíber, antes llamado Thybris, y primero Álbula, discurre desde la mitad aproximadamente de la cadena del Apenino por las comarcas de los arretinos. De escaso caudal al principio, no es navegable (igual que el Tinia y el Glanis que vierten en él) salvo cuando se retiene en estanques y se le deja salir después de haber estado represadas las aguas nueve días, a no ser que llueva. Pero el Tíber, que por lo áspero y pedregoso del terreno no se deja navegar por largo trecho y más bien con balsas que con barcas, se extiende a lo largo de ciento cincuenta mil pasos. No lejos de Tiferno, Perusia y Ocrículo separa a Etruria de los umbros y de los sabinos etc.»; Winkler- König 2002, 47: «Der Tiberis, sonst Thybris und noch früher Albula genannt, entspringt ungefähr in der Mitte der Längsseite des Apennin im Gebiet der Bewohner von Arretium; er ist anfangs unbedeutend und kann nur, so wie die in ihn mündenden (Flüsse) Tinia und Clanis, dadurch schiffbar gemacht werden, daß man sein Wasser in Becken zusammenfließen und wieder ausströmen läßt, wozu man neun Tage benötigt, sofern nicht Regengüsse zu Hilfe kommen. Aber der Tiberis kann wegen der unebenen

Amid the vast consensus of manuscripts, editions, and translations, only two faint notes seem out of tune. One is a brief remark in a footnote in Le Gall's monograph: «le passage est moins claire qu'il ne paraît au premier abord»[7]. Le Gall does not specify the reasons for his puzzlement. He faults Pliny for not having tried to use the correct words, by writing *trabes* and *rates*[8] – which in his translation become 'pirogues' and 'barques', respectively[9]. But one wonders whether his discomfort actually came from his failure to correctly identify the geographical area to which Pliny's description referred. While Pliny locates the *piscinae* in the first (*primo*) stretch of the Tiber, Le Gall identifies the Forello Gorges[10], slightly upstream of Corbara, as the 'rugged and uneven' stretch of the river navigable only by *trabes* rather than *rates*, and places the *piscinae* 'au haut fleuve en amont du confluent du Glanis (Paglia-Chiani)'[11]. It should be understood that from the sources to the Forello Gorges (more than 180 km), the Tiber would only have been navigable by *trabes* rather than *rates*, and with the help of *piscinae* that held and released water[12].

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und felsigen Stellen nicht einmal auf diese Weise, außer eher mit Balken als mit Flößen, lange befahren werden. Er trennt 150 Meilen nicht weit von Tifernum, Perusia und Ocriculum Etrurien von den Umbrern und Sabinern»; Zehnacker 2004, 62: «Le Tibre, appelé auparavant Thybris et précédemment Albula, prend sa source à peu près au milieu de la longueur de l'Apennin dans le territoire des Arrétins. Faible d'abord, il n'est navigable que grâce à des réservoirs qui servent à le retenir puis à le relâcher, tout comme ses affluents le Tinia et le Clanis; encore faut-il les fermer à chaque fois pendant neuf jours, si les pluies ne viennent en aide. Mais même avec ce dispositif, le Tibre, en raison de son cours rocheux et irrégulier, n'est pas praticable sur une grande longueur, excepté pour la flottaison de grumes plutôt que de radeaux. Passant, sur une distance de 150 milles, non loin de Tifernum, de Pérouse et d'Ocriculum, il sépare l'Etrurie des Ombriens et des Sabins».

[7] Le Gall 1953, 28, nt. 1.

[8] Le Gall 1953, 220 nt. 1: «Les *trabes* me paraissent être précisément des *lintres monoxyli*. *Rates* n'est pas pris dans son sens strict, 'radeaux', mais dans son sens dérivé 'bateaux', comme le souligne l'opposition. Là non plus, Pline n'a pas cherché à utiliser le mot juste».

[9] Le Gall 1953, 333: «Peu abondant au début, il n'est pas navigable à moins qu'on ne réunisse ses eaux dans des bassins avant de les relâcher de même que ses affluents la Tinia et le Glanis après les avoir retenues pendant neuf jours, si les pluies n'y aident pas. En raison du terrain raboteux et inégal le Tibre n'est pas longtemps navigable, même dans ces conditions, si ce n'est pour des pirogues plutôt que pour des barques. Il sépare sur 150.000 pas l'Étrurie de l'Ombrie et de la Sabine, vers Tifernum, Pérouse et Ocriculum». Notice that *longe* is translated as 'longtemps', while Rackham has 'for a long distance'.

[10] Le Gall 1953, 125; 220; Cf. also Niessen 1883-1902, I, 319.

[11] Le Gall 1953, 124; 220.

[12] See also Lewin 1983, 127: «Anche così, tuttavia, a causa di alcune rapide per lungo

Fig. 1 – Hydrometric stations along the Tiber River
(based on Google Earth data)

Le Gall's theory stands in stark contrast to Dionysius of Halicarnassus's account of the navigability of the upper Tiber[13]:

> τοῦ γὰρ Τεβέριος ποταμοῦ καταβαίνοντος μὲν ἐκ τῶν Ἀπεννίνων ὀρῶν […] ἱκανοῦ δὲ ὄντος ἄχρι μὲν τῶν πηγῶν ποταμηγοῖς σκάφεσιν εὐμεγέθεσιν ἀναπλεῖσθαι, πρὸς αὐτὴν δὲ τὴν Ῥώμην καὶ θαλαττίαις ὁλκάσι μεγάλαις κτλ.
>
> The river Tiber, descending from the Apennine mountains […] is navigable

tratto non era percorribile *praeterquam trabibus verius quam ratibus*; solo dopo la confluenza con la Chiana diveniva transitabile da grosse imbarcazioni ed assumeva carattere di vero e proprio fiume».

[13] Dion. Hal. *Ant.* III 44,1.

> quite up to its source for river boats of considerable size and as far as Rome itself for large sea-going vessels (transl. by E.Cary).

More crucially, it is also at odds with some observations of Pliny the Younger. As the proprietor of a villa with arable land situated just upstream from Tifernum Tiberinum[14], Pliny the Younger possessed an exact understanding of the practical constraints on the navigability of the Tiber:

> Prata inde campique, campi quos non nisi ingentes boves et fortissima aratra perfringunt: tantis glaebis tenacissimum solum cum primum prosecatur adsurgit, ut nono demum sulco perdometur. Prata florida et gemmea trifolium aliasque herbas teneras semper et molles et quasi novas alunt. cuncta enim perennibus rivis nutriuntur; sed ubi aquae plurimum, palus nulla, quia devexa terra, quidquid liquoris accepit nec absorbuit, effundit in Tiberim. medios ille [*sc.* Tiberis] agros secat navium patiens omnesque fruges devehit in urbem, hieme dumtaxat et vere; aestate summittitur immensique fluminis nomen arenti alveo deserit, autumno resumit.
>
> *Then you reach the meadows and the fields - fields which only the most powerful oxen and the stoutest ploughs can turn. The soil is so tough and composed of such thick clods that when it is first broken up it has to be furrowed nine times before it is subdued. The meadows are jewelled with flowers, and produce trefoil and other herbs, always tender and soft, and looking as though they were always fresh. For all parts are well nourished by never-failing streams, and even where there is most water there are no swamps, for the slope of the land drains off into the Tiber all the moisture that it receives and cannot itself absorb. The Tiber runs through the middle of the plain; it is navigable for ships, and all the products are carried downstream to the city, at least in winter and spring. In summer the volume of water dwindles away, leaving but the name of a great river to the dried-up bed, but in the autumn it recovers its flood* (transl. by J.B.Firth, with modifications)[15].

Neither Dionysius' ποταμηγὰ σκάφη εὐμεγέθη denote rafts[16], nor Pliny the

[14] On Pliny's villa at San Giustino, see Braconi - Uroz Sáez 1999; 2008; Marzano 2007, 110-113; 736s.

[15] Plin. *epist*. V 6,10-12.

[16] Dionysius distinguishes σκάφαι from σχεδίαι (rafts): III 55,3; 56,3; V 26,1. His ποταμηγὰ σκάφη εὐμεγέθη are hardly anything other than the σκάφαι ποταμηγοί that transport provisions on the Tiber (II 53,2; 55,4; VII 12,3; XII 1,3) and unload the cargoes of the ships that are too large to enter the Tiber (III 44,4); σκάφαι also bring grain from the Pomptine plain to Rome (V 26,4).

Younger's *navium patiens* suggests a river not navigable by boats with some draught[17]. Given that during winter and spring all sort of agricultural produce (*omnes fruges*) was transported from Pliny's villa to Rome, it logically follows that in those seasons neither the Forello Gorges nor any other stretch of the Tiber posed insurmountable obstacles to river navigation with *naves* between Tifernum Tiberinum and Rome.

The striking contrast with Pliny the Elder's passage, as interpreted by Le Gall, becomes even more noteworthy when considering that Pliny the Elder was certainly acquainted with, if not a co-owner of, the villa inherited by his nephew. Owned by the senator M. Granius Marcellus between 2 BC and 15 AD[18], the villa of San Giustino and its statues came to Pliny the Younger 'through various bequests'[19], one of which may have been that of his maternal uncle, who named him his heir by AD 76 or 77[20]. Moreover, Pliny the Younger was appointed *patronus* of Tifernum Tiberinum 'scarcely more than a child' – not necessarily after his uncle's death[21]. Last but not least, Pliny the Elder writes that the rather dense soil *in Tuscis* requires the same exceptional number of ploughings (nine) as the San Giustino fields, according to Pliny the Younger[22].

Obviously, Pliny the Elder was aware of the greater value of a villa that is on the banks of the Tiber or at least in its sight[23]. Whether or not he was a co-owner of the villa inherited by his nephew, it is improbable that he ignored a detail as crucial to its value as the navigability conditions of the Tiber between Tifernum Tiberinum and

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[17] See also Liv. XXI 31,11; Plin. *epist.* VIII 8,3; Tac. *hist.* IV 26,3. Like *quamlibet magnarum navium ex Italo mari capax* at Plin. *nat.* III 54, the syntagm *navium patiens* is meant to specify the degree of navigability of a particular stretch of the river. I do not think that *naves* can refer here to simple *rates*, as suggested by Braconi 1998, 160.

[18] Uroz Sáez 1999, 43-46.

[19] Plin. *epist.* X 8,1. *Per plures successiones traditae mihi* implies at least two distinct inheritances.

[20] Plin. *nat. praef.* 20.

[21] Plin. *epist.* IV 1,4. Sherwin White 1966, 265 aptly recalls that there were no limits on the age or number of *patroni* a municipality could co-opt.

[22] Plin. *nat.* XVIII 181: *spissius solum, sicut plerumque in Italia, quinto sulco seri melius est, in Tuscis vero nono*; Plin. *epist.* V 6,10, quoted above. See Sherwin White 1966, 322-323. If Pliny the Elder was indeed referring to the San Giustino fields, it follows that he could include the *Tifernates cognomine Tiberini* in the sixth Augustan *regio* while designating them as *Tusci*, like Pliny the Younger: Mazzarino 1966, 228ss; Sisani 2009.

[23] Plin. *nat.* III 54: *pluribus prope solus quam ceteri in omnibus terris amnes accolitur adspiciturque villis*. Cf. Cic. *S.Rosc.* 20, where the excellent quality of Roscius' estate (*bonitas praediorum*) is attributed to the fact that nearly all of his thirteen farms are situated on the Tiber's banks (*Tiberim fere omnes tangunt*). Proximity to a navigable river is a valuable asset for a rural estate: Cato *agr.* 1,3; Varro *rust.* I 16,1;6; Colum. I 2,3.

Rome. At Plin. *nat.* III 53 the terms *trabes* and *rates* delineate the extent of the river's navigability in its first stretch. It seems implausible that they were inaccurately chosen.

The navigability conditions of the Tiber hold significant implications for both the scope of the task entrusted to the *curatores alvei Tiberis* and the nature of the economic ties between Rome and its riverine hinterland[24]. These aspects would markedly differ if the navigability of the Tiber extended, if for a restricted period, up to Tifernum Tiberinum and beyond, as opposed to a complete cessation at the Forello Gorges throughout the entire year. Did the *curatores alvei Tiberis* aim to enhance the navigability of the upper Tiber? Were the Tuscian and Umbrian ports visited by the grain trader T. Caesius Primus as far upstream as Tifernum Tiberinum, or no further than Ocriculum[25]? Since no ambiguity obscures the meaning of Pliny the Younger's lines, it is worth scrutinising whether the interpretation of Pliny the Elder's passage has been accurate.

2. Meabilis ≠ navigabilis

Plin. *nat.* III 53 had raised eyebrows long before Le Gall, and for a reason the French scholar did not recognise. In his 1587 edition of the *Natural History*, Dalechamps printed *longe meatibus fertur* instead of *longe meabilis fertur*, reporting that *in Vet.* the reading was *longis meatibus*.

The origin of the variants indicated by Dalechamps as *V., Vet., Vetust., Vet. cod.,* and *Vet. lect.* (explained in the index as *Vetus, Veteres, Vetusti, Vetus codex, Vetusta lectio*) remains, to the best of my knowledge, uncertain. While Sillig conceded that at least some of them could be derived from a manuscript, Jan – Mayhoff classified them as *coniectura(e) incerti hominis docti vel vetustioris alicuius editionis lectio(nes)*[26]. Dalechamps' reading *longe meatibus* was followed by the Stoer edition, and by Harduin, and Brotier[27] and still mentioned, together with the variant *longis meatibus*, in the *apparatus* of Sillig 1851. After Sillig, both the variant and Dalechamps' reading were forgotten.

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[24] For the task of the *curatores alvei Tiberis*, see Cass. Dio LVII 14,8. On Rome's hinterland, see Morley 1996, 63-68.

[25] *CIL* XIV 2852 = *CLE* 249 = *ILS* 3696, l. 7-13: *qui largae Cereris messes fructusq(ue) renatos / digerit in pretium cui constat fama fidesq(ue) / et qui divitias vincit pudor ire per illos / consuetus portus cura studioq(ue) laboris / litor(a) qui praestant fessis tutissima nautis / notus in urbe sacra notus quoq(ue) finibus illis / quos Umber sulcare solet quos Tuscus arator*. For shipments of foodstuffs to Rome from Etruria and Umbria, see Mart. VII 31,9ss.

[26] Sillig 1851, I, XXIX-XXXI; Jan - Mayhoff 1906, I, XV.

[27] Stoer 1593; Hardouin 1685; Brotier 1779.

It would certainly be unreasonable to prefer an isolated variant of uncertain origin to the reading unanimously attested by the known manuscripts, but it should be recognised that the emendation (if that is what it is) *longis meatibus* was a sensible attempt to correct a text that is puzzling when both *meabilis* and the traditional punctuation are retained. In fact, if a full stop after *imbres* and a comma after *ratibus* are kept, the words *ne sic quidem* can only connect with *longe meabilis fertur*, drawing in *praeterquam trabibus verius quam ratibus*. A river *trabibus verius quam ratibus* [...] *meabilis* is only one navigable with beams rather than rafts. In other words, the punctuation renders *meabilis* a synonym for *navigabilis*, which it certainly is not.

The other occurrences of the adjective, both in Pliny the Elder and in other authors, show that *meabilis* can have an active sense (*i.q. means*, 'passing through', 'penetrating'), or a passive one (*i.q. quo meari potest*, 'that may be gone through', 'passable')[28]. In combination with *longe – fertur* the passive sense is the only viable option. Indeed, a river (or a sea strait) is *meabilis* (or, as later authors prefer, *permeabilis*) when it is fordable. It is sufficient to refer to a passage in Orosius where we read of a horse *transmeandi fiducia persuasus* (confident to cross [*sc*. a river]), of an *amnis feminis vix genua tinguentibus permeabilis* (river fordable by women who barely wet their knees), and of *vada meabilia* (fords that can be crossed)[29].

The correction of *meabilis* to *meatibus* reflects unease in considering *meabilis* as a synonym for *navigabilis* and clearly necessitates different punctuation. If we put a full stop after *ratibus* and insert *sed Tiberis – ratibus* between parentheses, *ne sic quidem* would imply *navigabilis*[30], and *longe meatibus fertur* would be separated from the preceding sentence.

This would be the text and the translation:

> tenuis primo nec nisi piscinis corrivatus emissusque navigabilis, sicuti Ti<n>ia et <C>lanis influentes in eum, novenorum ita conceptu dierum, si non adiuvent imbres (sed Tiberis propter aspera et confragosa ne sic quidem, praeterquam trabibus verius quam ratibus). longe meatibus fertur per CL (milia) p. non procul Tiferno Perusiaque et Ocriculo Etruriam ab Umbris et Sabinis etc.

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[28] *ThlL* VIII 511,18 ss*; OLD* 1087. In the active sense, Plin. *nat.* II 10: […] *proximum spiritus, quem Graeci nostrique eodem vocabulo aëra appellant, vitalem hunc et per cuncta rerum meabilem totoque consertum*; in the passive one, Plin. *nat.* VI 2: […] *ad Bosporos duos vel bubus meabili transitu*.

[29] Oros. II 6,2-6.

[30] As Harduin 1685, 322 recommends: «*Ne sic quidem*] Subintellige, *navigabilis*».

> *It is small at the beginning and not navigable if not retained and released from* piscinae*, like the Tinia and the Clanis, its tributaries, with the collection of nine days, if the rains do not help* (*but the Tiber because of its bumpy and irregular course not even so* [sc. *is it navigable*]*, if not with beams rather than rafts*)*. For a long stretch, it flows with bends for 150 miles separating, not far from Tifernum, Perusia, and Ocriculum, Etruria from the Umbrians and Sabines etc.*

While correcting *meabilis* to *meatibus* is not advisable, it is essential to adopt the punctuation required for *meatibus*. Only by inserting a full stop after *ratibus* can *meabilis* be understood as 'fordable' without any hindrance.

I quote and translate again:

> tenuis primo nec nisi piscinis corrivatus emissusque navigabilis, sicuti Ti<n>ia et <C>lanis influentes in eum, novenorum ita conceptu dierum, si non adiuvent imbres (sed Tiberis propter aspera et confragosa ne sic quidem, praeterquam trabibus verius quam ratibus). longe meabilis fertur, per CL (milia) p. non procul Tiferno Perusiaque et Ocriculo Etruriam ab Umbris et Sabinis etc.

> *It is small at the beginning and not navigable if not retained and released from* piscinae*, as well as the Tinia and the Clanis, its tributaries, with the collection of nine days, if the rains do not help* (*but the Tiber, because of its steep and bumpy course, even so* [sc. *is navigable*]*, if not with beams rather than rafts*)*. It flows for a long stretch fordable, for 150 miles separating, not far from Tifernum, Perusia, and Ocriculum, Etruria from the Umbrians and Sabines etc.*

3. *Hydrometric data*

The remarks made by both Plinii regarding the upper course of the Tiber prove insightful when juxtaposed with the hydrometric data recorded in the twentieth century at various stations along the its course. The stations considered here are those of Città di Castello/Santa Lucia (347 km from the mouth of the Tiber, situated less than 20 km downstream from Pliny's estate), Ponte Felcino (300 km from the mouth), Ponte Nuovo (273 km from the mouth), Corbara (219 km from the mouth), Baschi (209 km from the mouth), and Passo San Francesco (163 km from the mouth)[31].

[31] Data are drawn from *Annali idrologici*.

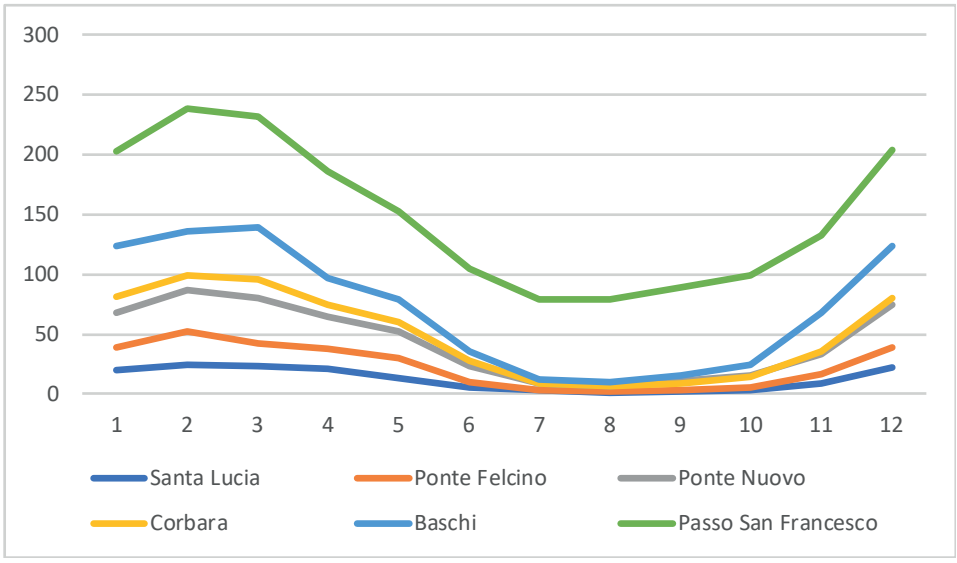


Fig. 2 – Averages of monthly flow rate averages, years 1951-1959, in m3/s.

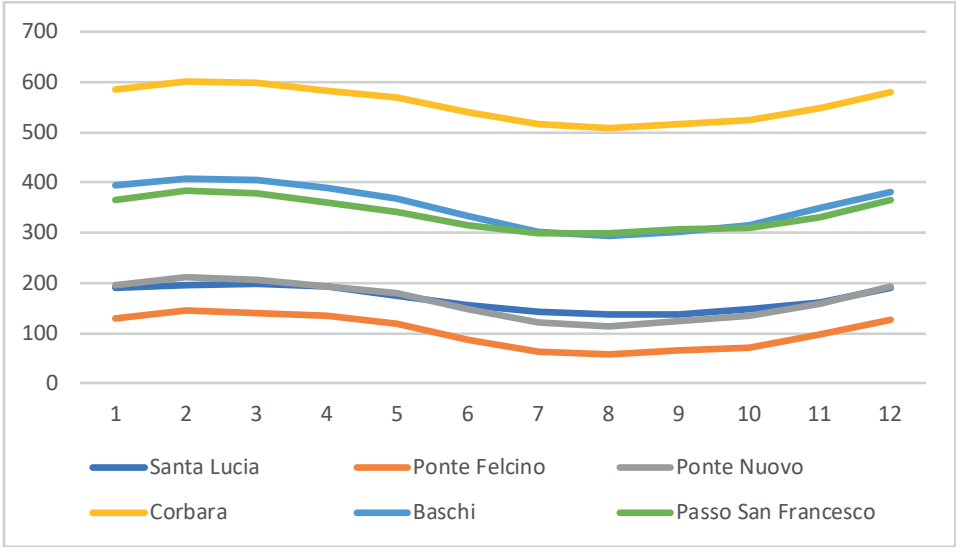


Fig. 3 – Averages of monthly hydrometric height averages, years 1951-1959, in cm.

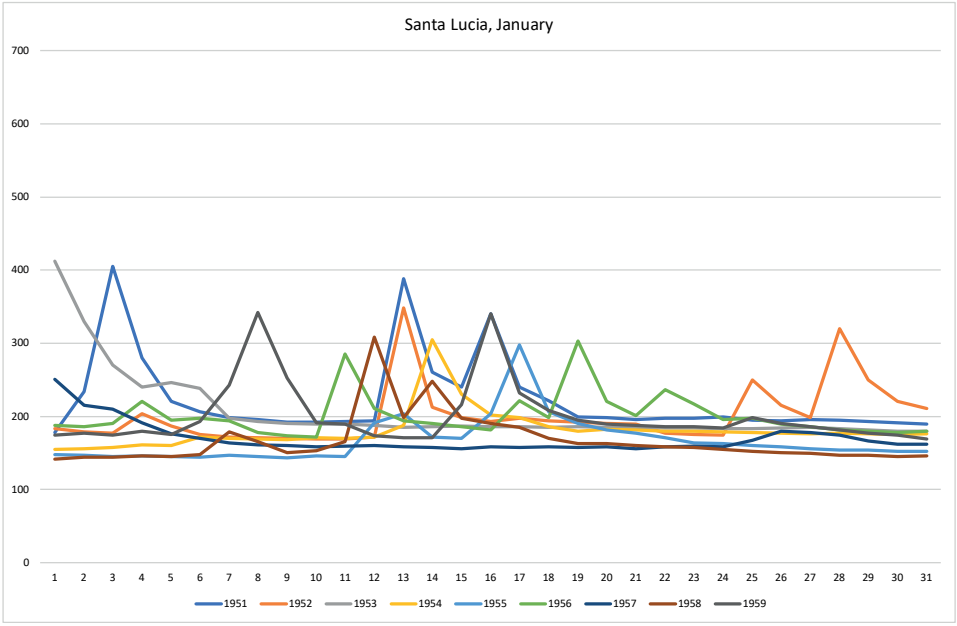
The graphs presented in Fig. 2 and Fig. 3 depict the averages of monthly flow rate and hydrometric height averages recorded from 1951 to 1959[32]. It may be helpful to point out that flow rates and hydrometric heights do not evolve similarly from one station to another. While flow rates consistently increase downstream, hydrometric heights exhibit irregular variations due to the diverse riverbed conditions and settings of hydrometers. Consequently, it should not be surprising that at Ponte Felcino and Passo San Francesco the river registers higher flow rates but lower hydrometric heights than at Santa Lucia and Corbara, respectively.

These graphs basically validate the seasonal dynamics alluded to by Pliny the Younger. On average, flow rates and hydrometric heights are significantly higher from November to May than from June to October. Besides, although the hydrometric height is a conventional measure and does not necessarily correspond to the water depth at a specific station or between one station and another, it is worth highlighting that at Corbara, Baschi, and Passo San Francesco, the average hydrometric heights consistently remain above 2 meters throughout the year. In contrast, at Santa Lucia, Ponte Felcino, and Ponte Nuovo, they predominantly hover below that threshold[33].

On the other hand, as these graphs represent the averages of monthly averages, they obscure both year-to-year deviations and, more significantly, the variations between days within each month. Consequently, they hardly show, for instance, the nearly dry riverbed (*arens alveum*) alluded to by Pliny the Younger, which was the lowest level achieved in a few days and places through a gradual dwindling (*summittitur*). More in general, it has to be emphasised that assessing the hydrology of the Tiber through monthly averages could be misleading because daily variations, especially in winter and spring, can be both frequent and intense. To exemplify this phenomenon, the graphs in Fig. 4 depict the daily hydrometric heights recorded at Santa Lucia, Ponte Felcino, and Ponte Nuovo during the months of January (left) and July (right) for the years spanning from 1951 to 1959, while those in Fig. 5 represent the monthly maximum, minimum and average hydrometric heights recorded each month in the same stations from, again, 1951 to 1959.

[32] The hydrometric height is a conventional reference value specific to each installed hydrometer and may not correspond to the distance between the surface and the bottom of the water body.

[33] At Santa Lucia, the hydrometric height ranged between 54 and 555 cm in the years from 1951 to 1971; at Ponte Felcino, between 9 and 665 cm in the years from 1933 to 1971; at Ponte Nuovo, between 70 and 810 cm in the years from 1925 to 1970 (data from *Annali Idrologici*).



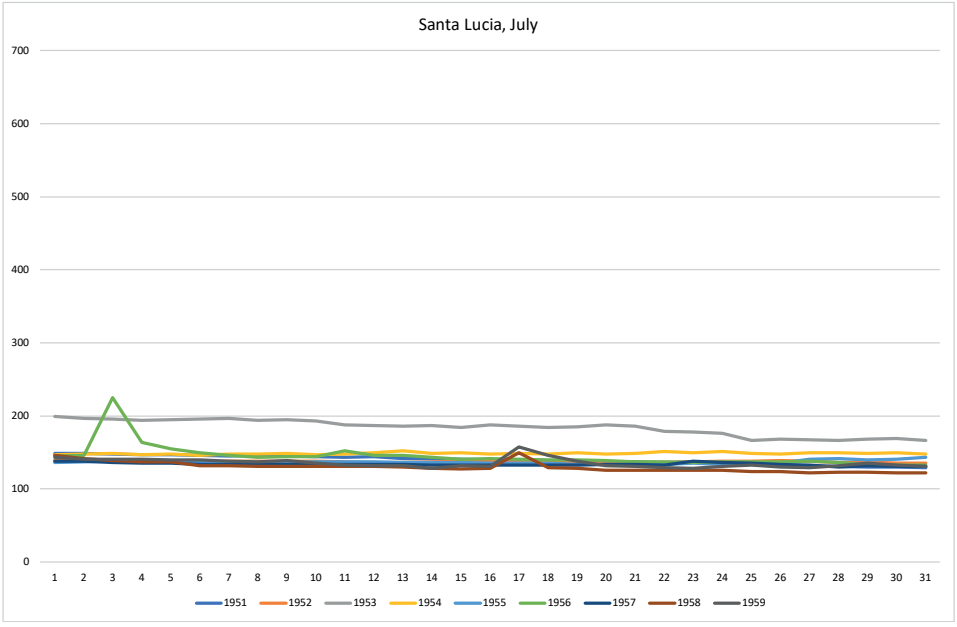


Fig. 4a – Santa Lucia:
January and July daily hydrometric heights, years 1951-1959 (in cm).

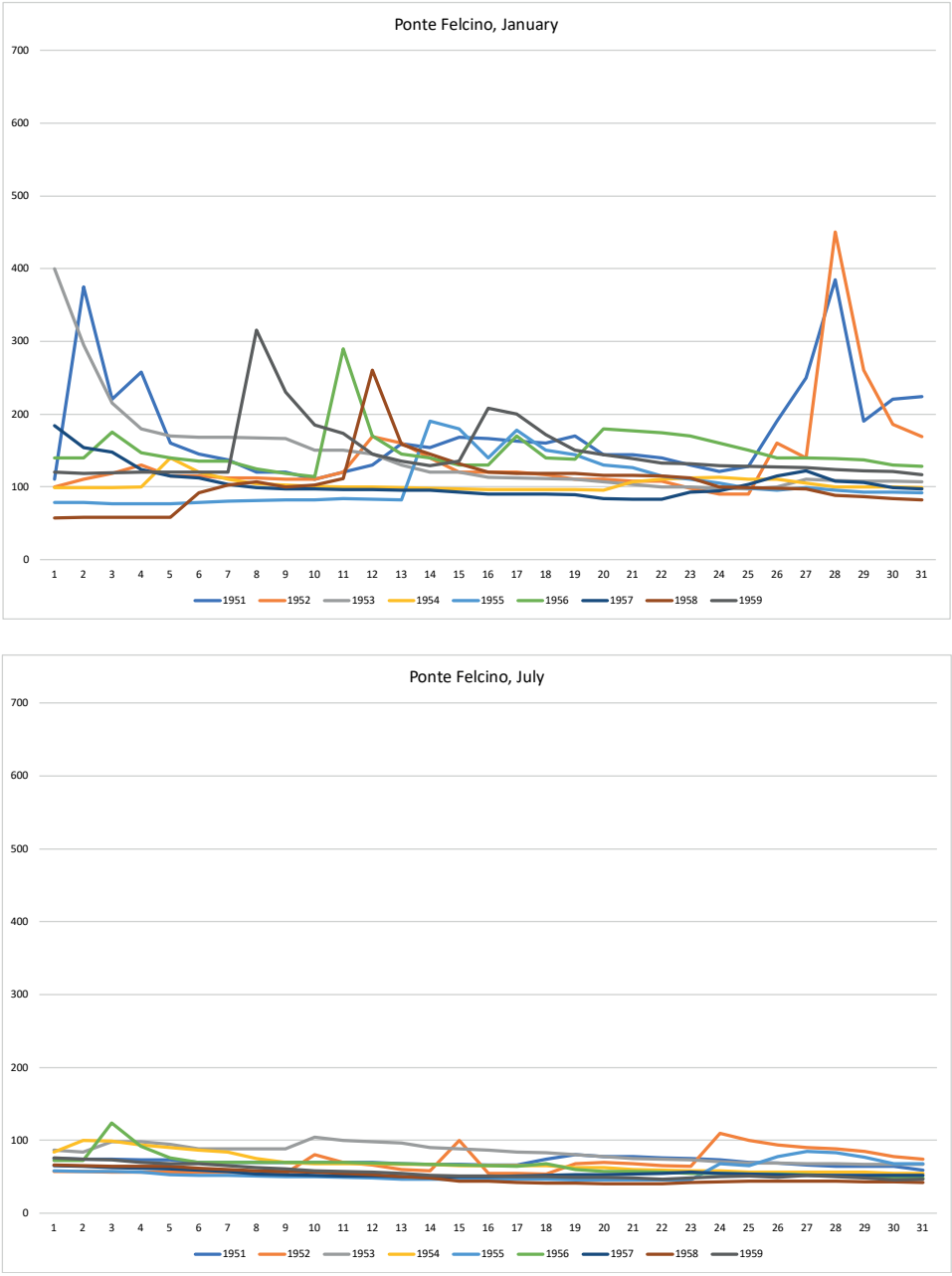
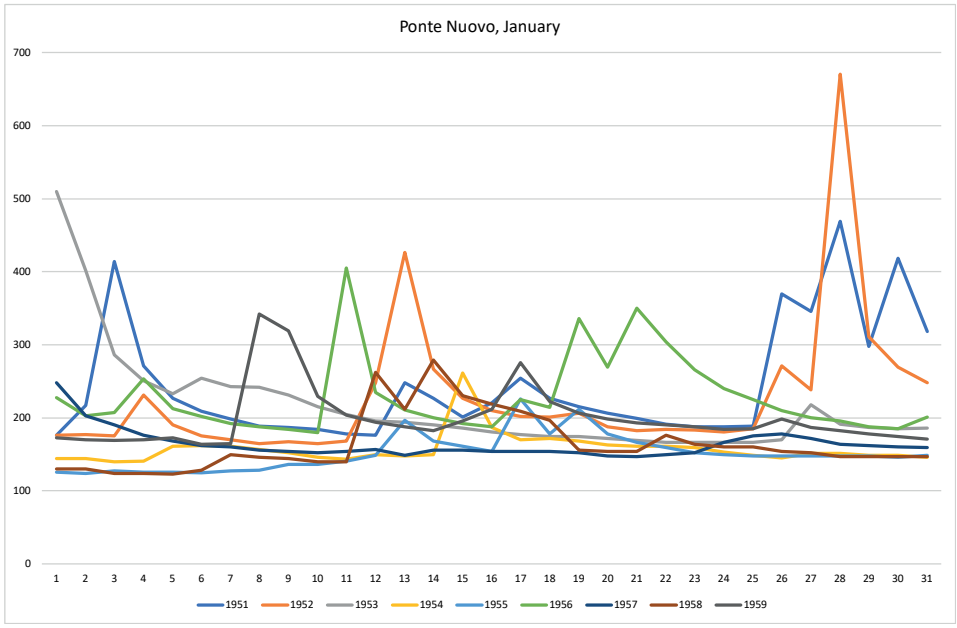


Fig. 4b – Ponte Felcino:
January and July daily hydrometric heights, years 1951-1959 (in cm).



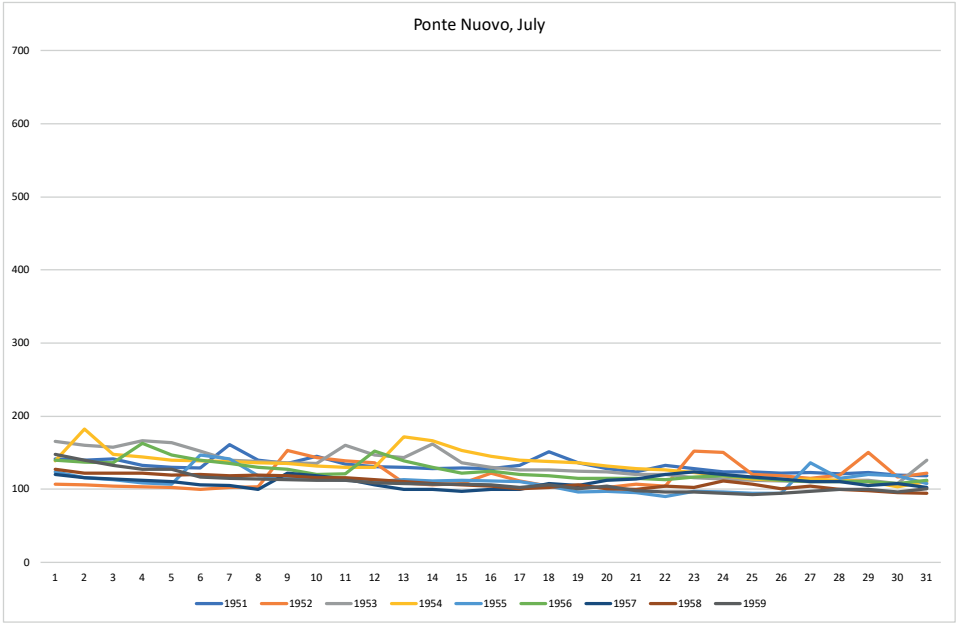
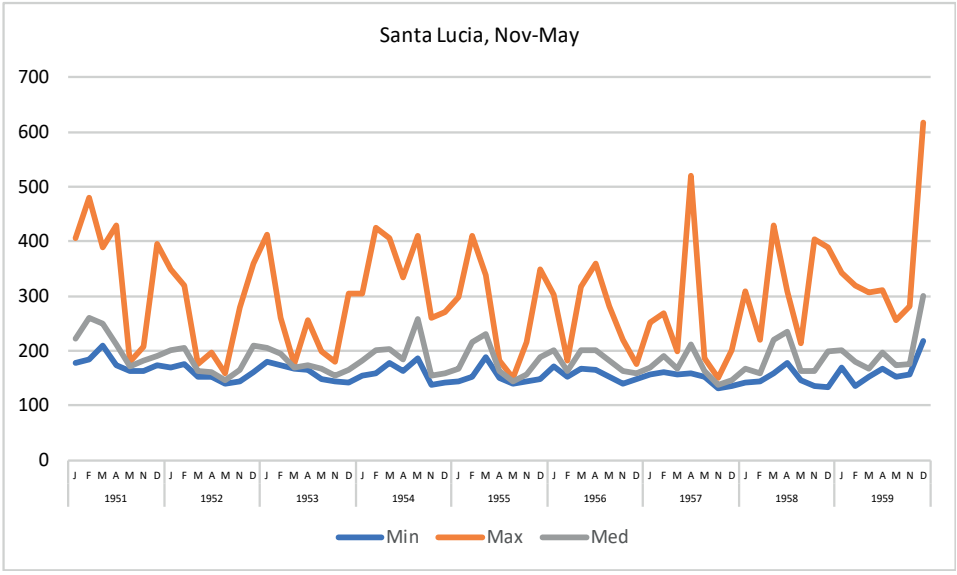


Fig. 4c – Ponte Nuovo:
January and July daily hydrometric heights, years 1951-1959 (in cm).



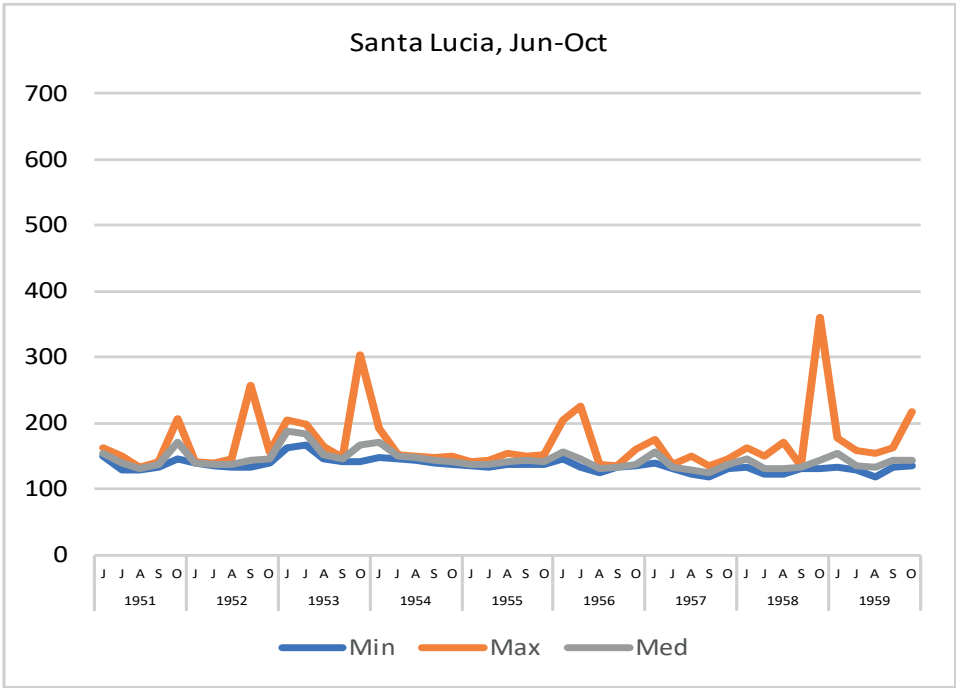
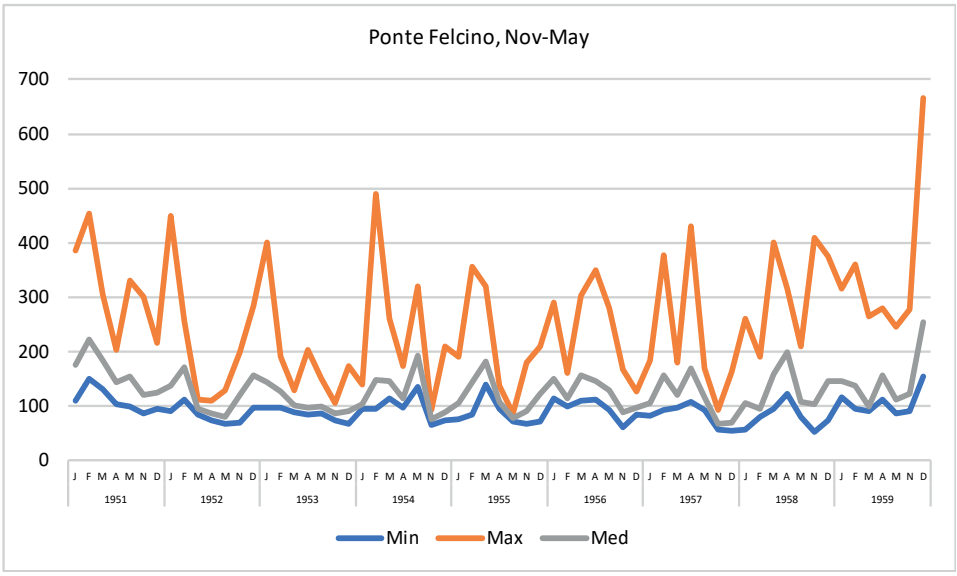


Fig. 5a – Santa Lucia: maximum, minimum and medium hydrometric heights from 1951 to 1959 (from November to May, from June to October), in cm.



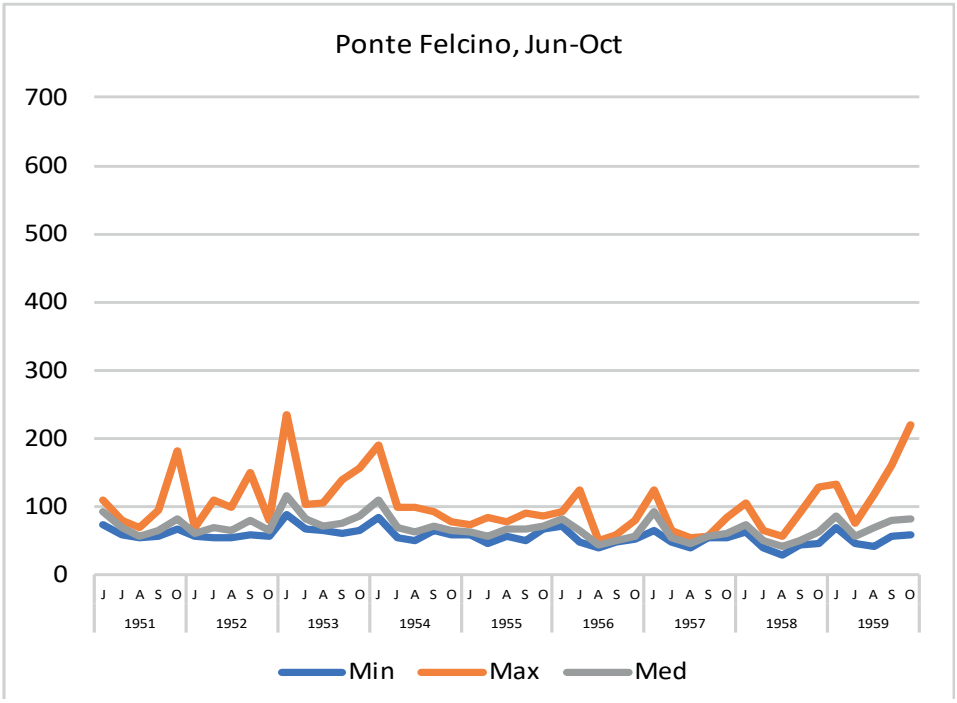
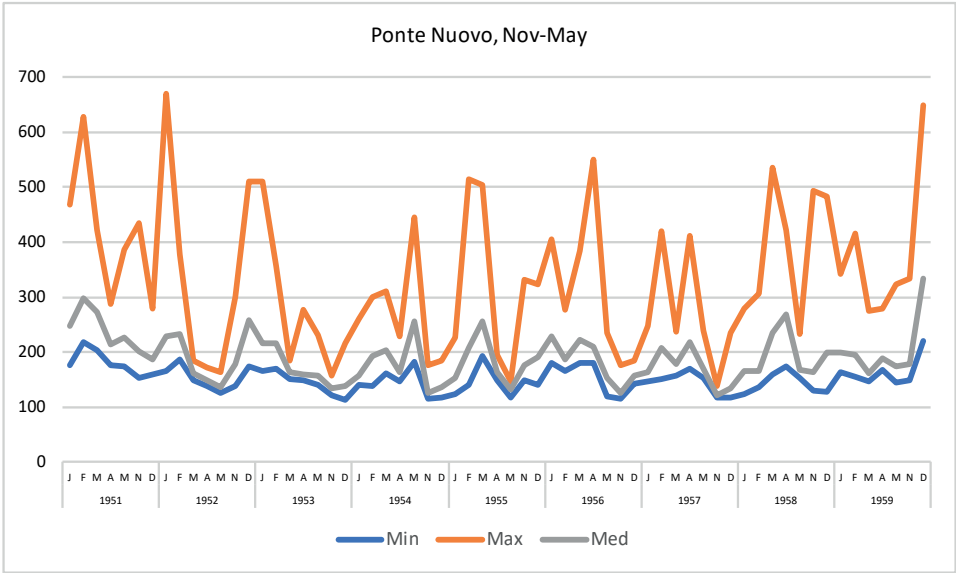


Fig. 5b – Ponte Felcino: maximum, minimum and medium hydrometric heights from 1951 to 1959. On the left, from November to May, on the right from June to October (in cm)



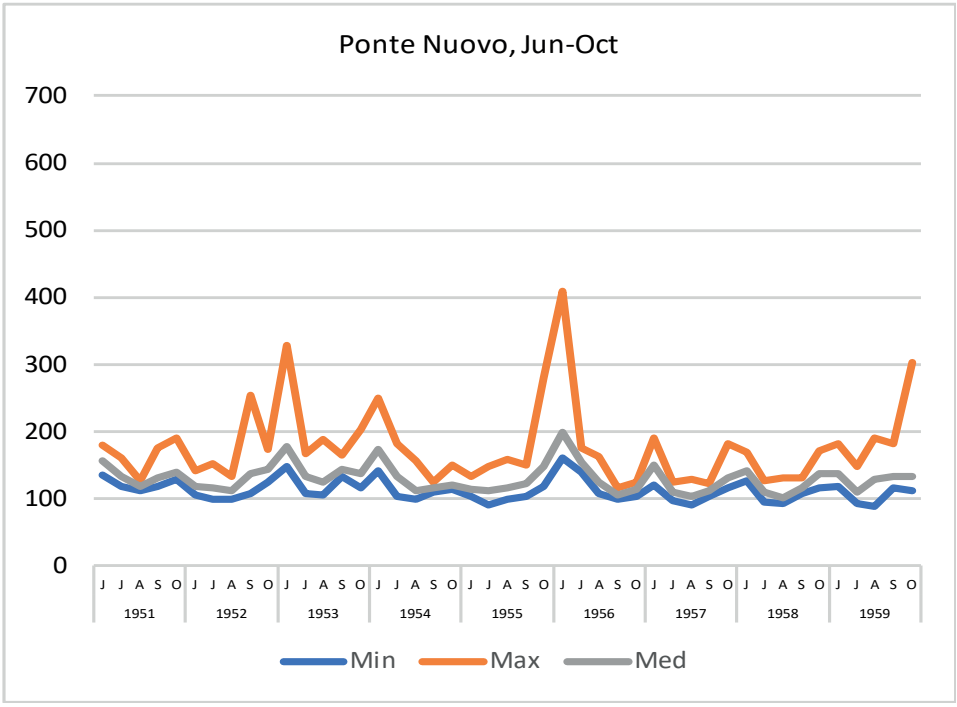


Fig. 5c – Ponte Nuovo: maximum, minimum and medium hydrometric heights from 1951 to 1959. On the left, from November to May, on the right from June to October (in cm).

Upon closer examination, the hydrometric data from the Santa Lucia, Ponte Felcino, and Ponte Nuovo stations cast a critical light on the statements of both Pliny the Elder and Pliny the Younger. In particular, one might question whether the navigability threshold precisely coincided with the narrow gap between the winter and summer minimum values. An alternative perspective could suggest that Pliny the Younger failed to specify the occurrence of days in winter and spring when the river was unnavigable due to insufficient water, as it always was in summer. But while Pliny the Younger's potential omission could be attributed to the need for concise general information, explaining why Pliny the Elder consistently described the upper Tiber as fordable although certain stretches experience a rapid 2- to 3-meter rise in water levels during winter and spring presents a greater challenge. The graphs show that the river was indeed fordable at Santa Lucia, Ponte Felcino and Ponte Nuovo, but only when not swollen by rain.

Pliny the Elder's distortion looks even more awkward when juxtaposed with his preceding statement that the initial stretch of the Tiber was rendered navigable «with the water gathered every nine days unless the rains help» (*novenorum ita conceptu dierum, si non adiuvent imbres*). The contrast is stark. How is it that Pliny failed to specify the intermittent fordability of the Tiber's lengthy middle stretch, yet took care to emphasise that the reservoirs of its initial stretch would fill within eight days only in the absence of rain?

The clause *si non adiuvent imbres* would make more sense before *longe meabilis fertur*. A phrase like *si non adiuvent imbres, longe meabilis fertur* (unless rains help, it flows fordable for a long distance) would offer a depiction of the upper Tiber's hydrology that aligns seamlessly with modern data and is more consistent with the seasonal variations implied by Pliny the Younger.

4. *Textual misplacements*

The relocation of *si non adiuvent imbres* from after *dierum* to after *ratibus* would not constitute an unprecedented modification of the text consistently transmitted by the manuscripts. The critical editions of the *Natural History* reveal numerous instances in which the repositioning of a group of words from the location assigned to them by the manuscripts has been proposed[34]. To delve into each

[34] The cases accepted or mentioned in Jan - Mayhoff 1875 and Jan - Mayhoff 1892-1909 (both *apparatus* and *appendices*) include: I 2,42; 32,28; II 86; 122; IV 105; VI 147; VII 30; 46; 55 (from 69); 69 (from 72); 81; 147; VII 81s; VIII 6; IX 37; 84; X 30; 59; 60; 62s; 194; XI 118; 191; 192; 194; 265; XII 112s; XIII 18 (from 15); 74 (from 77); XVI 144; 159; 167; 178; 250; XVII 41; 66; 81; 115; 138; 224; XIX 22; 43; 101; 179; XX 98s; 169; 172; 231; XXI 102;

case would take too long; it suffices to highlight a specific instance where the manuscripts, nearly all of those transmitting *nat.* III 53[35], uniformly present a text in which three words and one number unquestionably occupy an incorrect position.

Leaving aside variants that are irrelevant for our purposes, in Plin. *nat.* II 202 the manuscripts all give the following sequence:

> clarae iam pridem insulae Delos et Rhodos memoriae produntur; et natae postea minores, ultra Melon Anaphe, inter Lemnum et Hellespontum Neae, inter Lebedum et Teon Halone, inter Cycladas Olympiadis CXLV anno quarto Thera et Therasia, inter easdem post annos CXXX Hiera eademque Automate, et ab ea duobus stadiis post annos CX nostro aevo Iunio Silano Laelio Balbo cos. a. d. VIII idus Iulias Thia.

As K.L.Urlichs first recognised, Pliny could not have written that the islands of Thera and Therasia emerged only in the fourth year of the 145th Olympiad (197 BC)[36]. Instead, he must have written that the island of Hiera, also known as Automate, emerged between Thera and Therasia in that year, and that Thia had emerged in the consulate of Iunius Silanus (AD 46), 242 years later[37]. Consequently, *Olympiadis CXLV anno quarto* must be transferred after *easdem*; *post annos CXXX* must be deleted, and *post annos CX* amended to <*C*>*CX*<*XXXII*>[38]:

> clarae iam pridem insulae Delos et Rhodos memoriae produntur; et natae postea minores, ultra Melon Anaphe, inter Lemnum et Hellespontum Neae, inter Lebedum et Teon Halone, inter Cycladas ** Thera et Therasia, inter easdem <Olympiadis CXLV anno quarto> [post annos CXXX] Hiera eademque Automate, et ab ea duobus stadiis post annos <C>CX<XXXII> nostro aevo Iunio Silano [Laelio Balbo] cos. a. d. VIII idus Iulias Thia.

This type of textual corruption finds its explanation in omissions that were rec-

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145; 182; XXIII 11; 100s; 147s; XXIV 47; 93-100; 94; 135; XXV 74; 115; XXVI 116s; XXVII 14; XXVIII 24; 134; 198; XXX 127; XXXII 150; XXXIII 1; 90; XXXIV 63; 79; 171; XXXV 5s; 72; 97; 99; 108s; 116; 159.

[35] Except **p** (= *Munich Staatsbibl. Lat.* 11301), which omits *nat.* II 202. Conversely, **E** (= *Paris B.N. Lat.* 6795), **l** (= *London B.L. Arundel* 98), and *Paris B.N.* 6800 omit *nat.* III 38-70.

[36] Cf. Plin. *nat.* IV 70: *Thera, cum primum emersit, Calliste dicta. ex ea avolsa postea Therasia, atque inter duas enata mox Automate, eadem Hiera, et in nostro aevo T<h>ia iuxta easdem enata.*

[37] Cf. also Sen. *nat.* II 26,4; VI 21,1; Plut. *de Pyth orac.* 399[d]; Iust. XXX 4,1-2; Amm. XVII 7,13.

[38] Urlichs 1853, 26-29.

tified in the antigraph through marginal additions mistakenly reintegrated into the apograph's text.[39] To propose that this occurred one more time than so far acknowledged or surmised should not be summarily rejected. However, even considerations such as consistency with the hydrology of the upper Tiber, alignment with Pliny the Younger's observation regarding the river's navigability, and other instances of word group misplacements in the same manuscripts are insufficient to justify relocating *si non adiuvent imbres* after *ratibus* at Plin. *nat.* III 53. For such an alteration to be compelling, it must be convincingly demonstrated that *si non adiuvent imbres* cannot appropriately remain after *novenorum ita conceptu dierum*.

5. *Rainless nundinal cycles?*

Upon initial consideration, disputing the placement of *si non adiuvent imbres* after *novenorum ita conceptu dierum* may appear challenging. Syntactically, *ita* can be interpreted as proleptic, rendering *novenorum ita conceptu dierum* inseparable from its subsequent context[40]. In terms of content, the apparent correlation between the faster or slower filling of the reservoirs and the presence or absence of rain seems self-evident. Upon closer examination, however, the first argument lacks conclusiveness, and the second is rooted in a misunderstanding of how these facilities operated. It is easy to counterargue that removing *si non adiuvent imbres* still allows *ita* to relate to *sicuti Ti<n>ia et <C>lanis influentes in eum*[41]. Demonstrating the fallacy of the second argument requires a more detailed explanation. Subsequently, we will demonstrate that:

1) As it stands in the manuscripts, the sentence is inherently inconsistent.
2) It is highly improbable that *piscinae* on three different rivers could consistently fill in precisely eight rainless days, particularly irrespective of the season and atmospheric precipitations in the preceding days.
3) The likelihood that the reservoirs required a full eight days of discharge to fill is extremely low.

[39] On different types of transpositions in Pliny the Elder's text, see Jan - Mahyoff 1875, IX-XII.

[40] See, e.g., Plin. *nat.* VIII 119: […] *quod ita demum existimant ratum, si vulnere uno interierit*; X 158: *palumbis et turtur plurimum terna nec plus quam bis vere pariunt, atque ita, si prior fetus corruptus est.*

[41] See also Plin, *nat.* XXVIII 165: *mire continent ita fluentem capillum, sicuti carnis cinere ex oleo inlita supercilia nigrescunt.*

Let us begin by addressing the linguistic inconsistency. The manuscripts do not simply read *novem* but rather *novenorum ita conceptu dierum*. The distributive numeral *novenorum* indicates that the sluices' filling with water collected for eight days was conceived as a cyclical phenomenon, specifically, 'with water collected every ninth day'[42]. On the other hand, the clause *si non adiuvent imbres* subordinates the perpetuity of this cycle to the absence of rain. As it stands in the manuscripts, the sentence might make sense in an arid region where rain is extremely rare. It becomes inappropriate when applied to the upper Tiber valley.

For instance, the Montecoronaro station recorded an average of more than 108 rainy days per year, with only 356 rainless nundinal periods in the thirty years between 1960 and 1989[43]. Less than twelve occurrences per year fall short of suggesting a nundinal cycle, especially considering that for a rainless eight-day cycle to fit between two sluice openings, the first day must coincide with the closing of the sluice – probably a rare event. The contradiction between the cycle implied by the distributive numeral and the high frequency of its disruptive phenomenon leaves us with a choice: either amend *novenorum* to *novem* or remove *si non adiuvent imbres*.

The implications of the first option make it considerably more favourable to remove *si non adiuvent imbres*. In fact, if *ita* were proleptic of *si non adiuvent imbres*, the sluices on the Tiber, Tinia, and Clanis would only open every ninth day, contingent on the absence of rain. Such a scenario seems implausible, as sluices designed to facilitate navigation, even floatation, are installed with primary functionality in mind. It is difficult to fathom how Roman engineers could have serendipitously established reservoirs on three distinct rivers, all filling in eight rainless days.

Although on a different scale, the Tiber's flow rate in its first stretch may have been as unstable as in its middle[44]. The same volatility can be presumed for the Tinia and Clanis. Eight rainless days in August, following two months of scarce rainfall and another dry nundinal cycle would produce significantly less water than the same period in January after weeks of heavy rainfall. Given Pliny the Younger's acknowledgement of seasonal variations in the Tiber's flow rate, it seems highly

[42] Current translations (see above) fail to account for the distributive numeral. In Pliny's *Natural History*, examples of distributive numerals indicating cyclic time intervals include II 38: *signiferi autem ambitum peragit trecenis et duodequinquagenis diebus*; XVI 2: *vasto ibi meatu bis dierum noctiumque singularum intervallis effusus*. On the semantics and syntax of distributive numerals in a cross-linguistic approach, see Gil 1982.

[43] Data taken from *Annali idrologici*, years 1960 to 1989.

[44] No measured flow rate is available upstream of Santa Lucia. For the period 2012-2017, the estimated average flow rates of the stretch of the Tiber in the Emilia-Romagna region are 0.7 m^3/s (annual), 1.05 m^3/s (October to April) and 0.3 m^3/s (May to September): Regione Emilia-Romagna 2021, 15.

improbable that Pliny the Elder assumed a lack of rain for eight days would suffice to maintain constant flow rates in the Tiber, Tinia, and Clanis.

Finally, the assertion that the Tiber's reservoirs required the discharge of eight rainless days to fill is also highly unlikely. To clarify this point, it is imperative to investigate how these sluices operated and their intended purpose.

6. *Some* comparanda

In the *Natural History*, the term *piscina* is also used to denote reservoirs specifically crafted to retain and later discharge a significant volume of water, serving the purpose of carrying away materials excavated from the gold mines of Spain. The lexical coincidence between *nat.* III 53 (*corrivatus emissusque*) and *nat.* XXXIII 74s. (*corrugi – a conrivatione credo* […] *emissaria*) confirms that the reservoirs of the Spanish mines and those of the Tiber, Clanis, and Tinia likely operated similarly[45]. Fortunately, Pliny provides precise dimensions for the Spanish sluices[46]:

> ad capita deiectus in superciliis montium piscinae cavantur ducenos pedes in quasque partes et in altitudinem denos. emissaria in iis quina pedum quadratorum ternum fere relinquuntur, ut repleto stagno excussis opturamentis erumpat torrens tanta vi, ut saxa provolvat.
>
> *At the head of the waterfall on the brow of the mountains reservoirs are excavated measuring 200 ft. each way and 10 ft. deep. In these there are left five sluices with apertures measuring three square feet, in order that when the reservoir is full the stopping-barriers may be struck away and the torrent may burst out with such violence as to sweep forward the broken rock* (transl. by H.Rackham).

Using the Torricelli's law [$v = \sqrt{(2gh)}$], we can deduce how these sluices worked. When the 45-square-Roman foot outlets (equivalent to 3.94 m^2) were opened, the 400,000 cubic feet (equal to 10,404 m^3) flowed out at a rate gradually decreasing from approximately 30 m^3/s and emptying the tank in about eleven minutes and thirty-three seconds.

The purpose of the sluices on the Tiber becomes apparent through the medieval timber flotations from Massa Trabaria. In medieval times, the Apennine district called Massa Trabaria was obligated to supply beams (*servitium trabium* or *obsequium trabium*) for the basilicas of Rome[47]. The toponym 'Bocca Trabaria' suggests that the beams were then more precisely sourced from the mountains

[45] Plin. *nat.* XXXIII 74s. Pliny's description is compared with archaeological evidence by Domergue 1972-1974; Domergue - Hérail 1978, 247-284; Ruiz del Árbol *et al.* 2014.

[46] Plin. *nat.* XXXIII 75.

[47] Lewin 1983; Diosono 2008, 268-271.

east of San Giustino. Although the location of Pliny's sluices in the Tiber's first stretch implies that the logs were then obtained further upstream along the Tiber's course[48], the geographical proximity and lexical coincidence strongly suggest that Pliny's 'navigation' by *trabes* referred to the floating of loose logs on an impervious watercourse. In contrast, navigation by *rates* denoted the floating of rafts on the insufficient or uneven waters of the Tinia and Clanis[49].

If this interpretation is accurate, Pliny's sluices can be likened to the *Schwallungen* (sluices) that facilitated the transport of loose logs from the Black Forest to Gernsbach[50]. Notably, the largest of these *Schwallungen*, situated in Raumünzach, measured 120 meters in length and 9 meters in height and featured a 40,000 m^3 reservoir capable of filling in twenty-four hours or less[51]. The more modest *Schwallung* located near Herrenwies, spanned 76.2 meters in length and stood 7.3 meters high, filling in twelve to twenty-four hours and emptying in thirty to sixty minutes[52]. Filling times of not much more than twelve hours align with a 1583 *Floßordnung* (raft regulation) which restricted floating activities to Mondays, Fridays, and Saturdays, additionally stipulating that sluices should not be closed before 6 p.m. on Sundays and Thursdays[53].

Among comparable installations are also the eastern Italian *stue* or *serre*, sluices that played a crucial role in facilitating the descent of logs down the Adige, Brenta, Piave, and Tagliamento Rivers in medieval as well as in modern times[54]. The esti-

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[48] Occhini 1910, 96 saw 'avanzi di chiuse o saracinesche' at Valsavignone, Formole, and Montedoglio. Cf. Le Gall 1953, 124s., nt. 5; Quilici 1986, 215 nt. 92.

[49] Despite Le Gall (see above nt. 8), Pliny's reference to *trabes* and *rates* appropriately indicates the two different types of floating, with loose logs and logs tied into rafts, respectively. See Asche - Bettega - and Pistoia 2010, 7 for the difference.

[50] Jägerschmid 1828; Scheifele 1988; Konold - Suchomel - Hugelmann 2019/2020. In Gernsbach, the logs were assembled into rafts and dispatched to the Rhine, and then to Holland.

[51] Jägerschmid 1800, 81-84; Scheifele 1988, 281. Therefore, the water flow rate was at least 0.46 m^3/s.

[52] Jägerschmid 1800, 93-97; Scheifele 1988, 282. Neither the capacity of the reservoir nor the width of the outlets is specified. The 30-60 minutes allegedly required for emptying seem too long for outlets of *c.*11 m^2 (deducible from the scale drawing, Jägerschmid 1800, Tab. III Fig. 1) and a reservoir of 20,000/25,000 m^3 (this was the estimated capacity of the *Schwallung* when she was rebuilt in stone: Scheifele 1988, 282). Furthermore, Jägerschmid 1828, 2,128-129 is mistaken in inferring an average outflow of only 168 cubic feet per second from 56-square-foot openings at the bottom of a 30-foot-high barrage holding 5,810,600 cubic feet. That flow rate would only be achieved when the water had fallen to the level of the outlets, that is, when almost all the water had drained away. The barrage would empty in two hours, 27 minutes and 34 seconds.

[53] Konold - Suchomel - Hugelmann 2019/2020, 45.

[54] Asche - Bettega - Pistoia 2010; Occhi 2020. A similar technique may have been used

mated capacity of the *stue* in the Carnic Alps varies from 400 to 40,000/50,000 m^3. Built of wood, stone, and moss, these sluices featured two outlets that allowed the water to flow at the right time. The largest among them, the *stua* of Ramàz, exhibited dimensions of 2 meters at the base and 25 meters at the top, with a height of 12 meters and an estimated capacity of 40,000/50,000 m^3. This remarkable sluice filled in less than an hour during April and May when the natural siphons that replenished its reservoir reached peak flow rates[55]. In those weeks, the *stua* could undergo ten daily filling and emptying cycles[56]. Upon opening the two doors (the primary one measuring 4 x 4 m and the secondary one 1.5 x 1.5 m), the water collected at a 12-meter height near the barrier would have surged out at an impressive rate of almost 280 m^3 per second (Fig. 6). Gradually decreasing from this peak (Fig. 7), the 40,000 m^3 collected and the purported additional inflow of 11 m^3 per second would have completely discharged in just five minutes and 11 seconds[57].

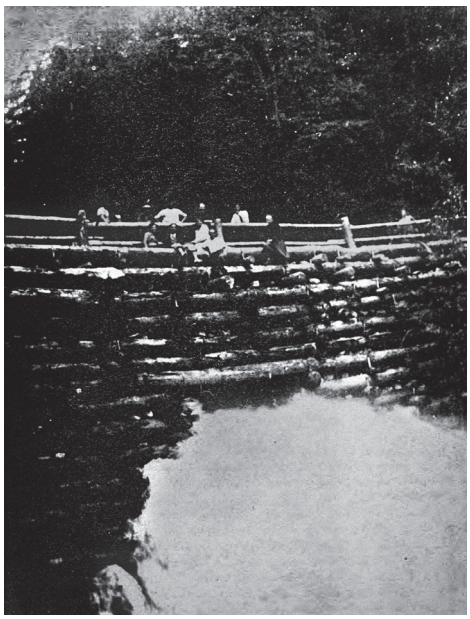

Fig. 6 – The *stua* of Ramàz at the beginning of its opening (from Fabbroni Grillo1977)

Fig. 7 – The stua of Ramàz at the end of its opening (from Fabbroni Grillo1977)

in Vitruvius' time to drag larch logs into navigable waterways for export to the Po Valley and coastal Hadriatic towns (Vitr. II 9,14).

[55] Cf. Fabbroni Grillo 1977, 142.

[56] Screm n.d. 10.

[57] As reckoned by Prof. Stefano Masini.

A conspicuous contrast emerges between the eight days required to fill Pliny's *piscinae* on the Tiber, Tinia, and Clanis, and the one to twenty-four hours needed by modern *stue* and *Schwallungen*. Maintaining the clause *si non adiuvent imbres* in the position designated by the manuscripts compels us to posit a significant disproportion between the capacity of the *piscinae* and the flow rate of the rivers that filled them. A filling duration of eight rainless days suggests either reservoirs of hundreds of thousands, if not millions, of cubic meters or watercourses with an exceedingly low flow rate, making it improbable for the transportation of loose logs over a considerable distance.

Ahell flow rate of only 0.3 m^3/s (the estimated average flow rate of the Tiber, 9 km from its sources, from May to September) over eight days results in an accumulation of 207,360 m^3, while a flow rate of 1.05 m^3/s (the estimated average from October to April) produces an accumulation of 725,760 m^3[58]. Even if the resulting water mass were to be divided into several *piscinae*, too many would be needed to obtain reservoirs comparable in size to modern *Schwallungen* and *stue*. We then have a third argument against accepting Pliny's passage as it is in the manuscripts.

7. *Nundinal floating*

The rationale behind placing *si non adiuvent imbres* before *longe meabilis fertur* and the grounds for removing it from after *novenorum ita conceptu dierum* mutually reinforce each other, but upon moving *si non adiuvent imbres*, a question arises: why did Pliny's *piscinae* necessitate precisely eight days of collection (*conceptus*) despite the capricious flow rate? To unravel this puzzle, we must posit a daily controlled storage system. The sluices, it seems, retained only one-eighth of their total capacity each day, allowing the remaining water to flow unrestricted. By storing merely one-eighth of the total capacity each day, the reservoirs would reach their total capacity precisely on the ninth day. In this way, we can imagine a capacity comparable to that of the modern *Schwallungen* and *stue*.

Yet, why impose a nundinal cycle if the reservoirs could be filled much more swiftly? It appears unlikely that the openings of the pools were synchronised with local market days to facilitate river transport of goods[59]. It is impossible to navigate safely when tens of thousands of cubic meters of water are swiftly released, drag-

[58] The surface and capacity of the *tris lacus amoenitate nobiles* (Plin. *nat*.III 109) or *Simbruina stagna* (Tac. *ann.* XIV 22) have been estimated at 36,000 m^2 and 540,000 m^3 respectively by Quilici 1997, 136.

[59] Le Gall 1953, 124; Quilici 1986, 215.

ging hundreds of beams in their current. The effect of these openings should have been akin to what nineteenth-century visitors to the Baden-Baden thermal baths admired on the Schwarzenbach (Fig. 8)[60]. There can be no doubt that when Pliny wrote that Tiber's initial stretch was only 'navigable' by beams, and when water was released from the sluices, he meant that it could only be used for floating loose logs.

Sailing may also have been unsafe along the Tinia and Clanis, where *rates* were allowed to float. The response given by Neratius Priscus concerning a *ratis* dragged by the *vis fluminis* onto the property of a plaintiff was probably prompted by one of the recurrent rafting accidents[61].

So, why implement controlled water collection? And why specifically adhere to a nundinal schedule? In sixteenth-century Baden-Württemberg, the rationale of restricting floating activities to Mondays, Fridays, and Saturdays was to avoid excessive disruption to the operation of watermills and meadow irrigation[62]. On the Tiber, Tinia, and Clanis, the intentional gradual pace of water collection may have been designed to prevent the downstream water level from dropping too low[63]. Since the flow rate was uneven, to a certain extent, also in winter and spring, a complete suspension of water flow for a day or so could adversely impact the continuity of navigation. In any case, it is evident that regulating the timber industry in the upper Tiber valley was essential to ensure that other activities were only moderately affected. This equilibrium was maintained by allowing the sluices to retain only one-eighth of the dam's capacity each day and to open only once in a nundinal cycle.

Besides, the synchronisation of the sluice openings with the nundinal cycle might have offered an additional advantage. The sudden, substantial release of water and beams could potentially cause damage to banks, bridges, and property downstream. Furthermore, it could pose a threat to people or animals near the river if it occurred unexpectedly. In nineteenth-century Carnia, the days and times of *stue* openings were communicated to communities on Sundays in church[64]. If downstream community members knew that the sluices would open, for example, at 9:00 a.m. on day A of the nundinal cycle, they would know without further warning when to stay away from the riverbanks so as not to be caught off guard by the downstream flow of water and beams.

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[60] The caption reads: «Schwallung im Obern Murgthal» and attributes the work to C. Roux; Scheifele 1988, 278 attributes the lithograph to J.W.Chr.Roux and explains the image with «Trift auf dem Schwarzenbach am 'Unteren Fall'».

[61] Dig. X 4,5,4; XXXIX 2,9,3; XXXXVII 9,8,pr., on which see Marrone 2001.

[62] Konold - Suchomel - Hugelmann 2019-2020, 44s.

[63] The *curatores alvei Tiberis* had «to look after the river, so that it […] should maintain as even a flow as possible all the time» (Cass. Dio LVII 14,8).

[64] Arboit 1871, 72-3.

Fig. 8 – Lithography of C. Roux (courtesy of Landesarchiv Baden-Württenberg).

8. *Conclusions*

Pliny the Younger's reference to the navigability of the Tiber from just upstream Tifernum Tiberinum, the modern measurements of the river's flow at the S. Lucia, Ponte Felcino, and Ponte Nuovo stations, the distributive *novenorum*, and the functioning of the *piscinae* that made sections of the Tiber, the Clanis, and the Tinia navigable for *trabes* and *rates*, all lead us to reposition the clause *si non adiuvent imbres* from after *dierum* to after *ratibus*.

Therefore, Plin. *nat.* III 53-55 should read as follows:

> Tiberis, antea Thybris appellatus et prius Albula, e media fere longitudine Appennini finibus Arretinorum profluit, tenuis primo nec nisi piscinis corrivatus emissusque navigabilis, sicuti Ti<n>ia et <C>lanis influentes in eum, novenorum ita conceptu dierum ** (sed Tiberis propter aspera et confragosa ne sic quidem, praeterquam trabibus verius quam ratibus). <si non adiuvent imbres>, longe meabilis fertur, per CL[65] (milia) p. non procul Tiferno Perusiaque et Ocriculo Etruriam ab Umbris ac Sabinis, mox citra XVI (milia) p. urbis Veientem agrum a Crustumino, dein Fidenatem Latinumque a Vaticano dirimens. sed infra Arretinum Clanim duobus et quadraginta fluviis auctus, praecipuis autem Nare et Aniene, qui et ipse navigabilis Latium includit a tergo, nec minus tamen aquis ac tot fontibus in urbem perductis, et ideo quamlibet magnarum navium ex Italo mari capax rerum in toto orbe nascentium mercator placidissimus, pluribus prope solus quam ceteri in omnibus terris amnes accolitur aspiciturque villis.

And this is my translation:

> The Tiber, formerly called Thybris and before that Albula, springs from about the centre in longitude of the Apennines, in the territory of Arretium. It is small at the beginning and not navigable if not retained and released by *piscinae,* as well as the Tinia and the Clanis its tributaries, with the collection of nine days each time (but because of its steep and bumpy course, the Tiber not even so, if not with beams rather than rafts). If rains do not help, it flows fordable for a long distance, dividing, not far from Tifernum, Perusia, and Ocriculum, Etruria from Umbria and the Sabines for 150 (?) miles, then, at less than 16 miles upstream of Rome, the land of Veii from that of Crustumium, then that of Fidenae and Latium from that of the Vatican. But downstream of the confluence with the Arretine Clanis, increased by forty-two rivers - the main ones are the Nera and the Anio, which, also nav-

[65] Cf. Plin. *epist*. X 8,6 *neque enim angustius tempus praefinire possum, cum et municipium et agri, de quibus loquor, sint ultra centensimum et quinquagensimum lapidem*.

igable, closes Latium from behind - and not less by the waters and springs conveyed to Rome, it can accommodate Italic Sea ships of any size. A placid merchant of things that are born all over the world, the Tiber is bordered and looked upon, he alone, by almost more villas than all the other rivers on Earth.

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