



Metrological Notes

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METROLOGICAL NOTES.

I.—THE ORIGIN OF THE STADION.

IN a former paper in the *Journal of Hellenic Studies* I endeavoured to show that the primitive Hellenic unit of land measure was the γύης or *plough-land*, which was the portion of land lying between landmarks (οὔρα), being the amount which a pair of oxen (or mules) could plough in a day, the length of the furrow being a fixed quantity. Whilst I was able to point out some data for estimating the *breadth* of the piece, I was unable to throw any light on its *length*, or in other words on the *length* of the furrow.

The object of this paper is to inquire if we have the means of arriving at any solution of the question, based on fairly probable grounds. The scholia on the word πεντηκοντόγουν (cf. Ebeling, *sub voc.*) are as follows: πεντήκοντα πλέθρων, οἱ δὲ πεντήκοντα ζευγῶν. γύης μέτρον γῆς μικρῷ τῶν δέκα ὀργυῶν ἔλασσον. ἡ ζύγον, ἡ πλέθρον ἡ ἐκατὸν ποδῶν· παρ' ἑτέροις δὲ ἐξήκοντα πηχῶν.

On the other hand the scholiast on *Odyssey* vii. 113 says: ὁ δὲ γύης δύο στάδια ἔχει.

Now in the first group of scholia it is evident that the explanations of γύης by πλέθρον, ζύγον, and ζεύγος are all equivalent. The ζύγον and ζεύγος mean a day's ploughing of a yoke of oxen (answering to Lat. *iugum*). The *plethrum* probably varied as the *acre* varied in extent in different parts of England. Of this we have a clear indication in *Il.* xxiii. 164, πυρὴν ἐκατόμποδον ἔνθα καὶ ἔνθα. From this we may infer both that πλέθρον was neither 100 feet square, nor even 100 feet in length. Square measure is still unknown, and ἐκατόμποδον probably differs from πλέθρον. But the statement that the γύης is a *little less than 10 fathoms* is of the utmost importance. This has all the appearance of being no mere guess on the part of a scholiast, who explains off-hand the γύης by the ordinary land measure of his own day. Furthermore the extent is given in ὀργυαί, a measure which is used in Homer to express short lengths—of timber, rope (*Il.* xxiv. 327, *Od.* x. 167), whilst we do not find ποῦς so used except in the compound ἐκατόμποδος (*Il.* xxiii. 164). This latter circumstance would indicate that the scholiast is giving us a traditional interpretation, not merely one evolved from his own inner consciousness. If we regard this as the most probable statement, it follows that the breadth of the γύης was a little less than 60 Greek feet, as Greek feet were in the time of the scholiast.

But when we come to the scholion on *Od.* vii. 113 (ὁ δὲ γύης δύο στάδια ἔχει) we are met by an apparently hopeless difficulty. The stadion invariably consisted of 600 feet, even though the feet differed in size in different times and places.

Dr. Hultsch (*Metrologie*², 41) tries to escape from this by taking the stadion here as a measure of area, equal to six square plethra, that is, a strip of land 100 feet broad, and 600 feet long. The γύης would therefore be 200 feet broad, and 600 feet long. This suggestion is at once open to the objection that the stadion is otherwise unknown as a land measure on Greek soil (Hultsch, *Metrol. Script.* I. 28). Again whilst the scholia variously explain γύης as πλέθρον (= 100 feet), 60 πήχεις (= 100 feet), yet none of these measures are more than half the breadth of the γύης as assumed by Hultsch. There is finally a fatal objection, admitting that γύης means a day's work of a plough, inasmuch as the piece assumed by Hultsch (200 × 600 = 120000 feet) is nearly three times the size of the English acre (66 × 660 = 43560 feet), which we know as an established fact to be a day's work for a plough. Hultsch assumes from *Od.* xviii. 371-4 that a piece of ground containing four γύαι (τετράγνον) represented the day's work with a pair of oxen of a sturdy ploughman. But this view is not supported by the passage. In the lines immediately preceding, Odysseus challenges Eurymachos to a contest of endurance,

ὥρη ἐν εἰαρινῇ, ὅτε τ' ἤματα μακρὰ πέλονται,
ἐν ποίῃ, δρέπανον μὲν ἐγὼν εὐκαμπὲς ἔχοιμι,
καὶ δὲ σὺ τοίου ἔχοις, ἵνα πειρησαίμεθα ἔργον,
νῆστιες ἄχρι μύλα κνέφαος, ποίῃ δὲ παρείῃ.
εἰ δ' αὖ καὶ βόες εἶεν ἐλαυνέμεν, οὔπερ ἄριστοι,
αἰθῶνες, μεγάλοι, ἄμφω κεκορηότε ποίης,
ἥλικες, ἰσοφόροι, τῶν τε σθένος οὐκ ἀλαπαδνόν,
τετράγνον δ' εἴη, εἴκοι δ' ὑπὸ βῶλος ἀρότρῳ,
τῷ κέ μ' ἴδοις, εἰ ὄλκα διηνεκέα προταμοίμην.

If we regard the ploughing match as a test of *endurance*, the conditions of the first part probably apply to the second part of the challenge. Eurymachos will likewise have a pair of oxen. They will therefore have two γύαι each. But the conditions are, that it is to take place in the season of spring when the days are long, without stop for meals until dark night. The cattle are to be prime. Hence one γύης would not suffice, as all such 'acre-pieces' represent an easy leisurely day's work.

But there is an alternative explanation more simple still, and that is that there is no reference at all in the passage to the extent of work to be done in a day, but it is simply his *skill* as a ploughman which he vaunts. He says: give me good oxen, well matched, well fed, drawing evenly, not in jerks, and you will see the straight unbroken furrow which I will open up. The term τετράγνον is only used as a general expression for a piece of ground in a chief's Temenos, just as the orchard of Alcinous is of the same extent

First now let us ask ourselves why the term *stadion*, which is especially reserved for measures of distance, should be brought into relation with γύης, the unit of area. Some light is thrown on this subject as soon as we find that the stadion was anciently known as αῦλος, and when we recall that the double stadion (διστάδιον) was regularly known in historical times as δίαυλος. The *Etymologicum Magnum*, s.v. στάδιον, says στάδιον κατὰ τὸ ἄρχαιον ἐκαλεῖτο αῦλος, and Suidas, s.v. αῦλος, gives one of its meanings as μέτρον. Next comes the question, what is this αῦλος? It can hardly be αῦλος = pipe or flute (from which Liddell and Scott and Pape derive δίαυλος). The compiler of the *Etymologicum Magnum* himself, although in great straits for a derivation, keeps clear of αῦλος = pipe, for after the words already quoted he proceeds thus: ὅθεν δίαυλος, τὰ δύο στάδια, ἀπὸ τοῦ δύο αὐλώνας ἔχειν. καλεῖται δὲ, ὅτι φασὶ Δάναον ἐπὶ τοῖς γάμοις τῶν θυγατέρων ἀγῶνα ἐπιτελοῦντα δεῖξαι τοῖς μνηστῆρσι τὸ τοῦ δρόμου τέρμα ἐν ᾧ ἐπεφύκει σέλινά ἐξ ὧν σπάσαι τὸν φθάσαντα καὶ τοῦτο σύμβολον γενέσθαι τῆς νίκης, ὥσπερ νῦν τὰ βραβεῖα· ἀπὸ δὲ τοῦ σπάσαι κληθῆναι σπάδιον καὶ στάδιον. ἡ ὅτι τετραποδιστὶ τὸ πάλαι περιπατοῦντες, μετὰ τὸ εὐρεθῆναι τὸν Δημητριάκον καρπὸν ἀνέστησαν, εὐρωστίας ἐπίδειξιν ποιούμενοι δρόμον ἡγωνίζοντο· διὰ τὴν στάσιν οὖν στάδιον.

There are several points worth noticing in this extract. First, δίαυλος is derived not from αῦλος, but from αὐλών, which of course is impossible. Next let us remark that the invention of the στάδιον is in no way connected with Olympia. Danaos has nothing to do with Elis in any form of the legend. Lastly we find the stadium connected with the first cultivation of corn. What if this last connection were to contain the truth, although in a somewhat disguised form?

Let us now take a passage from Pausanias (v. 17, 6), where he employs the term δίαυλος to explain a phrase, the precise meaning of which we perfectly understand. Pausanias in describing the archaic inscription on the chest of Cypselus, says: σχήματα ἄλλα τῶν γραμμάτων βουστροφηδὸν καλοῦσιν Ἕλληνες· τὸ δὲ ἐστὶ τοιόνδε· ἀπὸ τοῦ πέρατος τοῦ ἔπους ἐπιστρέφει τῶν ἐπῶν τὸ δεύτερον ὥσπερ ἐν διαύλῳ (al. διαύλου) δρόμῳ. Bustrophedon of course is a metaphor from ploughing, the oxen turning back when they reach the end of the field, and returning to the headland (τέλσον ἀρούρης). In such fashion did the oxen plough a double furrow in the short intervals between the refreshment of the ploughmen in the scene on the Shield (Il. xviii. 541):

πολλοὶ δ' ἄροτῆρες ἐν αὐτῇ
 ζεύγεα δινεύοντες ἐλάστρεον ἔνθα καὶ ἔνθα.
 οἱ δ' ὅποτε στρέψαντες ἰκοῖατο τέλσον ἀρούρης,
 τοῖσι δ' ἔπειτ' ἐν χερσὶ δέπας μελήδεος οἶνον
 δόσκειν ἀνὴρ ἐπιών· τοὶ δὲ στρέφασκον ἀν' ὄγμους
 ἰέμενοι νειοῖο βαθείης τέλσον¹ ἰκέσθαι.

¹ Hesychius explains τέλση (a byform of τέλσον) by τὰς στροφὰς (sc. τῶν βοῶν). Cf. Germ. Anwänder.

It is this *βουστροφηδόν* process which Pausanias explains by *ἐπιστρέφει* (—*στροφηδόν*) and *δίαυλος δρόμος*. Has Pausanias a feeling that *δίαυλος* means not merely a racecourse but also a double furrow? If *δίαυλος* were not accompanied by *δρόμος* in the passage, we would have no hesitation in saying that he used it simply in the sense of double furrow. But the reading varies between *ἐν διαύλου δρόμῳ* and *ἐν διαύλῳ δρόμῳ*. Was the original reading *ἐν διαύλου δρόμῳ* altered into the common *δίαυλος δρόμος*? *ἐν δίαυλου δρόμῳ* would mean in a course of a double furrow, the descriptive genitive being emphatic in relation to *βουστροφηδόν*.

Did then the word *αὔλος* really represent *αὔλαξ* in ancient usage, supplanted and forgotten in this sense save in *αὔλος* = *μέτρον*, and *στάδιον*, and *διαύλος*? In that case *αὔλαξ* : *αὔλος* = *λίθαξ* : *λίθος*, *βῶλαξ* : *βῶλος*. *Αὔλος* seems to be an old word meaning any kind of groove or track, or furrow, from which were derived by differentiating suffixes the distinctive forms *αὔλῳν*, a large groove, valley, and *αὔλαξ* (*ὥλξ*), a small groove, especially of the plough, although used sometimes in a wider way, *e.g.* Aretaeus (i. 70, 42) says: *ἀτὰρ καὶ ἐντομαὶ βαθεῖαι, ὁκοῖον αὔλακες μέλανες, τῶν ῥινῶν*. This passage makes clear the use of *δίαυλοι* in Oppian (2, 101) to describe the nostrils, and shows that we need not even here derive *δίαυλος* from *αὔλος*, a flute. The scholiast on Pindar (*Pyth.* iv. 105) says: *αὔλακες... παρὰ τὸν αὔλον· πᾶν γὰρ ἐπίμηκες οὕτως εἴρηται*. Again Eustathius explains *αὔλαξ* as *διὰ τὸ στενοεπίμηκες ἐκ τοῦ αὔλου παρωνόμασθαι*. These references show at all events the close connection in the Greek mind between *αὔλος* and *αὔλαξ*. Finally it is worth noticing (although he is a late writer) that Heliodorus (*Aethiopica*, I. 29) uses *αὔλακες* of the passages of a cavern, showing that *αὔλαξ* could be used as equivalent to *αὔλος* even in the sense of pipe, or cylinder, and not merely as a groove. But there are some other considerations to influence us in favour of this explanation of *αὔλος* = *στάδιον*.

Now the Dorians used a form *σπάδιον*, with which there can be little doubt the Latin *spatium* is connected. Some have made efforts to identify etymologically *στάδιον* and *σπάδιον*, but as this can only be done by postulating a form *σκαδ-*, and as the evidence in favour of the connection of *στάδιον* with *ἵστημι* (STA) is overwhelming, the effort is fruitless. Scholars now, as did the compiler of the *Etymologicum Magnum* above, connect it with *σπάω*. *σπάδιον* is probably older in use than *στάδιον*: for if *σπάδιον* and *spatium* are cognates, not derived the one from the other, they evidently form part of the common stock of an earlier period. If on the other hand *spatium* is a loan-word borrowed from the language of the Greek race-course in later times, we would have had a form from *στάδιον* rather than from *σπάδιον*. Are we justified in saying that *σπάδιον* is older in Greek than *στάδιον*, which eventually supplanted it? Its explanation is not far to seek if we recognize that its equivalent *αὔλος* simply means the standard furlong (furrow-long). *σπάδιον* is a derivative from *σπάω*, 'to draw,' and probably means the space covered in a single draught of the plough. With this we may compare the Latin *actus*, the distance which the oxen were driven at a single stretch

(Columella, v. 1). Did then the term *στάδιον* come into use to express the regular *standard* distance, just as *στατήρ*, another derivative of *ἴστημι*, became the name for the standard weight unit?

We have now got a natural unit of length developed out of the Greek land system, just as our own furlong has originated. It is hard to imagine a more simple origin for the space employed in the athletic contests of early days. To run the length of the ordinary field furrow would form the simplest kind of race contest, and such still survives in our own customary race of 220 yards, the old English furrow-long. If double the distance was required, let the athletes double round the landmark (*νύσσα*, *οὔρον*, *meta*) at the end of the *γῆης* strip, and run back down the other side of the balk (*limes*, *οὔρα*). But have we any facts to support this suggestion? We turn naturally to the games in Homer. In *Iliad*, xxiii. 327 *seqq.*, Nestor, while giving his son Antilochus 'the straight tip' for the race, describes the course appointed by Achilles:

ἔσθηκε ξύλον αὖτον, ὅσον τ' ὀργυί' ὑπὲρ αἴης
 ἢ δρυὸς ἢ πέυκης. τὸ μὲν οὐ καταπύθεται ὄμβρῳ,
 λᾶε δὲ τοῦ ἐκάτερθεν ἐρηρέδαται δύο λευκῶ
 ἐν ξυνοχῇσιν ὁδοῦ, λείος δ' ἱππόδρομος ἀμφίς·
 ἢ τευ σῆμα βροτοῖο πᾶλαι κατατεθνηῶτος
 ἢ τόγε νύσσα τέτυκτο ἐπὶ προτέρων ἀνθρώπων,
 καὶ νῦν τέρματ' ἔθηκε ποδάρκης δῖος Ἀχιλλεύς.

The *τέρματα* then are either the grave-mark of some hero, or a *νύσσα* in the days of men of old time. The Lexicons take *νύσσα* as equivalent to *goal*, and it is compared with *meta*. Just as *meta* originally meant *landmark*, so too *νύσσα*. But in the case of the latter there is no evidence that it ever had the technical sense of *goal*. Certainly there is no trace of it at Olympia. The starting-point is *ἄφesis* or *βαλβίς*, the turning-post *καμπτήρ*. The *νύσσα* here must simply mean a *landmark* in days of yore, when that part of the plain was in cultivation. That such stones lay on the plain we know positively from *Il.* xxi. 404, where Pallas Athene smites Ares with a stone which she found:

κείμενον ἐν πεδίῳ, μέλανα τρήχυν τε μέγαν τε
 τὸν ῥ' ἄνδρες πρότεροι θέσαν ἔμμεναι οὔρον ἀρούρης.

Of like nature was probably the *τέρμα* selected by Achilleus. It is important likewise to notice that *νύσσα* is used, just like *σῆμα*, to describe the *τέρμα*, which represents the technical word for *goal*. In like manner in the legend quoted already, Danaos points out to the suitors the spot where the parsley grew as *τὸ τοῦ δρόμου τέρμα*.

If my development of the racecourse out of the Greek land system is right, it affords a curious parallel to the origin of our own cricket crease of twenty-two yards long, that is, a chain, four rods, the breadth of the acre between the balks in the common field.

Let us next examine the stadion at Olympia in historical times, and see

if it can throw any light on its own origin. Pausanias (vi. 20, 8) says: τὸ μὲν στάδιον γῆς χώμά ἐστι, πεποιήται δὲ ἐν αὐτῷ καθέδρα τοῖς τιθεῖσι τὸν ἀγῶνα. Again he says (ix. 23, 1): Θηβαίοις δὲ πρὸ τῶν πυλῶν ἐστὶ τῶν Προιτίδων καὶ τὸ Ἰολάου καλούμενον γυμνάσιον, καὶ στάδιον κατὰ τὰντὰ τῷ τε ἐν Ὀλυμπίᾳ καὶ τῷ Ἐπιδαυρίῳ γῆς χώμα. From these two passages we learn that not only at Olympia, but also at other places the stadion was not the actual running-path, but a bank of earth alongside of which they ran. Is it going too far to conjecture that this bank represented the balk (*οὔρον*, *limes*) of the γύης strip?

At this point it will be convenient to review our results, and define clearly the position of the stadion in relation to the Greek land system. We have arrived at the conclusion that it is probable that the stadion, anciently called the αἶλος, was only the length of the furrow in the ordinary field. The stadion always contained 600 feet, whether the foot unit varied or not in size. We saw above likewise reason for believing that the breadth of the γύης was about 60 feet. Hence the γύης or acre was a strip ten times as long as it was broad. Now to this we get curious parallels in the English and Irish acres. The former is 660 feet long, 66 broad, the latter 840 feet long, 84 feet broad. The shape is the same in each. It would seem that in this custom of making the plough-land ten times as long as it is broad we have a very ancient Indo-European institution. But the exact words of the scholiast respecting the breadth of the Homeric γύης are μικρῷ ἔλασσον τῶν δέκα ὀργυιῶν, a little less than 60 feet. Now the scholiast without doubt reckons by the standard foot of his own time, which almost certainly was the common Greek and Roman foot of .297 metre. If at an earlier period a foot of slightly smaller size had been in use, this would account for the form in which the scholiast has stated the breadth of the γύης. Besides the common Greek foot of .297, there was without doubt the Olympic foot of .325, by which the stadion of Olympia was measured, and which tradition declared to be the foot of Herakles himself (Aulus Gellius, i. 1). This has been verified very exactly by the excavations of Adler and Dörpfeld at Olympia. Many circumstances point to the probability that the metric system of Olympia was imported from the East at a comparatively late period. The worship of Herakles everywhere indicated connection with the Orient, and the ascription to him of the founding of the games at Pisa may well point in the same direction. Furthermore the very close agreement between the Olympic foot and that which Lepsius (*Langenmasse*, p. 72) calls the small Assyrian foot of .31968 is so close that we can hardly doubt the connection. But we want a foot smaller, rather than larger, than the common Greek and Roman foot of .297. Now there was a very ancient foot of .277 retained in use in Italy among the Oscans and Umbrians, and even in Rome. Was it this foot which formed the smaller unit of the Homeric system? Ten orgyiae, each of six feet of .277, would explain perfectly the way in which the scholiast describes the breadth of the γύης.¹ So now when

¹ I owe this suggestion to Mr. F. Seebohm.

we compare the γῶγς to the English acre, we must remember that probably the Greek acre consisted of 600×60 feet of $\cdot 277$, whilst the English = 660×66 feet of $\cdot 301$. We can now get a rational explanation of the words of the scholiast, ὁ γῶγς ἔχει δύο στάδια. The γῶγς is an oblong patch of ground, forming a parallelogram. It has two short sides, two *plethra*, and two long sides, two *stadia*. The scholiast expresses himself thus because he wants to explain this archaic shape of the land unit to an age which knew only the square plethron.

Finally now let us bear in mind that if the Greek stadion is simply the ancient furrow-length, we are brought back to so early an epoch for its institution that we may set at rest all theories of the importation of the *stadium* from the East. Here then is the place to notice the only theories of the origin of this measure which are as yet in the field. Brandis (*Münz-Mass- und Gewichtswesen*, p. 20) holds that the Babylonians determined the length of an hour of equinoctial time by the waterclock; in one hour the sun traversed a portion of the sky thirty times his own diameter, therefore every two minutes a portion equal to his apparent diameter. With this they equated the distance which 'ein tüchtiger Fussgänger in derselben Zeit auf der Erde aufmachen kann.' The stadion therefore is the distance traversed by an active walker in two minutes. Hultsch (*Metrologie*², p. 33) adopts the same doctrine. Lepsius (*Langenmasse*, p. 33) on the other hand makes the Greeks to have borrowed their long measures from Egypt. Yet all these authorities agree in making the parts of the human body the basis of all the smaller units of length, the finger, the palm, the span, the foot, the ell. Why should one people have to borrow standards of measure which they themselves carried likewise about with them? But if there was no need to borrow the smaller units, why was it necessary for them to borrow the longer ones, such as the *plethrum* and the *stadium*? In the case of the former the authorities themselves admit its connection with the unit of land measure, the day's ploughing. There is then only left the *stadion*. Is it rational to declare it an alien imported into Hellas? But if the stadion is nothing else than the furrow, the question is settled. For every schoolboy now knows that the Aryans, whether they came from Finland or from the Hindu Kush, had the plough and knew its use before their separation. It will be therefore absurd to regard as imported from the East, and as based on the sun's equinoctial course, a measure intimately connected with an art possessed by the Aryans themselves from the earliest times. The agreement between the Greek, Babylonian, Egyptian, and Hebrew stadion may be easily explained by the fact that over these countries agriculture was carried on in very like conditions, and consequently measures based on it would exhibit considerable uniformity. Doubtless in later times under the influence of mathematical science certain alterations would arise, as standards of greater precision were required. Improvements in the art of agriculture would likewise modify the length of the furrow. With an improved plough men ploughed deeper, and consequently it was necessary either to shorten the distance traversed at each draught, or to increase the number of oxen. The

latter was the case in England, the former seems to have been the case in Italy, as we may infer from Columella, ii. 2, 27: Sed nec in media parte uersurae consistat (arator) detque requiem (bubus) in summa, ut spe cessandi totum spatium bos agilius enitatur. Sulcum autem ducere longiorem quam pedum centumuiginti, contrarium pecori est; quoniam plus aequo fatigatur ubi hunc modum excessit. Evidently in some places still the furrow was longer. That however the *actus quadratus*, or square patch, each of the sides of which were 120 feet, was of late introduction is shown by Columella, v. 1, 5: *Actus minimus* (ut ait M. Varro) latitudinis pedes quattuor, longitudinis habet pedes cxx. *Clima* quoque uersus pedum est lx. *Actus* quadratus undique finitur pedibus cxx. Hoc duplicatum facit *iugerum*, et ab eo, quod erat iunctum, nomen iugeri usurpauit. Sed hunc actum prouinciae Baeticae rustici *acnuam* uocant: eidemque triginta pedum latitudinem et clxxx longitudinem *porcam* dicunt.....*Stadium* deinde habet passus cxxv, id est pedes Dcxxv, quae mensura octies multiplicata efficit mille passus, sic veniunt quinque millia pedum. In conjunction with this passage let us read the following extract from Varro (*R.R.* i. 10, 1): Modos, quibus meterentur rura, alius alios constituit. Nam in Hispania ulteriore metiuntur iugis, in Campania uersibus, apud nos in agro Romano ac Latino iugeris. Iugum uocant, quod iuncti uno die exarare possint. Versum dicunt centum pedes quoquo uersum quadratum. Iugerum quod quadratos duos actus habeat. Actus quadratus qui et latus est pedes cxx, et longus totidem: is modus acnua Latine appellatur.¹

First we learn from a comparison of these quotations that the rustics of the Province of Baetica, who called the *actus acnua* were not the native Spaniards, but the colonists from Italy. Secondly as Baetica and Hispania ulterior indicate the same region, we may infer likewise that those inhabitants of Further Spain who measured by the *iugum*, or day's work of the yoke of oxen, were likewise settlers from Italy. These colonists therefore had brought with them an ancient measure, different from the *iugerum*. It is important to observe that neither Varro nor Columella connect *iugerum* with a day's ploughing. Perhaps Columella is right and it only means a pair of *actus*. But the point to which I want to call especial attention is that we have here plain evidence that the Roman land unit had been originally not square, but oblong. The *porca* of Baetica, 30 feet by 180 feet, evidences this, and likewise proves that the coloni had brought from home with them a customary measure 60 feet longer than the *actus*. It is reasonable to infer that the *porca* was older than the *actus*, and this lends good support to my hypothesis of the gradual shortening of the length of the furrow, until at last the length of the *actus* (headland) of 120 feet was reached, which became the basis of the square measure of the Roman *gromatici*. Having thus seen the history of the Roman unit of 120 feet square, we may not unreasonably

¹ The *actus minimus* is the headland (iter inter vicinos). The Gaulish *arepennis* (Fr. *arpent*) is identified in size with the *actus quadratus* by Columella. It too probably originally meant

headland (*ara-penn*). The Irish *air-cenn* (Gaelic *cenn* = head = Gaelic *penn*) means both the headland and a piece of ground.

assume a somewhat similar development for the Greek unit of 100 feet square—the *plethron*, and also for the Oscan *versus*, namely that it arose from a land unit of larger extent, and oblong in shape, the breadth of which originally may have been about 60 feet, like the *clima* of Columella mentioned above. Finally it is worth observing that Columella evidently intends to bring the *stadium* and *mille passus*, which he gives as measures of *length* only, into immediate relationship with the *actus*, the unit of area, a tendency which is in favour of my attempt to connect the Greek *στάδιον* with the original land unit.

If this connection is real, we get two units of length derived from the original unit of area, first the *stadium*, or *αἶλος*, the length of the piece, secondly the *πλέθρον*, derived from the *breadth*, and which after having probably varied in amount finally became fixed at 100 feet.

To this we find an exact parallel in the case of the Yorkshire acre, which Mr. Seebohm has pointed out to me. Not only did the *length* of the acre give the *furlong*, but its *breadth* was likewise used as a measure of length called an acre.

Such then is my attempt to find a rational origin for the *stadiou*. We have got the *stadiou* beyond doubt identified with a term *αἶλος*, which cannot be *αἶλος* = pipe or flute, for Suidas says it is a *μέτρον*, and it would be ridiculous to suppose a measure of 600 feet derived from a flute. I have given some evidence to show the close connection of *αἶλος* with *αἶλαξ*, a furrow, and I have called to aid the comparative method, which has shown us that the shape and dimensions of the Greek *γῆς* would be thus in strict harmony with those of land units found elsewhere. I had not data to show the steps by which gradually the change of shape and extent took place from 600 × 60 to 100 feet square, but I was at least able to show from the Roman writers that a very analogous change from a larger oblong piece to a smaller square had taken place, and at the same time to point out that Columella evidently thought that there was a connection between the *actus* and the *stadium*, which he makes the eighth part of the Roman mile. I do not say that my thesis is proved, but I submit that the evidence brought into court establishes a probability, which I have little doubt will be considerably strengthened by further research, and which is far more rational than the theory that the Greeks borrowed from the East a standard unit calculated by the Chaldaeans from the sun's apparent diameter at the time of the equinox.

II. PECUS AND PECUNIA.

IN a late number of the *Journal of Hellenic Studies* the present writer endeavoured to show, (1) that in the Homeric poems the gold talanton simply represented the value of the ox or cow, a relation which remained at Delos down into historical times, and (2) that the actual value of both units was a gold daric, or gold Attic stater (two drachms) of 130-135 grains Troy; in fact

the standard on which all the gold coins, and a large proportion of the silver coins of Greek Proper were struck; and at the same time the basis of the standards of Asia Minor, Syria, and probably of Egypt. I then confined myself to the countries immediately bordering on the Aegean, and did not attempt to deal with the weight system of the Italian Peninsula. I propose in the present paper to examine the Roman system, and to seek for it, as I have tried for the others, a natural unit, by which I mean a metallic unit based on some older unit of barter.

Dr. Hultsch remarks (*Metrologie*², p. 151) that whilst the weight unit of the Roman pound is the most accurately known of all ancient standards, its origin on the other hand is the most obscure. The Roman libra weighed 327·45 grammes. Though it was adjusted at a later period to the Attic system, it plainly dated from a period long before Rome had come into contact with the culture of Athens. Hultsch thinks he finds the clue as follows. Athens used the Aeginetic standard down to Solon's time. The mina of this system weighed about 150 Solonian drachms (of 67·5 grains each). In antiquity (he says) each weight unit was able to evolve a new unit out of its own half. Such a smaller unit he supposes to have existed side by side with the larger and older Aeginetic mina. Accordingly the Roman libra, which is equal in weight to 75 of Solon's drachms, corresponds to this supposed light mina. In support of this conjecture we find traces of the heavy mina on Italian soil in Vitruvius and Dionysius of Halicarnassus, and in the older Etruscan monetary system. Hultsch then suggests that the Roman libra is the half of a Phoenician trade-mina, which had penetrated to Greece and Italy in early times, appearing in the former region as the so-called Aeginetic (655 grammes).

Hultsch shows (§ 19, 3) that gold being to silver as $12\frac{1}{2} : 1$, the small talent called the Sicilian or Macedonian, used exclusively for gold, and weighing six Attic drachms, is equivalent to a Roman pound of silver. The Aeginetan silver mina of 150 Attic drachms (more accurately 153) would be equivalent to 6 Attic gold staters (12 drachms) or 52·4 grammes. If then as in Etruria (§ 57, 9) silver was to copper as 288 : 1, this gold talent of 6 staters (of whose existence there is no trace) would have a corresponding copper talent of 3600 units, each of which was of like weight with the gold talent, and would have as its equivalent in silver a quarter obol. This then was the twelfth of the old Italian mina, *i.e.* the *uncia*, or small unit. Taking then instead of the heavy one of 655 grammes the light one of 327·5 grammes, that is, the Etruscan, Latin, and Roman pound, we find the pound of silver equivalent to three Attic gold staters, that is to the *known* small gold talent of Sicily and Magna Graecia. Since at Rome, prior to the reduction of the as (268-3 B.C.), the scrupulum of silver was the equivalent of the *as libralis* of copper, consequently the pound of silver, and small gold talent of 3 staters were equivalent to 288 *asses librales*. So far I have given a summary of Dr. Hultsch's excellent piece of work.

First let us divide 288 by 3, which will give us the value in copper of 1 Attic stater ($288 \div 3 = 96$). One Attic gold stater accordingly is worth

96 asses librales of copper. But the Attic stater is the Homeric talanton = ox.

Have we got any data for determining the value of the ox in Italy in early times, such as we employed for fixing its value in early Hellas? The Law known as Aternia Tarpeia dealt with questions of penalties; certain notices of it fortunately preserve for us most valuable material. Cicero (*De Rep.* ii. 35, 60) says: Gratam etiam illam legem quarto circiter et quinquagesimo post primos consules de multae sacramento Sp. Tarpeius et A. Aternius consules (A.U.C. 299) comitiis centuriatis tulerunt. To this same law Dionysius of Halicarnassus refers (x. 50): ἐπὶ τῆς λοχιτίδος ἐκκλησίας νόμον ἐκύρωσαν, ἵνα ταῖς ἀρχαῖς πάσαις ἐξῇ τοὺς ἀκοσμοῦντας ἢ παρανομοῦντας εἰς τὴν ἑαυτῶν ἐξουσίαν ζημιοῦν. τέως γὰρ οὐχ ἅπασι ἐξῇ, ἀλλὰ τοῖς ὑπάτοις μόνον. τὸ μέντοι τίμημα οὐκ ἐπ' αὐτοῖς τοῖς ζημιοῦσιν ὅποσον θεῖναι δοκεῖ κατέλιπον, ἀλλ' αὐτοὶ τὴν ἀξίαν ὥρισαν, μέγιστον ἀποδείξαντες ὅρον ζημίας δύο βόας καὶ τριάκοντα πρόβατα, καὶ οὗτος ὁ νόμος ἄχρι πολλοῦ διέμεινεν ὑπὸ Ῥωμαίων διαφυλαττόμενος.

Again Aulus Gellius (xi. 1, 2-3) has a curious notice: Coniectare autem ob eandem causam possumus, quod Italia tunc esset armentosissima, multam, quae appellatur suprema, institutam in singulos [dies] duarum ouium, triginta boum; pro copia scilicet boum, proque ouium penuria. Sed cum eiusmodi multa pecoris armentique a magistratibus dicta erat, adigebantur boues ouesque alias pretii parui, alias maioris. Eaque res faciebat inaequalem multae punctionem. Idcirco postea lege Aternia constituti sunt in oues singulas aeris deni, in boues aeris centeni. Minima autem multa est ouis unius. Suprema multa est eius numeri, cuius diximus: ultra quem multam dicere in singulos ius non est, et propterea suprema appellatur, id est, summa et maxima.

Festus, *sub voce* Peculatus (p. 206), says: Peculatus furtum publicum dici coeptus est a pecore, quia ab eo initium eius fraudis esse coepit, siquidem ante aes aut argentum signatum ob delicta poena grauissima erat duarum ouium et xxx bouum. Ea lege sanxerunt T. Menenius Lanatus, et P. Sestius Capitolinus cons. quae pecudes, postquam aere signato uti coepit P.R. Tarpeia lege cautum est, ut bos centussibus, ouis decussibus aestimaretur. Niebuhr considers that Dionysius and Cicero, who evidently mean that Aternius and Tarpeius fixed the number of animals, are right. C. Julius and P. Papirius (coss. 325 A.U.C.), to whose *aestimatio multarum* Livy refers (iv. 30) probably changed the penalties in cattle into money equivalents. Gellius and Festus have muddled their authorities. But the important thing for us is that both agree in giving the value of the ox at 100 asses. As the as was not reduced till long after, these 100 asses are *librales*. But we saw above that 1 Attic gold stater (= Homeric ox-unit) = 96 asses librales, according to Hulstsch's calculation of the relative values of the metals in Italy. The agreement in the value of the Italian ox (100 asses) with the value of the Homeric ox as calculated in Italian money (96 asses) is too close to be accidental.

It seems beyond doubt (cf. Hulstsch, p. 280) that the earlier we go back

the cheaper we find copper in relation to silver. Thus whilst in 263 B.C. silver is to copper as 250 : 1, in the fourth century B.C. it was as 288 : 1. It is not improbable that a little earlier (429 B.C.) the relation was 300 : 1, in which case the silver pound = 300 copper pounds. Therefore one gold stater ($\frac{1}{3}$ Sicilian talent) = 100 asses, which is the actual value of the ox in the Law of Julius and Papirius.

As in the case of the Greek ox-unit we gained from Draco's laws and the ritual of Delos the means of identifying it with the gold stater, so in this case likewise we owe the clue to legal conservatism.

The question next arises, was this gold unit (= the ox) brought by the Italic tribes into the peninsula, and may it thus be considered as identical in origin with the Greek unit of like value, or was it under Greek influences in Etruria and Magna Graecia brought directly from Greece, in which case the unit of barter, the ox, had been adjusted to the newly imported unit of metal, as we found (in my former article) had been the case in Ireland. Again, it might be urged by some that the Etruscans if they came from Asia Minor might have brought with them the light Babylonian shekel. If however on inquiry we find on Italian soil traces of a system entirely foreign not only to that of the Greeks, but also to that of Etruria in its earlier coinage, we shall have a strong presumption that such a system is indigenous, and therefore dates from a period prior to any influence from the East. Now in Sicily the original Sikel and Sikanian population began to coin money a little before 480 B.C. 'These coins are *Litrae*, weighing 13.5 grains, and were equal in value to the native copper libra, which the Sikels had brought with them from Italy when they first crossed the straits' (Head, *Historia Numorum*, p. 99). This pound (libra), which = $\frac{1}{1\frac{1}{2}0}$ of the Attic talent = 50 Attic drachms, had beside it a silver equivalent = $\frac{1}{5}$ drachm. Twenty-four Attic drachms therefore are equivalent to a copper talent. Had this talent likewise an equivalent in gold? The light Babylonian shekel at once suggests itself, that is the daric, or Attic gold stater. This would give the relation of gold to silver as 12 : 1, which is nearly the relation found in Italy (Hultsch, p. 665). Hultsch adduces also the tradition that the daric was used as a talent. He (*ibid.*) adds the further conjecture that to this talent of twenty-four Attic drachms (= one Attic gold stater) there corresponded one of double its size = fifty Euboic silver drachms = two gold staters = 288 minae or pounds of copper of the weight of fifty Euboic drachms each. Therefore one gold stater (= ox-unit) = 144 librae = ninety-six asses librales.

To sum up then, I have shown (1) that in 429 B.C. at Rome the ox = one hundred asses librales; (2) that following Hultsch's computation of the relative values of the metals in Italy the gold stater of 135 grains (8.73 grammes) = ninety-six asses librales; but this gold stater I have shown to be the *τάλαντον* of Homer, and the metallic equivalent of the ox in the Homeric poems; (3) that taking Hultsch's computation for Sicily we find once more this ox-unit at the base of the Sicilian system, and equivalent to 144 copper litrae (= ninety-six asses librales). But all the authorities are agreed

that the Litra is an indigenous production. There is then a fair presumption that it is related closely to the Roman system, especially as the gold unit in each case = ninety-six copper asses librales. But the Roman equivalent in copper to the gold unit (ox-unit) approximates so closely to the known value of the ox at Rome that it can scarcely be fortuitous, and we therefore may without being over rash come to the conclusion that the Roman system of money (pecunia) was based on the ox, which was *par excellence* the *pecus* of Italy.

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