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Pay and Numbers in Diocletian's Army

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Pay and Numbers in Diocletian's Army

In any general study of the Roman army in its different phases it is essential to have some notion of its size and of how much troops were paid. The first is crucial to our assessment of the defence and policing of the Empire. The second is important for assessing the standing of the military in Roman society, as well as for estimating the Empire's budget and for gauging the impact of prices on public salaries. Both numbers and pay are fairly well established for the main period of the Principate.[1] However developments during the half century of warfare, steeply rising prices and violent dislocation after the Severi are very difficult to discern.[2] But our documentation suddenly improves at the end of this period, thanks to discoveries in Egypt.

The Beatty papyri from Panopolis, published in 1964, provide material for inferences about pay and manning levels in the army in Upper Egypt at the end of the third century.[3] The papyri have already given rise to two sets of military estimates, based mainly on the money totals (Appendix II). But when details of the payments in kind are taken fully into account, quite different conclusions

The examination of Egyptian dry measure carried out in CAM (see below) is important to part of the present argument. The arguments for a variable choenix measure advanced by J. SHELTON in ZPE 24, 1977, 55–67 do not appear convincing; they will be considered in a forthcoming article.

CAM = R. P. DUNCAN-JONES, The choenix, the artaba and the modius, ZPE 21, 1976, 43–52.

LRE = A. H. M. JONES, The Later Roman Empire, 1964.

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[1] For recent work cf. G. R. WATSON, The Roman Soldier, 1969, and M. SPEIDEL, JRS 63, 1973, 141–7.

[2] For discussion of this period cf. G. ALFÖLDY, GRBS 15, 1974, 89–111, and R. MAC-MULLEN, The Roman Government's Response to Crisis A. D. 235–337, 1976. For military developments, E. RITTERLING, Festschrift O. Hirschfeld, 1903, 345–9; R. GROSSE, Römische Militärgeschichte von Gallienus bis zum Beginn der Byzantinischen Themenverfassung, 1920; L. VÁRADY, AAntHung 9, 1962, 333–396.

[3] P. Beatty Panop. edited by T. C. SKEAT. The span of time covered by the letters authorising payment was 28 January – 1 March 300 (not 1–27 February as in LRE III, 187 n. 31): 2. 249; 270. Virtually all the payments were made in arrear.

emerge. *Stipendium* appears to be three times and *donativum* two times greater than in the standard interpretation by A. H. M. JONES. The army units appear correspondingly smaller. In the case of auxiliaries, the garrisons shown here are much smaller than complete auxiliary units of the Principate. But other cases of garrisoning at these low levels in the late Empire are suggested by literary and archaeological sources (Appendix I).

These findings if accepted are potentially useful both for interpreting government pay policy under Diocletian and his predecessors, and for assessing unit strength in the late Roman army.

The payments in grain

The first Beatty papyrus records payments in kind to what was evidently a troop-unit whose receipts in money are listed in the later document. ‹The soldiers under the prefect Papas, stationed in the fort of Thmou› were assigned as allowances in kind for Thoth and Phaophi (29 August – 27 October) 2,610 Italic modii of barley and 128 ⁷/₈ artabas of wheat. The two payments were authorised on 24 September 298 (1.392–8). Sixteen months later, on 30 January 300, ‹the cavalrymen under the command of Besas, decurio of the *ala I Hiberorum* stationed at Thmou› were paid 73,500 denarii as *stipendium* for the 4 months due on 1 January 300, and 23,600 as *annona* for the (same) 4 months starting on 1 September 299 (2.36–42). As SKEAT concluded, both documents refer to the same detachment: it was thought unnecessary in the first document to individuate the detachment of troops at Thmou by name, implying that there was only one detachment there. But the barley payment indicates that they were cavalrymen. The *ala I Hiberorum* at Thmou is also referred to in another Diocletianic papyrus, and the unit appears as the garrison of this fort in the ‹Notitia Dignitatum›.[4]

The barley allocation is defined unequivocally as 2,610 Italic modii (22,494 litres).[5] The official fodder ration (*capitum*) in a sixth century military papyrus was 4 choenices (3.2 litres) of barley per horse per day.[6] Applied here, this rate produces

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[4] P. B. Panop. xxvi; P. Oxy. 2953; Notitia Or. 31. 46.

[5] For the Italic modius as 8. 6185 litres, see CAM Appendix.

[6] P. Oxy. 2046 (see LRE III, 192–2 n. 44; cf. RE s. v. Capitum). The allowance is 1/10 artaba per day; the artaba used there has 40 choenices (1. 58 and note), so the allowance is 4 choenices = 3/8 of an Italic modius = 3. 232 litres (cf. CAM 43–4). The barley ration for cavalry horses in a Ptolemaic papyrus of 169 B. C. was 3 choenices per day (SB VI 9600). But inserting this figure in the present document creates seriously irregular totals for wheat rations, for *stipendium,* and for *annona.* Cavalry under the mid-Republic apparently received far more, citizen horses 12. 1 and allied 8. 6 litres of barley per day (Polybius 6.39; for the Attic medimnos as 6 Italic modii, see CAM n. 16). But other late evidence shows much lower levels. The stone measure labelled as a *capitum hordei* found

a total of exactly 116 rations.[7] Assuming that as in other official papyri of the early fourth century, the tax-artaba of $4^1/_2$ Italic modii was being used, the wheat allowance for the cavalrymen themselves ($128^7/_8$ artabas) contains 116 shares of 5 Italic modii.[8] The implied wheat ration of $2^1/_2$ modii per man per month is relatively low, but provision in kind was not apparently comprehensive, since the troops also received a cash payment for *annona*.[9]

JONES did not refer to these payments in kind, but argued from the total 32,866 (Table V line U) that the usual payment for *annona* for 4 months must have been $66^2/_3$ denarii per head and therefore exactly 200 per year. It followed that the *annona* total for the Thmou garrison at the beginning of 300 (Table V line B) gave a total of 354 men. This is 238 men more than the total apparently indicated by the payments in kind sixteen months before. Though it is conceivable that the manning had changed radically, the possibility that numbers remained constant should be considered as well. On a ‹steady state› view, the rate of *annona* should be three

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at Cuicul in Numidia has a capacity of 5.7 litres, indicating a lesser original capacity, allowing for the internal bronze measure that is missing (E. ALBERTINI CRAI, 1920, 315–9; probably set up c. 386, following the instructions about public tax-measures in CTh. 12, 6,21). Barley was not the only ingredient in horse feed: the cavalry in P.Oxy. 2046 also received daily rations of hay. Chaff was also important (cf. e. g. P. Beatty Panop. p. 177 s. v. ἄχυρον). In the U. S. Cavalry a 1,000 pound horse was fed 10 pounds of grain (7.3 litres if barley) and 11 pounds of hay per day (H. S. THOMAS, Horses, their breeding, care and training, 1974, 223, 230).

[7] For accounting purposes 2 months = 60 days. 60 x $^3/_8$ Italic modii = $22^1/_2$ Italic modii. 2610 ÷ $22^1/_2$ = 116.

[8] See e. g. the long account in P. Princ. Roll of A. D. 310–324 (2. 4; 4. 4; 6. 4; 8. 12); P. Thead. 31 (319-320). P. Lips. 97 shows that the *metron modion (xyston)* had 48 choenices (Chiron 6, 1976, 259). The artaba of 48 choenices = $4^1/_2$ Italic modii (CAM 44–5). $4^1/_2$ x $128^7/_8$ = 579.94 modii; to reach the figure 580 exactly, the artaba total should be $128^8/_9$ (and the papyrus should thus read $128^1/_2 \, ^1/_3 \, ^1/_{24} \, ^1/_{72}$, instead of $128^1/_2 \, ^1/_3 \, ^1/_{24}$). The ratio of wheat to barley is nonetheless stated as $1:4^1/_2$ with an error of only 1 part in 2.000. The precision is almost as great in sixth century figures for wheat and barley issued to numeri at Hermopolis, where the target ratio is 1:4, not $1:4^1/_2$ ($240:958^1/_4 = 1:3.99$; JOHNSON-WEST, Byzantine Egypt 223). Polybius' wheat:barley ratios are $1:3^1/_2$ (citizen cavalry) and $1:3^3/_4$ (allied cavalry; 6. 39).

[9] Table I, line 8. The alternative would be to read the Thmou wheat ration as 5 modii per man per month. This might agree with the ration of 1 artaba per man attested for troops of the Principate (Rom. Mil. Rec. 78. 1–14; 81; cf. 79), since a 5-modius artaba is known in the fourth century (CAM 50 and n. 30). But it would double *stipendium,* reduce the Thmou garrison below 60, and reduce the governor's troops to the level of a half vexillation (Table I, line 2). It would also produce a much more extreme wheat: barley ratio (1:9) than that attested for cavalrymen and their mounts in other cases (see n. 8).

The fall in the bread ration at Rome from 50 to 36 ounces per day in 369 is of interest (the quality was improved). Since wheat produced 25–26 pounds of bread per modius (cf. Pliny, NH 18, 66–8), this presumably corresponds to a cut from the old wheat ration of 5 modii per month to one of 3. 6 (cf. CTh. 14, 17, 5; LRE II, 696).

times the rate deduced by JONES, 200 denarii per man for 4 months in place of 66²/₃. This leads to a total of 118 recipients, only 2 more than that implied in the rations issued 16 months earlier. Being the lesser hypothesis, the view that numbers remained constant is easier to credit. JONES's estimate of 354 men comes nearer to the establishment for an *ala* under the Principate; but there are other indications that some garrisons were kept at a much lower level under the later Empire (see Appendix I). JONES's figure is very close to being an exact multiple of that suggested by the first papyrus (354 where an exact 3-fold multiple would be 348).

At this point the rate of *stipendium* becomes intelligible. 73,500 denarii represents 118 shares of 622.9 denarii as payment for 4 months. Assuming 118 men, the plausible rate of 600 denarii emerges if 2,700 denarii was absorbed by higher grades. The excess is exactly enough to make 4 men *duplicarii* ($+4 \times 600$) and one a *sesquiplicarius* ($+1 \times 300$).[10]

Taken overall, the figures for Thmou suggest annual payments to cavalrymen (*alares*) in A.D. 300 of 600 denarii for *annona* and 1,800 for *stipendium*. Their salary is still only ¹/₃₀ of that paid to the officer recorded in the papyri. The *praepositus* of the *equites promoti* of the *legio II Traiana* was being paid 54,000 denarii per year (18,000 for 4 months; 2.201).

The donatives

There are evidently two rates of donative in the papyrus. One (type A) given as JONES noted for the birthday or accession day of an Augustus was about twice the amount of the other (type B), given for the consulship of the Caesars. But the ratio between them was 25 : 12 rather than 2 : 1 as suggested by JONES (see p. 557 and 560 below).

The papyrus tells us that an officer (the *praepositus* of the *equites promoti* of the *legio II Traiana*) received type A donatives of 2,500 denarii (Table V lines L-M). JONES assumes that because the recipient is an officer his donative was higher than that of the rank and file.[11] But as SKEAT noted, there seems to be no evidence for proportioning of payments to rank in what is known of *donativa*.[12] The rate shown here, equal to 10,000 sesterces in the currency of the Principate, is already attested in earlier evidence. This rate was allegedly given by Octavian to his troops in 43 B.C., unsuccessfully demanded by the Danube legions who supported Septimius Severus, and was given to the praetorians by Caracalla. At the joint accessions of

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[10] The 223 cavalry of the *cohors XX Palmyrenorum* at Dura in 223/5 included 5 decurions, 7 *duplicarii* and 4 *sesquiplicarii* (Rom. Mil. Rec. 47).

[11] LRE III, 188.

[12] P. Beatty Panop. xxviii; cf. WATSON (n. 1) 108–114.

Marcus Aurelius and Lucius Verus the praetorians were even promised double this amount.[13]

Thus it appears possible that donatives were homogeneous and did not vary within a unit according to rank.

The payments in oil

The best opportunity of testing this hypothesis is the conjunction of donatives and payments in kind in the references to the *lanciarii* of the *legio II Traiana*. If this unit was given the same type A donatives as the officer recorded elsewhere, it would have received 439 shares (Table V lines P-Q; $1,097,500 \div 2,500 = 439$). The unit also received as part of its *salgamum* allowance 3,596 pounds of oil for 2 months (Table V line S).[14] The rate per head if there were 439 men equals almost exactly $1/11$ of a sextarius per day.[15] Though not identical with a known rate, this is close to the rate of $1/10$ of a sextarius per day attested as an army oil-ration in sixth century papyri.[16] Worked out exactly, a rate of $1/11$ produces 439.51 shares.

JONES's hypothesis about the donatives gave this unit a much larger, but shifting, membership, 878 men on 20 November and 22 December 299 (type A) and 843 on 1 January 300 (type B) (Appendix II p. 560). His inference about *salgamum* gave a rate of 4 pounds of oil per month, which should have been stated as 2 pounds since the allowance covered a 2-month period. This gave the unit yet another total, 899 men. But none of these strengths leads to an oil-allowance anywhere near the attested rate. Even the smallest yields only $1/21$ of a sextarius per head per day.

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[13] Appian, BC 3, 94; HA Sev. 7, 6; Herodian 4, 4, 7; HA M. Ant. 7, 9; WATSON, op. cit. 113–4.

[14] The papyrus lists 3,596 pounds of oil and 3,596 Italic sextarii of salt. SKEAT inverts the measures so as to read the oil in sextarii and the salt in pounds, both here and in the other *salgamum* provision (Table V line O) (P. B. Panop. xxvii and 149 *ad* 2.247–8). But the gross mistake that this assumes is unlikely to have been repeated in letters despatched on different dates. In any case there is other explicit evidence for the official usage shown here: the Codes contain a direct parallel where oil is reckoned by weight (in pounds) and salt in capacity-measure (modii) (CTh. 8, 4, 17; 385). Moreover metrological sources frequently measure oil in pounds (HULTSCH [ed.], MSR II, 176 s. v. ἔλαιον; 190 [4]); and salt is measured by capacity-measure in a Trajanic customs tariff (SB IV 7365).

[15] 1 Italic sextarius = $1^{1}/_{2}$ pounds of oil (HULTSCH, n. 14 above), so 3,596 pounds $= 2,397^{1}/_{3}$ sextarii. For accounting purposes 2 months = 60 days; $2,397^{1}/_{3} \div 60 = 39.9555$; $39.9555 \div 439 = 1/10.987$.

[16] P. Oxy. 2046; 1920. See also n. 6. The recipients were *symmachoi*, who were messengers rather than regular troops (LRE III, 191). The regular troops, *stratiotai,* received $1/8$ of a sextarius; but their daily allocations appear generous by ancient standards: 4 pounds of bread per day, 1 pound of meat and 2 xestai of wine.

The present hypotheses assume an oil-allowance close to an attested rate and bring the unit-strengths projected by the three types of distribution into effective agreement. The type A donatives now yield 439 shares, type B yields 439 $^1/_{16}$, and the oil allowance yields 439 $^{46}/_{90}$. Overall variation between these totals is less than 0.12 %.

This reconciliation between the three statements about the *lanciarii* offers support for the underlying hypothesis. The 2,500 denarii given as donative to the *praepositus* of the *equites promoti* thus appears to have been the standard type A rate for legionary or equivalent troops. The corresponding type B donative must have been $^{12}/_{25}$ of type A, from the respective totals for the lanciarii (526,875 : 1,097,500). It would therefore have been 1,200 denarii.

Numerical results

The rates of payment deduced are:

stipendium (*alares*): 1,800 denarii per year
annona (*alares*): 600 denarii per year
donativum (type A for legionaries and equivalent troops): 2,500 denarii
donativum (type B for legionaries and equivalent troops): 1,200 denarii
oil-allowance: $^1/_{11}$ sextarius per day

These rates can be applied to other evidence in the papyrus. The results are shown below.[17] *Cohortales* seem to have been paid one third less than *alares*, since their *stipendium* is about twice their *annona*, not three times (Table I lines 8 and 10).

Establishment

Some of these unit-strengths agree quite closely with other evidence.[18] It is possible nonetheless that *stipendium* figures (lines 2, 8 and 10) are slightly inflated by extra payments to *duplicarii* and *sesquiplicari* (cf. p. 544 above). Line 1 shows a mixed legionary *vexillatio* whose suggested strength is 1,000 men (998$^1/_2$ shares). Vexillations with a nominal strength of 1,000 (*vexillationes milliariae*) are attested in

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[17] It is assumed here (with JONES, LRE III, 188–9) that *alares* and legionaries were paid the same at this date. The strength that ensues for the legionaries in question (572, line 2) is close to that of a *vexillatio*. If however *alares* were paid at two-thirds of the legionary rate, as has been conjectured for the Principate (WATSON [n. 1] 100), the numbers in line 2 fall to 381; the rate of legionary *stipendium* under Diocletian will then be 2,700, not 1,800 denarii.

[18] A possible difficulty is the untidy fractions posited here, though these represent

TABLE I
Revised interpretation of payments in P. Beatty Panop. 1–2

	Suggested number of shares	Form of payment	Total (denarii)	Conjectured rate per head (denarii)
Legions				
1. *Vexillatio* eastern legions at Potecoptus	998 ½	Donatives (type A)	2,496,250	2,500
2. Soldiers of *leg. III Diocl.* with governor of Thebaid	572 ⅙	*Stipendium*	343,300 (4 months)	1,800 per year
3. *Vexillatio leg. III Diocl.* at Syene	506	*Salgamum*	(8,280 pounds of oil) (4 months)	(1/11 sextarius per day)
4. *Vexillatio leg. II Trai.* at Apollinopolis Superior	554 ½	Donative (type A)	1,386,250	2,500
5. *Lanciarii leg. II Trai.* at Ptolemais	439/439 ½	Donatives (types A & B); *salgamum*	1,097,500: 526,875; (3,596 pounds of oil for 2 months)	2,500; 1,200; 1/11 sextarius per day
6. *Equites promoti* of *leg. II Trai.* at Tentyra	77 ⅗	Donative (type B)	93,12 [5]	1,200
Other cavalry				
7. *Equites sagittarii* at Potecoptus	121	Donatives (type A)	302,500 x 2	2,500
8. *Ala I Hiberorum* at Thmou	116 (A. D. 298); 118 (A. D. 300)	Rations; fodder; *stipendium; annona*	(128 ⅞ art. wheat; 2,610 modii barley); 73,500 (4 months); 23,600 (4 months)	(2 ½ modii per month; 11 ¼ modii per month); 1,800 per year; 600 per year
9. *Ala II Herc. dromedariorum* at Toëto & Psinabla	21 ½ (?)	Donatives (type A)	53,750 x 2	2,500
Cohorts				
10. *Cohors XI Chamavorum* at Peamou	163 ¾ 164 ⅓	*Stipendium; annona*	65,500 (4 months) 32,866 (4 months)	1,200 per year; 600 per year

Note: For references see Table V. The two main rates of donative, and the oil-allowance, are deduced from line 5 in conjunction with other evidence. Rates of *stipendium* and *annona* are deduced from line 8 in conjunction with other evidence (detailed argument above). The suggested number of shares in line 9 is implausibly low, especially since the unit was divided between two forts. But it is difficult to see why a camel *ala* should have received a lower donative than the rest. However the figures for this unit may be incomplete, since overpayment had been made to some of its members in the previous month, and 21,000 denarii was reclaimed (2.31). The presence of 100 *kameloi despotikoi* at Elephantine is recorded in A. D. 295 (P. Oxy. 43 recto II. 1. 6; cf. W. ENSSLIN, Aegyptus 32, 1952, 168–9).

second and third century inscriptions.[19] Their numbers seem to be identified in
inscriptions because they were above the normal level, which was probably as with
alae and cohorts about half this strength. John Lydus writing under Justinian duly
makes the *vexillatio* a unit of 500; Hyginus had spoken of a unit of *vexillarii* as
having 600 men.[20] The Lydus evidence is closely supported in line 3 which suggests
a *vexillatio* of 506. Line 4 shows a *vexillatio* with 554. There are roughly as many
in the un-named detachment from *legio III Diocletiana* with the governor of the
Thebaid, whose total is 572.[21]

The main legionary units (lines 1–4) thus appear to fit quite well with numbers
known from other sources. The remainder (lines 5–6) are less easy to evaluate. But
if the *lanciarii* of the *legio II Traiana* were 439 men (line 5), their numbers would
produce a combined total very close to 1,000, taken in conjunction with the 554
in the *vexillatio* of the same legion (line 4). The number of *equites promoti* of
legio II Traiana approaches the strength of a *centuria* of 80 men (77, line 6).[22]

Only two of the auxiliary totals can be easily compared with other evidence.
Line 8 shows an *ala* with a suggested strength of just under 120 men. Line 7 shows
a unit of *equites sagittarii* numbering 121.[23] But the *ala* is conventionally taken as
being of the order of 500. Arrian gives it 512 men, and John Lydus 600.[24] The

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much smaller deviations than the large discrepancies sometimes assumed by JONES (Appen-
dix II, p. 557 ff.). There may however have been small deductions at source (see p. 561). Three
of the totals are just short of very large round figures: 2, 496, 250 (line 1) is 0.15 % short
of $2^{1}/_{2}$ million; 1, 386, 250 (line 4) is 1 % short of 1.4 million; and 1, 097, 500 (line 5) is
0.23 % short of 1.1 million. Some of the payments may also have taken into account pre-
vious overpayments like that apparent in 2. 31, where 21, 000 is reclaimed. For a case
where army ration allocations lead to a fractional total of recipients, see P. Oxy. 1920, l. 3
note.

[19] ILS 2726; 531. JONES's statement that «1,000 men may be conjectured to have been
the norm» for vexillations, based only on these inscriptions and on his reading of the
Beatty evidence, does not appear convincing (LRE II, 680). The papyrus describes the
present double vexillation as being drawn from eastern legions. Though the editor does
not point this out, the unit is evidently the vexillation of *III Gallica* and *I Illyrica*
(both stationed in Phoenice in ND Or. 32. 30, 31) recorded soon afterwards at the same
fort (ILS 8882, A. D. 315/6). Coptos = Potecoptos (P. Beatty Panop. 2. 162 note).

[20] De mag. 1, 46; de mun. cast. 5.

[21] This does not appear to be «the main body of the legion» as suggested by JONES, who
estimated its numbers at 1716 (LRE III, 210, n. 171).

[22] Hyginus, de mun. cast. 1. A detachment of Palmyrene cavalry in Egypt referred to
in a document of A. D. 271 apparently numbered 75 (P. Oxy. 3115; the editor's first inter-
pretation, which assumes the barley ration of 4 choenices per day, appears preferable to the
second, based on Ptolemaic evidence; see n. 6 above).

[23] Though it need not be pertinent, these two figures are very close to the strength of
120 found for the *equites* in a *cohors quingenaria equitata* (Hyginus 26–7).

[24] Tactica 18, cf. G. L. CHEESMAN, Auxilia of the Roman Imperial Army, 1914, 26–7;
Lyd. de mag. 1, 46. The three *alae* with average complements of 145 men listed in an
Egyptian inscription of the beginning of the Principate appear not to have been at full

cohort of 164 men listed in line 10 is likewise far below totals known elsewhere. Hyginus gives the auxiliary cohort 6 centuries of apparently 80 men, pointing to a total approaching 500. Actual auxiliary cohorts whose numbers we know under Trajan and Antoninus Pius totalled 546 and 505 men.[25]

Comparisons thus show four and three-fold discrepancies between these two auxiliary totals and strengths attested elsewhere. However, there are other indications of small garrisons in late Empire forts (see Appendix I). They do not necessarily represent the whole of the units concerned. A single unit might man two forts, as shown in line 9 of Table I. But some small garrisons may have been all that survived of once larger units. Only a minority of the units in the ‹Notitia Dignitatum› are listed at more than one post. On the other hand, comparison with archaeological surveys (n. 56) suggests that the ‹Notitia› is not always a complete account of the forts and garrisons of the Empire even for the frontier zones that it purports to cover.

The present interpretation suggests that legionary units in the Thebaid were up to strength in 299/300, but that the secondary units belonging to the *auxilia* were either at very low strength, or were now being split up between more than one fort.

Remuneration

The most interesting of the figures conjectured here is that for *stipendium,* set at 1,800 denarii for legionaries and higher auxiliaries (*alares*), and 1,200 for lesser auxiliaries (*cohortales*). The figure for legionaries invites direct comparison with the rates of pay known under the Principate. The one established fact is that legionary pay was increased to 300 denarii in the late first century, that is, to one-sixth of the rate apparently shown in the Beatty papyri.[26]

Septimius Severus's increase of unknown amount may have brought pay to 400 denarii, in which case Caracalla's increase of 50% then made it 600.[27] Since it is uncertain whether Maximinus's later doubling of pay had general application,[28] this leaves a three-fold gap between pay of 600 in the Severan period and 1,800 increases in the course of the third century. If alternatively Maximinus's doubling of pay had general application, and if Septimius had in fact doubled pay also, the rate of 1,800 denarii would already have been reached by A.D. 235, and would have remained at this level until A.D. 300 or later.

strength (ILS 2483, with new reading in CIL III p. 2297; MOMMSEN, Eph. Ep. V, p. 8).
    [25] Hygin. de mun. cast. 27–8; 1; Rom. Mil. Rec. 226; 64.
    [26] Cf. WATSON (n. 1 above) 89–91.
    [27] R. DEVELIN, Latomus 30, 1971, 687–95 at 692, arguing from Dio's statement (78, 36, 3) that Caracalla's increase cost 70 million denarii per year.
    [28] Cf. C. R. WHITTAKER *ad* Herodian 6, 8, 8 (Loeb edition).

What is clear is that *stipendium* did not keep pace with inflation throughout this period. The price of wheat used in official transactions in Egypt was already three times the second century level by A.D. 246. By 294 it had increased a further nine-fold or more to reach 220–300 drachmae per artaba.[29] Even if *stipendium* did increase three-fold between 217 and 300 (accepting the first hypothesis above), this would clearly have been far behind the actual rate of price increase over the intervening period. Assuming that grain prices (by the present index) still stood at a late second century level of 18 drachmae in 217,[30] their increase to 220–300 drachmae by 293–4 would amount to 12 or 17-fold, four to six times the maximum rate of pay increase that the evidence suggests.

But this is only part of the picture. By the time of Diocletian the government had evidently adopted a practise of paying large donatives on a more or less regular basis. The donatives for the birthday and accession days of Diocletian look like regular events; as JONES points out A.D. 299 was not a quinquennial year.[31] The Beatty papyri cover cash payments made over a period of little more than a month.[32] No doubt there were various other donatives in the course of the year, and possibly a repeat of the two main donatives, to reflect the birthday and accession day of the other Augustus.[33] If so, on the present interpretation, the legionary stood to receive 10,000 denarii per year or more in regular donatives alone, quite apart from the occasional ones such as the donative of 1,200 denarii given for the consulship of the Caesars (see p. 546). This could create a cash income of over 12,000 denarii when *stipendium* of 1,800 denarii and *annona* of 600 were added.

Comparisons with the rate of price-increase are difficult without firm information about the rate of pay attained in the Severan period. If donatives were not yet a significant contribution to regular pay in the Severan period, *stipendium* of 600 denarii at the death of Caracalla would suggest a possible 20-fold increase in payment by the time of Diocletian. This would be roughly in keeping with the rate of increase in official wheat prices as far as Egypt was concerned (see above). But the wheat price in the Edict of 301 is much higher than the Egyptian figures, and this may well represent conditions in the rest of the Eastern Empire.[34] Thus even

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[29] P. Oxy. 3048, to be added to Chiron 6, 1976, 254; ibid. nos. 63 and 64.

[30] Cf. ibid. 246.

[31] LRE III, 188.

[32] See n. 3.

[33] It seems possible however that donatives in the East would honour only the Eastern half of the Imperial College, in which case the regular donatives would presumably be 5, 000 (for accession and birthday of the Augustus). The papyri do not indicate in so many words that accessions and birthdays of the Caesars were also honoured in this way. JONES assumed that the birthdays and accession days of both Augusti and both Caesars (8 occasions) would all give rise to the donatives at the respective rates which he inferred (see Table V; LRE II, 623).

[34] 220 Egyptian drachmae (n. 29) for 1 official artaba of 4$^{1}/_{2}$ Italic modii (n. 8) equals 12. 2 denarii per Italic modius. The wheat price in the Edict (1. 1) of 100 denarii per

on the most favourable interpretation, the likelihood is that pay was seriously lagging behind food prices in most of the Eastern Empire by A.D. 300.

Adopting the alternative hypothesis outlined above, if *stipendium* was already 900 denarii at the death of Caracalla, remuneration of 12,000 denarii in the time of Diocletian would represent a 13-fold increase, well below the actual degree of inflation. The inability of military pay to keep pace wih inflation was a specific complaint in Diocletian's Price Edict, though expressed in terms which criticised profiteers who robbed the soldier of his pay by dishonestly overcharging. And it is in keeping with the Beatty evidence that the soldier's pay is referred to as *dona-tivum . . . stipendiumque* in that order.[35]

This pay structure seems to have had an alarming consequence for officers. If donatives were made to all ranks within a given unit at a flat rate, as seems to have been the case, that would benefit the rank and file much more than the officer. The Roman world was accustomed to the most extreme differentials of army pay depending on rank: in the Principate the extremes of pay within the legion seem to have differed by a factor of 67.[36] The Beatty evidence suggests a severe con-traction of money differentials between officers and the rank and file. Taking the *praepositus* of *equites promoti* whose remuneration we know (Table V lines K–M) and a legionary *miles,* the ratio of their *stipendia* would be 30:1 (54,000:1,800). But the ratio of their gross pay on present inferences would only be about 5 : 1 (64,000:12,000). By a later date in the fourth century large-scale payments in kind had certainly become the main remuneration for officers. Their position was probably often enhanced by the abuse known as *stellatura,* drawing compulsory contributions from the men under their command.[37]

Conclusion

If we accept that the number of shares assigned to a given unit is likely to have been more or less constant, whether payment was being made in money or in kind, the estimates outlined above appear the most logical. They are however partly dependent on points of reference from another period: figures for fodder and oil-rations have to be imported from military papyri of the sixth century. It is possible that fresh papyri of earlier date will reveal ration-details which may alter these conclusions. Nevertheless the findings as they stand point to vexillations of the normal size of 500–600. And the very small auxiliary units that they imply, though

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castrensis modius is some 5 times as much (probably 66. 7 denarii per Italic modius; R. P. DUNCAN-JONES, ZPE 21, 1976, 59).

[35] S. LAUFFER, Diokletians Preisedikt, 1971, 95, l. 8. The same word-order in Ammianus 17, 9, 6: *nec donativum meruit nec stipendium.*

[36] Cf. P. A. BRUNT, PBSR 17, 1950, 71.

[37] LRE II, 643–5.

anomalous at first sight, seem to be also indicated in other evidence from the Late
Empire.

Appendix I: Small army-units and garrisons under the Late Empire

It is often accepted that some tendency towards smaller army units had made
itself felt by the mid-fourth century.[38] Vegetius (2,3) states that it is no longer
possible to keep the legions up to strength, and indicates that service in the auxi-
liaries was now preferred because of the less rigorous conditions. Figures in Ammi-
anus for the siege of Amida in 359 have been taken to suggest legionary strengths
of the order of 1,000.[39] The creation of the ‹small› legion is laid at the door of
Diocletian's successors.[40]

But the realities are obscured by looseness in the terminology of the sources. The
‹Notitia Dignitatum› compiled about the end of the fourth century refers indif-
ferently to a unit as a legion whether it was a whole legion or only part of one.
Thus the *legio III Diocletiana* is listed five times, four times in Egypt and once in
Thrace. The only indication that any one of these listings does not represent the
whole legion is the fact that the name recurs elsewhere.[41] The usage is also apparent
in literary sources. We can deduce from the Notitia that two Theban legions in
Thrace (one of them *III Diocletiana*) were only parts of legions, since they recur
again in Egypt. Yet they are referred to by Ammianus, discussing affairs in Thrace
in 354, as *Thebaeas legiones in vicinis oppidis hiemantes,* giving no hint that they
were less than complete legions.[42] If Ammianus' usage (and that of his contem-
poraries) did not distinguish a legion from a legionary detachment, his statements
about the siege of Amida do not necessarily show anything significant about legio-
nary establishment in his day.[43] Nevertheless GROSSE's observation that legions
were now commanded by a tribune, the title of the officer who had commanded
one-sixth of a legion under the Principate, may be suggestive.[44]

JONES suggested that Diocletian was working in terms of full-strength army units
of the Principate, and his interpretation of the Panopolis papyri appeared to bear

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[38] See e. g. D. VAN BERCHEM, L'armée de Dioclétien et la réforme constantinienne, 1952,
110; LRE II, 680–2; L. VÁRADY, AAntHung 9, 1962, 333–396 at 367.

[39] Anm. 19, 2, 15. GROSSE (n. 2 above) 30 ff.; LRE II, 681–2.

[40] VÁRADY (loc. cit. n. 38), etc.

[41] ND ed. SEECK, p. 310 s. v. *III Diocletiana.*

[42] Or. 8. 36, 37; Amm. 14, 11, 15.

[43] Cf. VAN BERCHEM (n. 38): «Le titre de legion . . . ne doit pas faire allusion sur leur
effectif réel.»

[44] GROSSE (n. 2) 34.

this out.[45] The present analysis offers different conclusions, since it points to an *ala* and a unit of *equites sagittarii* with only about 120 men each, and an auxiliary cohort with only 160 or so (Table I, lines 7, 8, 10). The legionary strengths in the Panopolis papyri refer to vexillations and other subsidiary units. Though they point to 500 as the nominal strength for a *vexillatio*, they leave the position about overall legionary numbers uncertain. Vegetius (1,17) offers what may be a hint that legions before Diocletian had less than 6,000 men. He states that the two legions of Mattiobarbuli in Illyricum founded before Diocletian each had 6,000 men. The figure was apparently noteworthy, at least to Vegetius.

Some other evidence about small size units is more clear-cut. The *centenaria* were small forts, apparently commanded by a centurion, himself called a *centenarius* by Vegetius' day (2, 8).[46] These were presumably garrisoned by a force equivalent to a *centuria* of 100 men, though a *centuria* might be as few as 80 or 60 in some contexts.[47] The forts varied considerably in size.[48] Their existence before Diocletian's time is beyond doubt. A *novum centenarium* was built at Tentheos on the *limes Tripolitanus* in A. D. 244/6. A *centenarium* at Aqua Frigida in Mauretania Caesariensis was restored under Diocletian.[49] Other *centenaria* are recorded during the fourth century.[50]

Other references to miniature units occur in the ‹Notitia›. Though the date of its compilation is not earlier than 395, in some cases where its evidence can be corroborated, the garrisoning appears to go back to Diocletian.[51] The Notitia lists a *cohors [c]entenaria* at Tarba in Palaestina. At Bethallaha in Mesopotamia it lists a *cohors quinquagenaria Arabum*. In a third case we find a *tribunus cohortis* stationed at a *burgus Centenarius* in Valeria.[52]

The forts called *centenaria* and the *cohors centenaria* point to units whose strength, nominal or actual, was about 100 men. The *cohors quinquagenaria* (if

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[45] LRE I, 56; II, 680; III, 187–8. The same view, advanced by NISCHER, was soon contested by H. M. D. PARKER, JRS 23, 1933, 175–189 at 187.

[46] L. LESCHI, Études d'épigraphie, d'archéologie et d'histoire africaines, 1957, 47–57; R. G. GOODCHILD, Libyan studies, 1976, esp. 28–30; J. F. MATTHEWS, British Archaeological Reports, supp. 15, 1976, 171.

[47] Cf. E. R. BIRLEY, Corolla E. Swoboda, 1966, 54.

[48] Tentheos (Gasr Duib) 2 storeys, 0. 02 hectares, GOODCHILD (n. 46) 24 ff. Tibubuci, probably 2 storeys, 0. 09 hectares, P. GAUCKLER, CRAI 1902, 327–330. Aqua Viva, 0. 76 hectares, GOODCHILD 40. For the sizes of other African forts, see P. ROMANELLI, Topografia e archeologia dell'Africa romana (Enc. classica 3, 10, 7), 1970 ,40 ff.

[49] IRT 880; ILS 6886.

[50] See e. g. CIL VIII 8713; 9010.

[51] Cf. above at n. 4 and A. K. BOWMAN, The Military Occupation of Upper Egypt in the Reign of Diocletian (forthcoming).

[52] ND Or. 34, 40: ‹cohors prima agentenaria›; ‹centenaria› Gelenius (1552) Or. 36, 35. Oc. 33, 62.

the text is sound) was apparently a unit of 50.[53] Both figures occur in a military context in the ‹Anonymus de rebus bellicis› (5,5), who suggests that gaps in the standing army should be filled by the recruitment of *centeni aut quinquageni iuniores, extra hos qui in matriculis continentur*. Obvious though the numbers are, the coincidence with the Notitia evidence possibly suggests that the writer had in mind unit sizes current in his own day.

Some circumstantial evidence for small units in this period comes from the size of forts in which units were stationed. Apparent anomalies have been noted in passing by archaeologists. A small fort in Raetia measuring 0.16 hectares in area has been identified as the fort at Pinianis, listed in the Notitia as headquarters of a *tribunus cohortis,* though it is far too small for a conventional cohort of 500 men.[54] And the fort at Rutupiae (Richborough) at which the Notitia locates the prefect of *legio II Augusta* is 2.6 hectares in area, enough only for 1,000 legionaries by conventional standards.[55]

Other cases of forts which are too small to hold the units ascribed to them by the Notitia, if these units were of traditional size, can be found without difficulty. Some are shown in the following Table II.[56]

The fort-area allowed per unit under the Principate sometimes varied from province to province, though clear patterns can be seen in most of the evidence. On the Rhine and Danube, forts generally seem to have been more spacious than those for corresponding units in Britain. The difference represents a factor of 1.6 or 1.7. The British evidence may thus be a reasonable guide to the minimum areas normally allowed under the Principate. The British norms are about 1.42 hectares for quingenary cohorts and 2.63 for quingenary *alae*.[57] In terms of the second module the three *ala* figures shown in Table II work out as follows (Table III).

The area of the fort at Betthoro (no. 7) available for the *legio IIII Martia* is about 25% of the average for full-size legionary fortresses in Britain.[58] The fort for

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[53] Alternatively however this numeral might be a corrupt version of the cohort serial number. The units adjacent in the list are numbered *ala secunda, ala octava, ala quintadecima* and *cohors quartadecima* (Or. 34. 32–4, 36).

[54] G. BERSU, Die spätrömische Befestigung «Bürgle» bei Gundremmingen, 1964, plan p. 44. I. A. RICHMOND, BJ 165, 1965, 493, comments that «the accommodation ... suits a *centuria* and its *centenarius,* with his under-officers».

[55] S. S. FRERE, Britannia 1967, 268; ND Oc. 28. 19.

[56] BRÜNNOW = R. BRÜNNOW, Die Kastelle des arabischen Limes, Florilegium M. de Voguë, 1909, 65–77.

BRÜNNOW – DOMASZEWSKI = R. BRÜNNOW – A. VON DOMASZEWSKI, Die Provincia Arabia, 1904–1909.

POIDEBARD = A. POIDEBARD, La trace de Rome dans le désert de Syrie, 1934.

POIDEBARD – MOUTERDE = A. POIDEBARD – R. MOUTERDE, Le limes de Chalcis, 1945.

SCHWARTZ – WILD = J. SCHWARTZ – H. WILD, Qasr-Qarun/Dionysias 1948, 1950

[57] FRERE (n. 55) 223.

[58] Id. 221.

TABLE II

Some units in the ‹Notitia› and their fort-sizes

Unit	Fort Area (hectares)	Fort-Name	Modern Name	Province	Sources
1. *ala I Francorum*	0.17	Cunna	Han al-Qattar	Foenice	ND Or. 32.35.; POIDEBARD 48–49 (see n. 56)
2. *ala nova Diocletiana*	0.22	Veriaraca	Han al-Hallabat	Foenice	ND Or. 32.34; POIDEBARD ibid.
3. *ala V Praelectorum*	0.76	Dionysias	Qasr Qarun	Aegyptus	ND Or. 28.34; SCHWARTZ-WILD 63
4. *cohors II Aegyptiorum*	0.25	Vallis Diocletiana	Han as-Sawat	Foenice	ND Or. 32.43; POIDEBARD 43, 54
5. *cohors V Pacata Alamannorum*	0.19	Onevatha (Anab[atha]?)	Han Aneybé	Foenice	ND Or. 32.41; POIDEBARD 47, 50; RE s. v. Syria 1703
6. *cohors I Iulia lectorum*	0.81	Vallis Alba	Han al-Manquoura	Foenice	ND Or. 32.42; POIDEBARD 45–6
7. *legio IIII Martia*	4.6	Betthoro	El Leggun	Arabia	ND Or. 37.22; BRÜNNOW-DOMASZEWSKI II. 25; BRÜNNOW 71
8. *equites sagittarii*	0.77	Acadama	Qdeym	Syria	ND Or. 33.21; POIDEBARD-MOUTERDE 109–110

Note: An alternative identification makes Han al-Qattar (line 1) the site of Neia (Carneia); HONIGMANN, RE s. v. Syria 1679, 1703. But if so it was still the fort of an *ala*, the *ala I Alamannorum* (ND Or. 32.36).

TABLE III

Areas of late ala forts related to British forts of the Principate

Reference (Table II)	Fort-area (hectares)	Percentage of British average (2.63 hectares)
1.	0.17	6 %
2.	0.22	8 %
3.	0.76	29 %

Related to the first module, the three cohort figures produce the following results:

TABLE IV

Areas of late cohort forts related to British forts of the Principate

Reference (Table II)	Fort-area (hectares)	Percentage of British average (1.42 hectares)
4.	0.25	18 %
5.	0.19	13 %
6.	0.81	57 %

equites sagittarii at Acadama (no. 8) has virtually the same area as the fort of another mounted unit, the *ala V Praelectorum* at Dionysias (no. 3; see Table III).

Area alone is not always a very precise guide to the garrison that a fort could hold. Though forts of the Principate were apparently single-storey as a rule, a number of smaller fourth century forts such as the one at Dionysias (no. 3) were evidently two-storey.[59] The layout of the buildings and the barrack space allowed per man might also vary.[60] Nevertheless, it is fairly easy to discern standard sizes almost certainly related to garrison numbers in the typology of fort-areas under the late Empire, as under the Principate. The subject would benefit from systematic study on a larger scale than it has so far received.

It does not seem at this stage that the other variables can possibly explain difference by as much as a factor of 6 or 8 in the area apparently assigned to a given type of unit at different dates. This suggests that garrisons in some late Empire forts were substantially smaller than whole units of the Principate, whose numbers generally ran at 500. That need not always argue for drastic reductions in the size of auxiliary units, since one unit might on occasion occupy more than one fort (see p. 549). Nevertheless, taken in conjunction with the Beatty evidence, it appears to raise serious questions about both the disposition and the typical size of auxiliary units in the period from Diocletian onwards.

Appendix II: Existing interpretations of the Beatty figures

The main figures have been interpreted by both JONES and SKEAT. SKEAT's interpretation owes something to interim suggestions by JONES, but appears to have been overtaken by JONES's later conclusions.[61] For JONES's results see Table V below.

I. J. first noted that an officer explicitly received 2,500 denarii for the birthday or accession day of an Augustus (22 December and 20 November in the present evidence) (L–M). He then observed that the highest common factor in the sums given to four of the units in respect of the same donative was 1,250 denarii. From this he deduced that the rank and file received half the rate of officers (D–E, H–J, P–Q), 1,250 denarii in these cases.

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[59] J. SCHWARTZ et al., Qasr-Qarun/Dionysias 1950, 1969, 23–26: see also n. 48 above.

[60] No comprehensive discussion of barrack-space per man is available, but see e. g. D. J. BREEZE – B. DOBSON, in: E. BIRLEY – B. DOBSON – M. JARRETT, Roman Frontier Studies 1969, 1974, 17. Some other garrison and size data in V. E. NASH-WILLIAMS, The Roman Frontier in Wales², 1969, 163; D. BAATZ, Der römische Limes, Archäologische Ausflüge zwischen Rhein und Donau², 1975, 79 ff.

[61] Cf. P. B. Panop. xxvi–xxx.

II. Comparing the donative given to the *lanciarii* of the *legio II Traiana* on the third occasion mentioned in the papyrus, the consulship of the Caesars (1 January), 526, 875 denarii in place of 1, 097, 500 (P–R), J. deduced that the rate was half as much as in the other donatives, namely 625 denarii. In support of this he pointed to the total 93, 12[5][62] denarii given to the *equites promoti* of *legio II Traiana* for the same occasion (line N). Divided by 625, 93, 12[5] equals a prime number, 149.

III. J. then argued that the 53, 750 denarii given to the *ala II Herculia dromedariorum* (F–G) for the first and second donatives implied a much lower rate of benefit, 250 denarii being «the only plausible figure» (presumably because a higher rate would have made the unit implausibly small). The total strength arrived at is 215 (not 211 as in JONES's summary).

IV. J. argued that the *annona* total of 32, 866 denarii for 4 months in line U «can hardly represent anything but 493 men at $66^2/_3$ denarii for the four-monthly period, i. e. 200 denarii a year». He found the same rate plausible in B (23,600 ÷ $66^2/_3$ = 354).

V. The ratio of T:U argues that *stipendium* for *alares* was three times their rate of *annona,* and the ratio of A:B argues that the *stipendium* of *cohortales* was twice the (same) rate of *annona*. This approximately suggests annual salaries of 600 denarii for *alares* and 375 for *cohortales* «which yield plausible strengths» (lines A–B, T–U).

VI. «For the stipendium of legionaries C appears decisive (343, 300 for soldiers of the legio III Diocletiana): any higher rate than 200 (600 a year) involves fractions less than a half, and so far as we know the half stipendium (for a sesquiplicarius) was the lowest fraction used.»

Most of the observations on which JONES's interpretation is based are undeniable in themselves. But there are clear inconsistencies in the results. And JONES did not look closely at the payments in kind, ignoring altogether those in the first Beatty papyrus.

Under II, J. concluded that successive donatives paid to the *lanciarii* of *legio II Traiana* in a ratio of 1, 097, 500 : 526, 875 argued that the smaller was made at half the rate of the larger. But the ratio is not in fact 2 : 1, besides which, if we assume that it is, the number of recipients wavers mysteriously between 878 on 28 February and 843 on 1 March. The ratio is actually 25:12.[63] Therefore, if the higher donative was 1, 250 denarii as J. thought, the smaller would be 600, not 625. This emendation leaves the number of recipients constant on the occasion of both

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[62] Though the 5 in 93, 125 has been restored by the editor, on the basis of JONES's view that 625 was the common factor in all the donatives (P. B. Panop. p. 147, cf. xxvii–xxviii).

[63] In the smaller total 75 denarii or 0.01 % are apparently superfluous. For inexact totals see below and n. 18 above.

TABLE V

Payments in P. Beatty Panop. 2 interpreted by A. H. M. Jones (LRE III, 187–8)

	Lines	Unit	Nature of payment Date	Amount of payment	Number of recipients [conjectured]	Rate of payment [conjectured]
A	36 ff.	ala I Iberorum	stipendium, 1 Jan. 300	73,500 den.	367 1/2	x 200 [4 months]
B	"	"	annona, 1 Sept.–31 Dec. 299	23,600 den.	354	x 66 2/3 [4 months]
C	57 ff.	legio III Diocletiana	stipendium, 1 Jan. 300	343,300 den.	1,716 1/2	x 200 [4 months]
D	161 ff.	equites sagittarii	donativum, 20 Nov. 299	302,500 den.	242	x 1,250
E	"	"	donativum, 22 Dec. 299	302,500 den.	242	x 1,250
F	168 ff.	ala II Herculia dromedariorum	donativum, 20 Nov. 299	53,750 den.	215	x 250
G	"	"	donativum, 22 Dec. 299	53,750 den.	215	x 250
H	180 ff.	vexillatio of legio II Traiana	donativum, 22 Dec. 299	1,386,250 den.	1,109	x 1,250
I	186 ff.	vexillatio of various Eastern legions	donativum, 20 Nov. 299	2,496,250 den.	1,997	x 1,250
J	192 ff.	"	donativum, 22 Dec. 299	2,496,250 den.	1,997	x 1,250

	Lines	Unit	Nature of payment Date	Amount of payment	Number of recipients [conjectured]	Rate of payment [conjectured]
K	197 ff.	*praepositus of equites promoti of legio II Traiana*	*stipendium,* 1 Jan. 300	18,000 den.	1	x 18,000 [4 months]
L	"	"	*donativum,* 20 Nov. 299	2,500 den.	1	x 2,500
M	"	"	*donativum,* 22 Dec. 299	2,500 den.	1	x 2,500
N	204 ff.	*equites promoti of legio II Traiana*	*donativum,* 1 Jan. 300	93,12[5] den.	149	x 625
O	245 ff.	*vexillatio of legio III Diocletiana*	*salgamum,* 1 Sept.–31 Dec. 299	8,280 lb. oil and sext. salt	1,035	x 2 per month
P	259 ff.	*lanciarii of legio II Traiana*	*donativum,* 20 Nov. 299	1,097,500 den.	878	x 1,250
Q	"	"	*donativum,* 22 Dec. 299	1,097,500 den.	878	x 1,250
R	266 ff.	"	*donativum,* 1 Jan. 300	526,875 den.	843	x 625
S	285 ff.	"	*salgamum,* 1 Nov. and 31 Dec.	3,596 lb. oil and sext. salt	899	x 2 per month
T	291 ff.	*cohors XI Chamavorum*	*stipendium,* 1 Jan. 300	65,500 den.	524	x 125 [4 months]
U	"	"	*annona,* 1 Sept.–31 Dec. 299	32,866 den.	493	x 66 2/3 [4 months]

Note: The few arithmetical mistakes in JONES's Table have been corrected and italicised here.

donatives, and is thus clearly necessary. If the lower rate was 12/25 and not half the higher rate, J.'s conjecture in line N also needs to be emended.

Under IV and V J. deduced that *cohortales* received annually salary (*stipendium*) of 375 and ration-payment (*annona*) of 200 denarii. That again led to a significant discrepancy of numbers, this time between the totals deduced for the *cohors XI Chamavorum* (T–U). *Stipendium* made them 524, but *annona*, paid on the same day, 493. But the ratio between these two payments in respect of the same four months is not the 375:200 that J. assumes. Instead it is effectively 2:1 (65, 500 : 32, 866 = 1.99 : 1). A ratio of 2 : 1 would make annual *stipendium* 400 if *annona* was 200 as J. argued. It thereby brings the numbers of shares virtually into line, at 491 ^{1}/$_4$ (*stipendium*) and 493 (*annona*), reducing the apparent discrepancy on J.'s figures from 31 to 2 men.[64]

These are two instances in which J.'s interpretations appear unsound. Another case is that of the oil-payments to the *lanciarii* (see p. 545 above). The alternatives proposed here suggest that argument from whole-number factors and highest common denominators cannot be watertight when applied to this evidence. The approach presupposes that the products of simple multiplication sums accurately executed were always forwarded intact to the units concerned. If instead there were calculating errors, or if paymasters sometimes took a commission, as conjectured from military pay records, the figures as they stand will not always exactly reflect troop strength.[65] There is a strong possibility of deductions. Besides the indirect evidence of Egyptian army records, there is a graphic description of triple commission deducted from payments for grain requisition in Sicily under Verres.[66] The levying of commission by bureaucrats is indicated in the supplementary payments imposed on taxpayers in Egypt and elsewhere, which seem to have been a regular practice.[67]

It seems that factorial inferences carried out in isolation will not necessarily produce reliable results. Other tools with which to interpret the Beatty figures are thus needed. As has been seen, those supplied by the payments in kind lead to totally different results.

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[64] But if payments were at the higher rate argued above, the discrepancy becomes less than 1 man (Table I, line 10).

[65] For deductions in Egyptian army pay-records, see M. SPEIDEL, JRS 63, 1973, 141–7 at 144.

[66] This may, like other failings for which Verres is castigated, have been not uncommon (Verr. 2, 3, 181–4; compare 2, 3, 214–5 where Verres is blamed for doing what two of his predecessors had done).

[67] For supplementary charges in Egypt, S. L. WALLACE, Taxation in Roman Egypt, 1938, 38–41; he comments (41): «these small supplementary fees ... were usually intended for the benefit of the sitologi and other local officials of the granaries who may have purchased the connivance or the silence of Roman officials». For the fees of tax-collectors in the later Empire see JONES, LRE III, 131 n. 137, and A. C. JOHNSON – L. C. WEST, Byzantine Egypt: Economic Studies, 1949, 289 ff.