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Anthony Spalinger

Baking during the Reign of Seti I.

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BAKING DURING THE REIGN OF SETI I

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The detailed and often troublesome baking accounts dated to the reign of Seti I are noteworthy for their complicated arithmetical reckonings. Indeed, this group of papyri, first translated and commented upon in detail by Spiegelberg, are evidence for the sophisticated nature of the ancient Egyptian economic system [1]. As this point will be stressed in the conclusion of this analysis, I will make only a few general remarks at the outset concerning Seti's account papyri and their importance for understanding the high development of the Egyptian economic system at this date.

It has become somewhat common for modern scholars to compare the Pharaonic economy to an immense redistributive system wherein goods (staples such as food and clothing as well as rare and costly non-essentials) are produced or manufactured and then are cycled by means of a system of exchanges (via the temples or a more primitive barter system with a measure of value at its base) [2]. As a result, recent modern Egyptological

[1] The research for this study was done with the help of an Alexander von Humboldt Fellowship of the Federal Republic of Germany. In addition, I would like to thank the kind assistance of Professors Hartwig Altenmüller and Wolfgang Helck of Hamburg for their support during 1984-1985 when I was a von Humboldt Fellow.

The basic study of these papyri is by Spiegelberg, *Rechnungen aus der Zeit Setis I.*, Strassburg (1894) with the modern compendium of K*RI* I, 243 ff. Additional analyses are : Helck, *Materialien zur Wirtschaftsgeschichte des Neuen Reiches* IV, p. 437-45; Barns, *JEA* 34, 40-3 and Plate XI; Janssen, *SAK* 3, 168-9 and his *Commodity Prices from the Ramessid Period*, p. 465, n. 8; Gardiner, *AEO* II 228*-29*; and Megally, *Considérations sur les variations et la transformation des formes hiératiques du Papyrus E. 3226 du Louvre*, passim (for the hieratic signs) with his *Recherches sur l'économie, l'administration et la comptabilité égyptiennes à la XVIII^e Dynastie*, and *Notions de Comptabilité à propos du papyrus E. 3226 du Musée du Louvre*, p. 101-8 for the hieratic signs for grain measures.

After this work had been finished I checked the unpublished notes of B. Gunn in the Griffith Institute in Oxford and therefore I would like to thank Dr. J. Málek for his kind assistance as well.

[2] In general : Janssen, *Commodity Prices*, p. 539-62, *SAK* 3, 137-9 and 183-85, *GM* 48, 59-77; « The Role of the Temple in the Egyptian Economy during the New Kingdom », in *State and Temple Economy in the Ancient Near East* II, Leuven (1979) (= *Orientalia Lovaniensia Analecta* 6), 505-15, and *Royal Anthropological Institute News* 15, 17-9; Gutgesell, *GM* 56, 95-109; and Kemp, «Temple and Town in Ancient Egypt». in *Man, Settlement and Urbanism*, p. 658-66.

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scholarship has not been adverse to borrowing many of its ideas from the field of anthropology and in particular American Economic Anthropology. However, as much of economic anthropology is founded upon the supposed non-rationality of economic exchange (the famous Gift Exchange of Mauss and his followers being the most well-known), one wonders whether such a methodology is readily transferable to a highly developed state such as Egypt — a state with cities, markets, a system of value allowing a rational system of exchange, complicated and well developed methods of measure (area, weights, arithmetic, and geometry)[1]. Since the superstructure of Pharaonic civilization remained the state, temples, and interrelated bureaucracies — not to mention the royal court itself — the question may be posed as to whether American anthropological traditions, or indeed those of Mauss or Godelier and his followers, can serve to any great extent[2]. It must not be forgotten that although the masses of physical laborers remained the kernel of productivity for Egypt — and therefore indispensible for the

[1] For markets, see now Janssen, *De Markt op de Oever*. In general, Helck, *Wirtschaftsgeschichte des alten Ägyptens*, and Gutgesell, *Die Datierung des Ostraka und Papyri aus Deir el-Medineh und ihre ökonomische Interpretation* I, p. 533-74.

[2] For the use of Mauss : Liverani, *Or. Antiq.* 11, 297-317 and his students : Zaccagnini, *Lo Scambio dei Doni nel Vivino Oriente durante i Secoli XV-XIII, Dialoghi di Archeologia* 3, 3-65, and *Bollettino dell'Istituto di Diritto Romano « Vittorio Scialoja »* 82, 203-21; and Pintore, *Il Matrimonio Interdinastico nel Vicino Oriente durante i Secoli XV-XIII*. The problem with some of these works is the overstress on ritualized commercial dealings between nations : i.e., situations paralleled by the modern « Panda Trade » between the Republic of China and the USA. Neither the present example nor the ancient ones provide much data on the normal mundane commercial relations among the powers that be. This is not to deny the fresh and interesting work that this school of Rome has done but I question its application to the bases of economic behavior.

For a Soviet approach to the problem I will cite only the Western surveys of that vast literature : Dunn, *The Rise and Fall of the Asiatic Mode of Production*, Boston, Melbourne, and Henley (1982) with Baily and Llobera, *The Asiatic Mode of Production*, London (1981). There are two useful summaries by Pečirka, *Eirene* 6 (1967), 141-74 and Pečírková, *ArOr.* 47, 111-22. By and large the research of Diakonoff looms large and I can best cite his survey, now translated into English, in *Oikumene* 3, 7-100. Other studies by him are scattered in the Assyriological literature. One advantage that the modern Russian scholarship has is the concentration on economics and the nature of corporate ownership.

Additional works worth mentioning are : Herkovits, *Economic Anthropology*, New York (1965); Sahlins, *Stone Age Economics*, New York (1974); and Niedenzu, *Die Entstehung von herrschaftlich organisierten Gesellschaft*, Frankfort (1982). For Godelier : *Un Domaine contesté de l'anthropologie économique*, Paris (1974); *Rationality, and Irrationality in Economy*, trs. Pearce, London (1972); and most recently *Le Problème des formes et des fondements de la domination masculine*, Paris (1976). The last study reveals the strengths of Godelier's arguments as well as the weaknesses.

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development of intellectual pursuits (art, science, writing, literature, etc.) — it equally cannot be denied that the unique contribution of Egypt to the world remains precisely within those categories of thought. Neither a materialistic approach nor an aesthetic one serves to elucidate the full range of objective expressions that Egypt gave to human development.

If the above paragraph appears somewhat abstract, especially in comparison to the expressed aims of this discussion, namely, the account papyri of Seti, this is not unintended. Any analysis of Egyptian written material must interconnect the mundane results (such as the percentage of bread lost in baking) with a more general theme : i.e., that of the Egyptian economy in toto and its importance in revealing to us certain facets of the ancient Egyptian mind and its mechanism of thought. Spiegelberg's edition will remain the basis for all future research; however, a reading of his translations and commentary demonstrates the necessity for further clarification and explanation of what, precisely, is occuring within the accounts. The recent re-edition of Kitchen has furthered the *editio princeps* by providing corrections in transcriptions together with new readings, and in most cases his copy is to be preferred. For the most part the following discussion will follow the arrangement of Kitchen in volume I of his *Ramesside Inscriptions*, 244 ff., albeit with alterations [1].

I. — **P. B.N. 206, col. I** (K*RI* I, 244, 11 ff.) [2].

Year 2 *4 šmw day 23*
King of Upper and Lower Egypt Menma'at-Re, l.p.h.,
son of Re, Sety Merenptah, l.p.h., who lives for ever
and ever like his father Re every day.

[1] For the study of bread in these papyri : Währen, *Brot und Gebäck im Leben und Glauben der alten Ägypter*, a work which is abbreviated from his detailed studies in *Brot und Gebäck* 14.5 (1960), 86-96, 15.1-2 (1961), 1-18, 16.1 (1962), 12-20, and 16.2 (1962), 30-38. In fact, some of the inconsistencies in the first work should be compared to the more careful reasoning in the latter studies. The entries of « Backen », « Brot », « Gerste » and « Getreide », in *LdÄ* vols. I and II, should be consulted as well as p. 205-8 in Helck's *Wirtschaftsgeschichte*. Additional comments may be found in *Egypt's Golden Age*, Boston (1982), p. 112-13. For the accounts of Seti I the most useful work that I have found regarding baking loss of weight is by Moritz, *Grain-Mills and Flour in Classical Antiquity*, Oxford (1958). The reader must consult Part II of the work for his scientific calculations. Handy, too, is the standard *A Primer on Bread-making*, Oxford (1951) by Bennion. The reader will also find the recent work of Verhoeven, *Grillen, Kochen, Backen*, a mine of pertinent information.

[2] Helck, *Materialien* IV, p. 633; Spiegelberg, *Rechnungen*, Pls. V-VI and p. 15; for the store-house : Janssen, *Commodity Prices*, p. 456-7; note that the arrangement in K*RI* follows that of the regnal years of Seti.

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This day. One was in Memphis in the estate of A'a-kheper-ka-Re.
Missive. Receiving the emmer from the granary of Pharaoh, l.p.h., in Memphis
in order to make it into breads in the bakery (*ḥ3yt*) [1]
which is placed under the authority of the
Mayor of Memphis, *Nfr-ḥtpw.*
Transferred to the storehouse of Pharaoh, l.p.h.

The day accounts then follow. Note that the emmer wheat is here called « grain », *šs*, old *śšr*, as it is in some of the later accounts (K *RI* I, 260, 13 & 15; 261, 11; probably also 269, 16) [2]. The above text indicates that the grain came in from the granary and was immediately placed under the supervision of the mayor of Memphis. It was sent in its final state to the *wḏ3t* which I have translated as « storehouse » [3]. The order of processing is therefore : granary to bakery to storehouse. The following fragmentary lines indicate the actual deliveries :

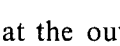
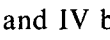
[4] *šmw*	day 23	Grain	100
[4] *šmw*	day 28	«	150
.....		»	180
[1 *3ḫt*]	day 14	»	180
.....		»	190
.....		»	180
.....		»	180
.....		»	180
.....		»	[260?]

[1] Helck, *Materialien*, p. 640; Spiegelberg, *Rechnungen*, p. 44-5; and Meeks, *ALex* III, 177 with *Wb.* II, 476, 14. The word appears to be derived from *ḥ3yt*, « portico », *Wb.* II, 476, 4-13 and *ALex* I, 226, II, 229 and III, 177.

[2] In these cases the word for « grain » is connected with emmer.

[3] Helck, *Materialien*, p. 640; note that the person in charge is the mayor of Memphis : Helck, *Materialien*, p. 440 and Megally, *Notions de comptabilité*, p. 39. For *'ḳw* as « breads », or « rations », see : Janssen, *Two Ancient Egyptian Ship's Logs*, p. 22-3; Scharff, *ZÄS* 57, 55 and n. 4; Müller, *JNES* 34, 255-7; *ALex* I, 74, II, 80 and III, 56; and the general study on Egyptian rations by Janssen in his *Commodity Prices*, p. 460-6 and *SAK* 3, 166-70. See also Le Clerc, *et al.*, *Journal of the American Society of Agronomy* 10, 215-7 on the milling and baking of emmer wheat. They note on p. 215 that it was difficult to remove the chaff from the grain with emmer.

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The measure used at the outset is the , which I will discuss in detail on pages 340-2 in Sections III and IV below. For the moment it is sufficient to note that 1  weighed 720 deben. As this small section of accounts merely deals with the arrival of sacks of emmer, nothing is related regarding the actual baking. The following passage deals with the deliveries and weighing of the baked breads.

II. — **P. B.N. 206, col. II** (K*RI* I, 245, 13 ff.) [1].

1 ꜣḫt day 7

One promenaded on the western shore.

Receiving the breads (*ḳw*) for/of the bakery (*ḥꜣyt*) which is under the authority of the Mayor of Memphis, *Nfr-ḥtpw*, from/in the storehouse of the Residence.

This day. Receiving from the storehouse of the Residence via the scribe of the altar *Ḥwy*, the son of *Pꜣ-ḥw*, and the scribe of the altar of the Residence, *Sꜣkꜣlꜣ* Small bread (?! sic) 1800 Each one 13 1/2 deben making 21500 deben.

This simple example reveals that the items weighed 13 1/2 deben apiece. If so, at first there appears to be a problem. As 13 1/2 × 1800 = 24300, 2800 deben are clearly lost. Per unit this comes to 1 5/9 deben. However, as is clear from the subsequent accounts of baking, there was the natural loss of weight in cooking to take into consideration [2]. For example, with 15 deben unbaked breads one normally lost ten per cent of the weight through the cooking, leaving 13 1/2 deben at the end. Here, however, the original unbaked loaves could not have weighed 15 deben apiece with an expected cooking loss of ten per cent as the first figure itself makes the final result in excess of the given 21500 deben. From the summary lists of the next account (see III below : K*RI* I, 250, 2-10) it is clear that 1800 large loaves weighed 12 deben apiece. With a little rounding off for this example (21500 to 21600), we arrive at the same result. In fact, the scribe probably made an error in writing 21500 for 21600 (although Spiegelberg's plate may be read otherwise) [3].

[1] Helck, *Materialien*, p. 636-7 and Spiegelberg, *Rechnungen*, Pl. VI and p. 10-11, 44-7. Megally has presented some discussion in his *Recherches*, p. 17-8 as well as his *Notions*, p. 20 and 59. For the term *šsp m-ˁ* see also Posener-Kriéger, *Archives Neferirkare*, p. 223.

[2] Barns, *JEA* 34, 42 with *Wb.* I, 21, 20. The modern compendium in Part II of Moritz, *Grain-Mills*, parallels perfectly the Seti I accounts : namely, the loss of 1/8 is standard. See in particular, his remarks on p. 195-209.

[3] See n. 2, p. 312.

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If both accounts coincide, we may then hypothesize that these large breads weighed 13.5 deben before cooking — as recorded here — but at the end lost about 11 per cent of their weight. The only problem with this attractive hypothesis is, why did the scribe note an incorrect deben total for breads a. 13 1/2 apiece. If they were baked, then the multiplication would have to be 13.5 × 1800 = 21500 (or even 21600). If, however, they were unbaked, beginning at 13.5 deben a piece, the same question remains. Finally, if they are unbaked but were reckoned a. 12 deben apiece from an original 13.5 deben size, why mention 13.5? I can only offer the following debatable reasons for this : (1) unlike the subsequent deliveries, there is no note that the loaves were actually weighed. Perhaps their final cooking weight was estimated, whereas the others were weighed; and (2) the later account does mention 1800 « large loaves » which come to 21600 deben : i.e., exactly a. 12 deben apiece. If the two references indicate the same loaves then the first is purely descriptive : i.e., it represents the type of bread by weight per loaf on the outset.

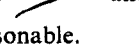
There is one additional problem to be mentioned here. The reading in line 2,3 appears to be « small bread » but it is clear that, a. 13.5 (or even 12) deben apiece, these breads were large ones [1]. The smaller types, described in the following lines, are the common kyllestis breads weighing normally c. 3.5 deben apiece after baking. Their large counterparts, called *ʿkk* loaves in Seti's accounts, were 15 deben before baking and normally 13.5 after. The hieratic itself is odd and perhaps « soft » or « weak » (*gnn*) was intended although this is a somewhat risky interpretation [2].

The next line refers to deliveries on 1 *ꜣḫt* 14 :

1 ꜣḫt 14

Receiving from the storehouse via the scribe of pure storehouse (?) [3] *Rʿ-ms* and the scribe *Nḫt*. Kyllestis bread 6000 making 18000 At the fixed rate of kyllestis bread 10 making 30 deben.

[1] See n. 3, p. 310 above, under *ʿḳw* and add Spiegelberg, *Rechnungen*, p. 41; Jecquier, *BIFAO* 19, 87; Janssen, *Commodity Prices*, p. 344-46; Barns, *JEA* 34, 42 and for the two types of breads : (a) *kršt : ALex* I, 399 and III, 311; Janssen, *Two Ancient Egyptian Ship's Logs*, p. 31; and Peet, *The Great Tomb Robberies of the Twentieth Egyptian Dynasty*, p. 56; and (b) *ʿkk : ALex* I, 75 and II, 81; Janssen, *Commodity Prices*, p. 344-5; and Helck, *Materialien*, p. 667.

[2] The hieratic reads :  and 600 instead of 500 seems most reasonable.

[3] Helck, *Materialien*, p. 636, reads « Wab und Schreiber ». However, it is probable that *wʿb* is an adjective. For *wʿb* attributed to the *šnʿ*, see *KRI* V, 119.10 and VI, 8, n. 5; Nelson, « The Calendar of Feasts at Medinet Habu », in *Work in Western Thebes*, 1931-33, p. 41; and Wiedemann, *PSBA* 7, 110.

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The latter phrase makes it easy to solve this problem for it indicates that a sample of 10 breads was chosen to estimate the entire load [1]. This was done with the subsequent three deliveries but thereafter the entire number of breads was weighed. Here, the kyllestis breads weigh 3 deben apiece. However, in the later deliveries these breads could weigh in excess of 3 deben per unit. Omitting the introductory comments concerning the deliveries, the figures are as follows :

1 *ḫt*	15	2400	kyllestis	breads	7400	deben	10	kyllestis breads	31
1 *ḫt*	16	1400	»	»	4590	»	10	» »	33.5
1 *ḫt*	18	2790	»	»	9795	»	10	» »	35

The calculations are almost exact : the bread can weigh 3.1 deben; 3.35 deben and 3.5 deben per unit. Note the increase in weight from the first delivery. Let us now turn to the subsequent deliveries, all of which are rather mundane.

1 *ḫt* 21 1090 + x (= 2090) kyllestis breads 8155 deben. He measured all of it.

The restoration of 2090 fits, as the final quotient becomes c. 3.9 deben for one bread.

1 *ḫt* 22 2200 kyllestis breads 7800 deben. He measured all of it.

These come out to 3 6/11 (= 3.5454.....).

1 *ḫt* 25 1600 + x (2600?) kyllestis breads 9453 deben. He measured all of it.

Here the most probable figure is 2600 (= 3.64 deben for one bread) but 3600, 4600, and 5600 are possible [2].

1 *ḫt* 28 668 + x (3668?) kyllestis breads 13800 deben. He measured all of it.

This fits best : 3.76 deben apiece.

2 *ḫt* 1

This day [his majesty, l.p.h.,] departed [for The]bes.

3710 kyllestis breads 13745 deben. He measured all of it.

Result : 3.705 (3 523/742).

[1] The « at the fixed rate of » : Gardiner, *JEA* 27, 49-50, n. 2; Megally, *Notions*, p. 112-3 and *Recherches*, p. 107; and Spiegelberg, *Rechnungen*, p. 45-6. See also *ALex* I, 157.

[2] See K*RI* I, 246, n. 8 a to line 8.

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2 ꜣḫt 4 4100 kyllestis breads 13580 deben. He measured all of it.

Result : 3 69/205 (= 3.336585.....). The remaining days merely confirm the calculations above : viz., that the kyllestis breads range between 3 and 4 deben and average out to a bit less than 3.5. This is partially supported by a later account of the *Rechnungen* wherein these same breads occur : see III below.

2 ꜣḫt 8 3715 kyllestis breads 17880 deben. He measured all of it.

There is a problem with the reading here and significantly Kitchen, Spiegelberg, and Helck disagree concerning the first figure : the result would be 4.8 if it is 1715, but this seems too high [1].

2 ꜣḫt 9 1200 + x kyllestis breads 4200 deben. He measured all of it.

The maximum must be 3.5.

2 ꜣḫt 12 3000 + x kyllestis breads 10230 deben. He measured all of it.

The maximum must be 3.41.

2 ꜣḫt 17 4000 + x kyllestis breads 15700 deben. He measured all of it.

The maximum is 3.925 (= 3 37/40).

2 ꜣḫt 20 4000 kyllestis breads 13620 deben. He measured all of it.

This is our first example over 4 deben per bread : 4 21/50 (= 4.42); it indicates that the correction for day 8, wherein one can read 1715, is not improbable.

2 ꜣḫt 22	3000 + x	10000 (Maximum = 3 1/3)
2 ꜣḫt 26	3820	13421 (= 3.53)
2 ꜣḫt 29	3870	12550 (= 3.24)
3 ꜣḫt 2	3843	12700 (= 3.305)
3 ꜣḫt 6	4986	16350 (= 3.27)
3 ꜣḫt 8	2390	7870 (= 3.292)

[1] K*RI* I, 246, 12 (= 1715); Helck, *Materialien*, p. 637 (= 3715 with a query); and Spiegelberg, *Rechnungen*, p. 11 (= 37(?)1(?)5).

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3 *ḫt* 10	2440	8050 (= 3.299)
3 *ḫt* 14	3790	12630 (= 3.33)
3 *ḫt* 16	2300	7850 (= 3.41)
3 *ḫt* 19	2880	9500 (= 3.298)
3 *ḫt* 22	2600	8900 (= 3.42)
3 *ḫt* 27	5266	17440 (= 3.31)
4 *ḫt* 8	11702	37220 (= 3.18)
4 *ḫt* 13	1000	3710 (= 3.71)
4 *ḫt* 17	1001	3090 (= 3.09)
4 *ḫt* 30	4205	18350 (= 4.36)

The average is interesting to calculate. By and large for the months of 2 and 3 *ḫt*, the median is c. 3.3 deben for 1 kyllestis bread. The days on which no breads were delivered unfortunately do not fit in neatly with the known festival days at this time [1]. However, since most of those known to us were associated with Thebes, the reasons for the omitted deliveries must be sought elsewhere. It is not too speculative to view the absence of the breads as dependent upon the various festivals in Memphis and, of course, the individual demands of her Mayor. In addition, even though the amounts recorded do not correlate nicely with the intervals between two days, it is probable that all of these intermittant deliveries fulfilled the state demands. Thus for the month of 2 *ḫt* around 33000 breads were baked whereas for the following month the total comes to 30495.

Before leaving this section the question regarding the significance of these deliveries must be tackled. Each entry points out that the breads were delivered from the storehouse; none notes anything concerning baking : i.e., there is no description of weight before or after baking nor any notation concerning expected and real weight loss in cooking. From the entries in Section I, I feel that this account deals solely with the arrival of the baked items direct from the storehouse. Instead of stating « received from the bakery », these entries state « received from the storehouse of the Residence » or something similar. The process has moved from the stage of baking as well as from the final one of storage. The weighing was performed in order to determine accurately the loaves and to check any unexpected weight loss. This also probably explains the problems with the first entry of the 13.5 deben loaves with the measure of c. 12 deben apiece. In sum, this lengthy entry describes the work after transportation to the bakery.

[1] These can be calculated from Schott, *Altägyptische Festdaten*, and Parker, *BiOr* 9, 100-3.

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III. — P. B.N. 204 « Col. II a » (K*RI* I 250, 2 ff.) [1].

In this small account a more meaty approach may be taken with the complex arithmetic of the breads. The first half of the text is located at the top right and top of Plate III a of Spiegelberg; it corresponds to the account at the bottom right and top. The first reads (K*RI* I, 250, 2-5) :

1601 1/4 392325
Total Small breads 107893 making 364371 deben
Small breads 6171 Large breads 1800 Making 21600 deben
Total 385971
Remainder 6354 deben.

As a first-level analysis the above figures can be interpreted as follows : the small breads weigh 3.377 deben apiece and the large 12. This is about the same as the deliveries in the previous account except that the larger ones appear to have gone from 13.5 deben to 12. Such cooking weight losses were normal, as the following sections will show. Second, the total of the two do not enter into the accounting : i.e., the third line is merely an equivalence between the number of small and large breads : both come to 21600 deben and the latter are not added to the final weight. In deben 364371 + 21600 = 385971. In the first line the second figure must be in deben : the first refers to the number of sacks () as seen from the complementary account (K*RI* I, 250, 7) where the amount (*ḥ*) of emmer wheat is equated with 1601 1/4. The final remainder matches 392325 — 385971. The difference cannot reflect the loss in cooking as the percentage is too low (1.6 %) [2].

The complementary account corresponding to the last one reads :

Total Emmer wheat 1601 1/4 sacks () Making small bread 112090
Coming to the storehouse Small bread 114000 + x (= 114265) Making 385971 deben
Remainder Small bread 6335 deben Making small bread 1825.

If the 1601 1/4 sacks of emmer are equal to 112090 small breads the latter a. 3 1/2 deben apiece come to 392315 deben. This must be used to correct the figure in line 1 of the

[1] Helck, *Materialien*, p. 637-8 and 640-1; and Spiegelberg, *Rechnungen*, p. 12 and 44-9.
[2] See the next section.

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previous account. Divided by 1601 1/4, it gives 245 1/183 deben for one sack (𓏏). (If the incorrect figure be used, then the quotient becomes 245 5/247 = 245.020242914 instead of 245.0054645.....). In any case, after considering the minute remainder involved in both cases, it is reasonable to conclude that one 𓏏 of emmer was 245 deben in weight [1].

The second account also tells us that the small breads were delivered to the storehouse. Hence, at least this list reflects the real state of affairs wherein one grand of small breads is counted. The first specifies two separate sums (reflecting two independent deliveries ?) in which some of the breads were a. 3.5 deben apiece and others a. 3.377. The remainder deben in the second account converted into small breads fits nicely : 6335 (instead of 6354) divided by 1825 gives 3.47, again about 3 1/2. The restoration of Peet in the third line (K*RI* I, 250, 9) seems most reasonable as he read 114[2]65 (?). The small breads in the first account total to 114064 (107893 + 6171). The deben loss in the second account matches the first : both come to c. 1.6 per cent, clearly too small to be considered as a normal cooking loss.

The two accounts therefore reflect two separate ways of determining the same results. The second begins with the total emmer wheat in sacks whereas the first does not name the grain employed. The number of small breads that were actually brought in was 114265. The per cent involved is : 114265 a. 3.37 deben apiece. In account one the scribe lists one group of breads, the small ones, a. 364371 deben total for 107893, that is a. 3.377 apiece. The third line with its equation of small and large breads reduces to 3.5 deben for 1 small bread. The question surrounding this line is explained in the next section. That is, why are the small breads valued at a higher rate than the first? The answer : different deliveries owing to different bakers or perhaps more precisely two separate weighings. The final remainder in account one of 6354 deben is the recorded weight loss.

The second account appears to contain a problem with respect to the number of small breads in line 1. 392306 deben / 3.5 = 112087.4 loaves (= 112090). This, however, merely indicates the possible number of 3.5 deben loaves than can be made from 1601 1/4 𓏏 of emmer. Turning back to the first account for a final word, the mathematics are :

$$(107893 \text{ a. } 3.377 = 364371) + (6171 \text{ a. } 3.5 = 21598.5) = 385971$$

This is the same figure as in account two allowing for the rounding off of the second number to 21600.

[1] See n. 2, p. 311 above. For the term « remainder » associated with this entry : Megally, *Notions*, p. 82-4 with *Recherches*, p. 118 and 150.

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In sum, then, account one is theoretical based on two separate rates for small breads whereas account two represents the actual deliveries based on one average rate for the breads :

	I		II	
TOTAL :	392315 (corrected)		392306	
	= 107893 a. 3.377 =	364371	= 114265 a. 3.377 =	385971
	6171 a. 3.5 =	21600		
	114064	385971		
LEFT		6354		6335

The fact that the two remainders are approximately rather than exactly the same is due to the minor difference of 6171 loaves a. 3.5 deben apiece entering into the equation of account one. This alteration was not important as they only came to a little over 5.3 per cent of the total weight at the outset. (The final weight in account two has summed all the variegated breads together whereas the first has not). The double reckoning in both accounts wherein inputs = outputs (after some detailed arithmetic) resembles a kind of double entry bookkeeping, a situation that repeats itself in other sections of Seti's accounts.

The question remains as to the precise stage in the cooking process reflected by these two reckonings. The mention of arrival at the storehouse appears to support the previous idea that the breads were manufactured from the emmer after arrival from the granary and later baked. Hence, the above two accounts — in my opinion the first being more detailed than the second — report on the storehouse activities. The sacks of emmer wheat are mentioned and so is the storehouse : i.e., the first and last stage in the cooking process. Finally, the remainder at the end of both accounts is definitely not a cooking loss as it is only c. 1.6 per cent. As normal losses ranged from 1/8 to 1/10, this remainder must refer to debens of emmer left over. The required number or weight was manufactured by the storehouse but some emmer still remained in its sacks.

IV. — **P. B.N. 204, Col. III, 208, Cols. I-II and 207, Cols. I-III** (K *RI* I, 250, 12 ff.) [1].

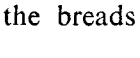
This lengthy account will help to clear up some of the presuppositions in the previous ones. The text reads at the beginning :

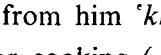
Regnal year 2, *1 ʾḫt 2*

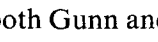
One was in Memphis in the temple of *ʾ-ḫpr-kꜣ-Rʿ*.

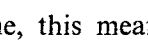
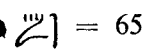
[1] Helck, *Materialien*, p. 634-6 and 640; Spiegelberg, *Rechnungen*, p. 16-9, and 36-43 and Megally, *Notions*, p. 59.

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Account of commands [1] to the bakers with flour for baking.
The šn' for the breads via *D3d3* Flour [2] *3 1/2* 

Come from him *'kk* bread 168 *Each one* 13 1/2 deben
1/10 for cooking () [3] 1 1/2 deben.

As this is quite easy to work with, the following remarks concerning the complex reckoning apply to all of the baking procedures in these accounts. Leaving off a discussion of  which both Gunn and Barns left untranslated, the following is clear : beginning with a weight of 15 deben per loaf, after baking the final product weighed ten per cent less (by 1 1/2 deben) [4]. Whereas this example incidentally reveals the normal loaf weight of such *'kk* breads to be 15 deben it also computes the final result. The flour is measured in this which is based on a sack of some sort. The sign  does not mean the normal *psw* measure. Rather, in these accounts, it indicates a loss through cooking and the heat sign is most apropos [5]. The total weight of the baked loaves came to 168 × 13 1/2 deben : 2268 deben. The ten per cent loss comes to 252. The total at the start was therefore 2520 deben. In terms of expected loaves we must have 2520 divided by 15; i.e., 168. QED.

The second, and perhaps more significant result of this single entry is the following : 2520 deben / 3.5 = 720 deben. That is, 1  = 720 deben. Comparing this account with the previous one, this means that the  of emmer wheat is approximately one third of the of flour. In addition, if the estimate of one deben at 91 grams be followed, then 1  = 65.52 kilograms [6].

[1] For *tp n :* Janssen, *Two Ancient Egyptian Ship's Logs*, p. 72 and *Commodity Prices*, p. 19, n. 18; Vernus, *RdE* 33, 110-11, n. b; Gardiner, *JEA* 27, 32, n. 4 and 38, 21, n. 3.

[2] For the *šn' : ALex* I, 374; II, 378; III, 292-93; Hayes, *A Papyrus of the Late Middle Kingdom in the Brooklyn Museum*, p. 107; Helck, *Wirtschaftsgeschichte des alten Ägypten*, p. 47-9 and 96; Bakir, *Slavery in Pharaonic Egypt*, p. 41-7; Janssen, *SAK* 3, 168 and n. 183; and Berlev, *The Workforce of Egypt during the Epoch of the Middle Kingdom*, p. 12-3, 21, 85-6, 101, 116-19, and 218-20.

[3] The best discussion remains that of Barns, *JEA* 34, 42, n. to 9 ff. He refers to the unpublished notes of Gunn in the Ashmolean Museum in Oxford. These I have checked in May 1985 with the kind courtesy and assistance of Dr. J. Málek and his assistants.

[4] The actual scientific study presented in Moritz, *Grain-Mills* is quite close to the accounts of Seti : see p. 195-209 for extraction rates of bread and his chapters on grades of flour.

[5] For this problem : Barns, *JEA* 34, 42, n. 1 and 2 with Spiegelberg, *Rechnungen*, p. 42.

[6] See note 2 above. For the grades (?) or types of flour as well as the words *nḏ* and *wḏyt :* Gunn, *JEA* 12, 135 with Peet, *The Rhind Mathematical Papyrus*, p. 114.

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The next line is merely a reiteration of the same method and presents the next delivery on the same day.

The šnʿ for the breads via *Ḫ³rw* Flour *3 1/4* (A ● 𓂝 =) «
Come from him *ʿkk* bread 156 5 *Each one* 13 deben
1/10 for cooking 1 1/2 deben *Remainder* lost
through cooking (?) *ʿkk* bread 5 [1] Dough 3 deben.

Here the calculations must be somewhat more complicated, since the required weight for the loaves was not obtained (13 deben instead of 13 1/2 per loaf). The second loss, which I have translated as « Remainder lost through cooking », is something else [2]. The baker actually delivered each loaf at a weight less than the prescribed amount. In other words the normal weight loss of ten per cent per loaf was superceded. Let us see how this was done.

The loaves were delivered at 13 deben apiece : off by 1/2 deben. This multiplied by 156 (the final amount delivered) gives 78. 78/15, the weight allowed at the beginning of the cooking process, gives 5 breads and 3 as a fraction. Both sums are indicated in line 3,4 (K*RI* I, 251, 1). The five has been crossed out, probably as a result of rechecking sometime after the original entry was written and it reappears to the left of the sum total of loaves, 156. The remainder of 3, left over after 78/15, is entered last : it was dough left over.

This calculation can be double checked in the following manner. 156 multiplied by 13 gives 2028; by 15 we get 2340. Likewise 3 1/4 × 720 deben (remembering that 1 A ● 𓂝 = 720 deben) = 2340, providing a useful check on the arithmetic and incidentally revealing that *Ḫ³rw* delivered the correct number of loaves, but each not of the desired weight. Now 2340 — 2028 is 312 and the last minus 1/10 (normal weight loss in cooking) of 2340 is 78, our desired number. QED.

Baldly put : for *Ḫ³rw*, the normal ten per cent was lost in baking but only with regard to 2028 deben's worth of loaves (each a. 13 deben at the end of cooking). His other

[1] No *sic* is needed in K*RI* I, 250, 16; see Spiegelberg, *Rechnungen*, Pl. III and p. 10-11 : the text reads : 𓏺𓏺𓏺 𓏺𓏺𓏺 ∩∩ , . The 5 is crossed out in K*RI* I, 251, 1 : 𓏺𓏺𓏺 𓏺𓏺𓏺 ∩∩∩ , .

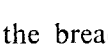
[2] For the problem : Spiegelberg, *Rechnungen*, p. 42-3 and 10-1; Helck, *Materialien*, p. 636; Gunn's notes and the remarks of Barns, *JEA* 34, 40-2; and Moritz, *Grain-Mills*, Ch. VII, p. 184-94 with comments on the different types of meal on p. 151-8 and their relation to baking losses. For the term *iw* + *m*(-ʿ), see Gardiner, *JEA* 27, 25, n. 5 and Megally, *Notions*, p. 75 and 86; and *ALex* I, 17; II, 20 (in accounts : « delivered »).

The hieratic for the final remainder (or deficit) is : *wḏ³t n* 𓂝; see also *iw n* 𓂝 in, for example, K*RI* I, 252, 1, line 3, 13.

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loss in weight was 78 deben. One final problem is the entry of 5 and the dough remainder of 3 : did, in fact, *Ḥ³rw* deliver the required number minus 5 loaves' worth of weight (= 75 deben)? This is, in fact, what the beginning of line 3,4 appears to indicate. If so, then the remaining 3 deben's dough makes sense : *Ḥ³rw* simply did not use it. As no dough can exist at the end of cooking, this conclusion seems more reasonable.

The next entry is :

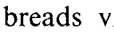
The šn' for the breads via *Nw-Imn* Flour *3 1/4* ( =) «
Come from him *'kk* bread 156 *Each one* 13 1/2 deben
1/10 for cooking 1 1/2 deben.

The line continues with the total for the three separate bakings on this day. Let us first work out *Nw-Imn*'s cookery. 156 breads a. 13 1/2 deben apiece were produced. The two figures multiplied give 2106. The latter is 9/10 of 2340, the original weight at the start. This fits : 3 1/4 × 720 = 2340. QED. *Nw-Imn* performed his job correctly. As for the total :

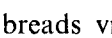
Total on this day large loaves 480 *Come for a*
cooking loss (?) 5 Grand total [48]5.

The three sums of 168, 156, and 156 correctly add to 480; note that the debit of 5 is also indicated. Furthermore, we learn that these *'kk* breads were also designated by the term « large breads »; the latter occurs in the last account wherein 1800 « large breads » a. 12 deben apiece were equated with small breads.

Line 3,7 continues the baking series of deliveries :

1 ³ḫt day 3 One was in Memphis.
The šn' for breads via *Ḏ³ḏ³* Flour *3 1/2* 
Come from him *'kk* bread 168 *Each one* 13 1/2 deben
1/10 lost for cooking 1 1/2 deben.

This is the same as the first entry for *Ḏ³ḏ³*.

The šn' for breads via *Ḥ³rw* Flour *3 1/4*  =) «
Come from him *'kk* bread 151 15 *Each one* 12 1/2 deben
1/10 lost for cooking 1 1/2 deben *Remainder* 1 deben
Making 'kk bread 10 Dough deben 6 (?).

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In this case *Ḥ3rw* delivered less than the total required in loaves by 5 (156-151) as well as incurring a deficit in weight by 1 deben (13 1/2 — 1). The reading of Spiegelberg for 12 1/2 is correct [1]. 10 + 5 is 15, the number written some time after the main entry, above and to the left of 151. The figure of 10 has been crossed out as in line 3,4 where the 5 (also the number of extra breads) has been corrected in the same manner. In deben this account can be interpreted as follows : 3 1/4 × 720 = 2340. 151 × 12 1/2 = 1887.5. 156 (the expected number of loaves a. 13.5) × 13.5 = 2106. (Remember 2340 deben — 1/10 loss (2340) = 2106). 2106 — 1887.5 = 218.5. The loaves were off by 1 deben apiece. 1 × 151 = 151 deben or 10 loaves a. 15 deben plus 1 deben dough remaining. 218.5 — 151 = 67.5. 67.5 / 13.5 (the final weight) = 5. The 15 entered after 151 is now located : it is equal to 10 loaves a. 15 deben plus 5 a. 13.5 deben. They are the separate losses in weight.

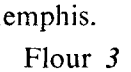
The šn' for breads via *Nw-Imn* Flour 3 1/2  =)
Come from him *'kk* bread 156 *Each one* 13 deben
1/10 lost for cooking 1 1/2 deben
Remainder 1/2 deben *Making 'kk* bread 5 Dough 3.

Again with the above in mind, *Nw-Imn*'s entry is simple to work out. The expected weight of 13 1/2 deben per loaf was not achieved, *Nw-Imn* producing only 13 deben breads. The figure of 5 was crossed out at the end and entered after the initial figure of loaves cooked, 156. With 2340 deben to be worked upon and the 9/10 of 2106 after cooking, the following results : 156 × 13 = 2028. The last subtracted from 2106 gives 78. This equals 15 × 5 (= 75) plus a dough remainder of 3. The account is verified. QED.

In line 3,9 we have the sum for this day's delivery :

Total of this day Large bread 480 *Come for a cooking loss* 15 Total 495.

The three deliveries of 168, 156, and 151 (with 15 lost in baking) total 175; the 15 is added in later. The missing 5 derives from line 3,9 wherein the extra 5 is noted after 156. This was not done in the summary of line 3,5.

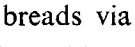
1 3ḫt day 4 One was in Memphis.
The šn' for breads via *D3d3* Flour *3 1/2* 

[1] No *sic* is needed in K*RI* I, 251, 7. The 15 fits the arithmetic perfectly and is probably to be read above and next to the figures for 151.

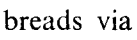
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Come from him *ʿkk* bread 167 1 *Each one* 13 1/2 deben
1/10 lost for cooking deben 1 1/2 *Remainder ʿkk*
bread 1.

Here the account is clear. Only one loaf (a. 13 1/2 deben) was not delivered. A figure of 1 can be faintly seen over the 167 but this was not noted by Spiegelberg or others [1].

The šnʿ for breads via *Ḫ³rw* Flour *3 1/4*  ◂
Come from him *ʿkk* bread 145 16 [2] *Remainder ʿkk*
bread 11 *Remainder lost for* cooking
Each one 13 1/2 deben *1/10 lost for* cooking
1 1/2 deben.

Fortunately, the reckoning is fairly simple. Note that the « Remainder *ʿkk* bread 11 » has been crossed out by checking and the figure of 16 (= 11 + 5) has been placed above and slightly to the left of the first entry, 145. Let us first interpret the grand sum of 145 : only this number of breads was delivered. As 156 was expected, 11 were thus missing and this is indicated in the entry. (Confirmation of this may be seen in line 3.5 above). 145 × 13.5 = 1957.5. 2106 (expected deben : 2340 − 1/10 × 2340) − 1957.5 = 148.5. The latter divided by 13.5 is 11, the number of breads missing. The final 5 comes from the next entry of *Nw-Imn,* which, added to 11, gives 16 [3]. There is no figure for the loss in cooking and so no number was entered in this report.

The šnʿ for breads via *Nw-Imn 3 1/4* flour  ◂
Come from him *ʿkk* bread 156 *Each one* 13 deben
1/10 lost for cooking 1 1/2 deben. *Remainder*
lost for cooking 5.

The final 5 was added into the additional entry in the previous line. (The grand total in line 1,17 confirms this) [4]. In *Nw-Imn*'s account the sums once again match. The correct number of breads was delivered but their weight was off by 1/2 deben apiece; i.e., 2106 deben expected weight but final weight of 13 × 156 = 2028. 2106 − 2028 = 78. 78 = 75 + 3. The latter figure is the outstanding dough; it was not entered. The final 5 is 75/15.

[1] Read in K*RI* I, 251, 12 (line 3, 11) : .

[2] The figures for 16 fit well enough : K*RI* I, 251, 14 (line 3, 12) has .

[3] The extra 5 can only be interpreted this way; there are no other digits left over in the account of *Ḫ³rw* to allow for the figure of 16.

[4] *Ibidem* for line 1, 17 : K*RI* I, 253, 4.

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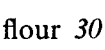
For the summary :

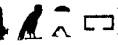
Total this day Large breads 479 *Come for a cooking loss* 5 Total 484.

This matches : 167 + 145 + 156 + 11 (remainder) = 479, which with the remaining 5 = 484. The 5 is listed separately as in the previous day summary.

The day summaries therefore list separately the loss due to baking but all add it to the total. Moreover, the first figure includes the breads delivered plus those expected as a normal effort. To put this in another way, the first figure includes the sum of the breads actually baked and delivered plus those which were expected to be baked. Owing to a reduction in number the accounts list both independent of each other under the individual entry. In the summary, however, the two figures are added together and entered first. The second figure in the summary is merely the amount of weight lost in cooking expressed in terms of loaves; this weight is not the expected percentage loss. The two sums are then added : breads in number desired (delivered plus deficit) and bread weight loss. This gives the required total in number : output = input. This is almost like a system of double entry book-keeping.

The final line (3.14 = K*RI* I, 252, 2-3) is a summary of the preceding :

Total flour *30* 
Come as large breads 1460 *Each one* 15 deben
Completed 13 1/2 deben in coming forth from cooking.

This grand total is partially inaccurate as clearly many breads did not « come forth from cooking (*m* ) » being 13 1/2 deben apiece. Although the 30 corresponds to 3 × (3 1/2 + 3 1/4 + 3 1/4), the total for the breads is 4 short (i.e., 485 + 495 + 484 = 1464). Even a simple calculation following the facts in line 3,14 would convince any Egyptian scribe : 30 × 720 deben = 21600. 1/10 of 21600 = 2160. The subtraction = 19440, which divided by 13.5 = 1440. Did the scribe confuse this ideal sum with the real one of 1464 and write instead of the latter a combination of both? i.e., did he forget the 4 owing to the 1440 but retain the 60 instead of the more correct 40? The problem cannot be resolved.

The second half of this account is even more interesting [1]. It involves the same three men, although a fourth, *ʿnḫ·tw*, enters at the end.

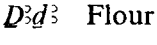
[1] Spiegelberg, Pl. VIII and p. 16-7; Helck, *Materialien*, p. 634-6.

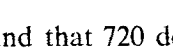
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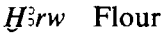
1 ꜣḫt day 5

Account of commands [1] to the bakers with flour
in order to make kyllestis bread Each one 4 deben
Finished 3 1/2 deben.

Before continuing, the reader will now see the justification for our supposition in account III above : namely, the description of small breads as kyllestis bread and their expected weight after cooking = 3.5 deben. However, in this case the alteration is from 4 to 3.5 deben, i.e., 12.5 per cent (1/8). This heading to the following entries was necessary as the bakers now had different commands from the state.

This day
The baker *Dꜣḏꜣ* Flour *3 1/2* 
Come kyllestis bread 602 *Remainder* 28
Remainder lost for cooking 78 3/4.

If it is kept in mind that 720 deben = 1 , what then results ? 3 1/2 × 720 = 2520 deben. 1/8 (2520) = 315. 2520 — 315 = 2205. This divided by 3 1/2 deben gives us the expected number of breads at the end as 630. The figures match : *Dꜣḏꜣ* actually brought 602 and that plus the missing 28 is 630. The other 315 deben when calculated into breads a. 4 deben apiece (beginning loss) = 78 3/4. In other words, the first remainder is loss in number and the second is loss in weight (converted back to number). Now *Dꜣḏꜣ* delivered 28 less than he was supposed to, but the total weight loss (third column) indicates that each loaf of the delivered 602 was actually less than 3.5 deben apiece [2]. How is this? The answer is simple : if the expected weight loss per loaf in the baking process was 1/2 deben then with 630 loaves we get the required figure of 315. *Dꜣḏꜣ* had an additional weight loss of 315 (78 3/4 × 4); hence, each of the 302 loaves delivered had to weigh < 3.5 deben apiece.

The baker *Ḥꜣrw* Flour 3 [1/2] 
Come [kyllestis bread 605] *Remainder* 25
Remainder lost for cooking 75.

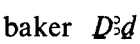
[1] For *tp n ḫnw :* see n. 1, p. 319 and Spiegelberg, *Rechnungen*, p. 36-7.

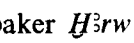
[2] That the final remainder (unexpected cooking loss) is not the normal 1/8 lost by cooking can be seen from the following entries. This is the only occurrence wherein a baker incurred an unexpected cooking loss equal to the normal percentage loss (= 78 3/4 deben).

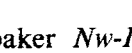
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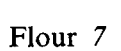
Since we know that 630 was the expected number of loaves, the fragmentary listing in line 1,5 is easily restored. The final figure ought to have been 78 3/4 if all went right. However, when it is remembered that incomplete deliveries could use up more weight per loaf than expected owing to the rather unscientific nature of the cooking process at this date, this is reasonable. Then too, the previous entries for *Dʒḏʒ*, et al., have revealed that the loaves could weigh less than the prescribed amount. As 75 × 3.5 = 262.5, the 605 breads weighed 262.5 deben less than they should have; per unit, this would be 262.5 / 2117.5 or 12 per cent. (The 2117.5 = 2205 − [605 × 3.5] and 2205 = 2520 [= 3.5 × 720] − 1/8 [2520]).

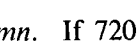
The next two lines (1,6 and 1,7) are missing, so it is impossible to determine with certainty the delivery of *Nw-Imn* or the grand total. (But see below, pp. 329-30).

[*1 ʒḫt day 6*]
[The baker *Dʒḏʒ* Flour *2 1/2* ]
Come kyllestis bread 430 *Remainder* 10 (sic) [1].
Remainder lost for cooking 53 1/4]

The baker *Ḥʒrw* Flour *2 1/2*  =)
Come kyllestis bread 450 *Remainder* 10 (sic) [1].
Remainder lost for cooking 67

The baker *Nw-Imn* Flour *2 1/2*  =)
Come kyllestis bread 430 *Remainder* 20
Remainder lost for cooking 37 3/4

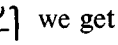
Total Flour *7 1/2* 
Come kyllestis bread 1310 *Remainder* 40
Remainder lost for cooking 158 Total 198.

Note the double form of book-keeping. As there is some difficulty with the first two entries, and the first is in fact restored from the day summary, let us turn to the report of *Nw-Imn*. If 720 deben = 1 , then 2 1/2 = 1800. 1/8 (1800) = 225 and 7/8 (1800) is 1575. 1575 / 3.5 = 450. Hence, the total of the first and second columns (i.e., breads delivered and remaining) must be 450. This locates an error in *Ḥʒrw*'s account (and presumably also in *Dʒḏʒ*'s : in both cases the entries

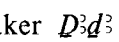
[1] This error will be explained below in the text.

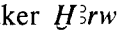
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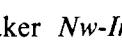
go above 450). With *Nw-Imn* the sums are correct (430 + 20 = 450). At 3.5 apiece they total to 1575, which is 7/8 of 1800. (The 1/8 expected loss of 225 = 56 1/4 breads). QED.

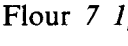
The report of *Ḥ³rw* is inaccurate since he delivered either 440 breads with 10 remaining or 450 with none outstanding. As the 450 is secure, I will henceforth read 450 0 and for *Ḏ³ḏ³* 430 20. Only by checking with the final grand totals in lines 2,10 - 2,12 (K*RI* I, 255, 3-5) will this problem be resolved. In the day's total the first two figures are accurate : for 7 1/2  we get 1350 (= 1310 + 10) breads a. 3.5 deben apiece or 5400 deben. 5400 — [1/8 (5400) = 675] = 4725 which, divided by 3.5, is 1350. The ideal case therefore has 168.75 (675/4) breads normally lost by the baking.

The next account is identical in format to the last :

1 ³ḫt day 7
The baker *Ḏ³ḏ³* Flour *2 1/2* 
Come kyllestis bread 430 *Remainder* 20
Remainder lost for baking 59

The baker *Ḥ³rw* Flour *2 1/2* ( =) ◂
Come kyllestis bread 430 *Remainder* 20
Remainder lost for baking ⟨5⟩7 3/4

The baker *Nw-Imn* Flour *2 1/2*  =) ◂
Come kyllestis bread 430 *Remainder* 20
Remainder lost for baking 35 3/4

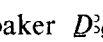
Total Flour *7 1/2* 
Come kyllestis bread 1290 *Remainder* 60
Remainder lost for baking 171 1/2 Total 232 1/2.

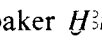
The entries follow those of the previous day and they are all accurate : the expected delivery of 450 loaves was met with a loss of 20 loaves in all three cases. The final line total (1,17) spells out « total », *wḏ³t*. The slip of the numeral « 50 » in line 1,15 can be checked; it must be restored [1]. I will omit the actual weight of the loaves as the fractions are insignificant.

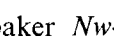
[1] Helck, *Materialien*, p. 634 and K*RI* I, 235, 2. No correction in Spiegelberg, *Rechnungen*, p. 17.

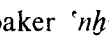
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1 ꜣḫt day 9

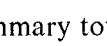
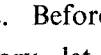
The baker *Dꜣḏꜣ* Flour *2 1/8* 
Come kyllestis bread 365 *Remainder* 17 1/2
Remainder lost for baking 52 3/8

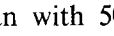
The baker *Ḥꜣrw* Flour *2 1/8*  =)
Come kyllestis bread 365 *Remainder* 17 1/2
Remainder lost for baking 28

The baker *Nw-Imn* Flour *2 1/8*  =)
Come kyllestis bread 365 *Remainder* 17 1/2
Remainder lost for baking 36 1/2

The baker *ʿnḫ·tw* Flour *2 1/8* 
Come kyllestis bread 365 *Remainder* 17 1/2
Remainder lost for baking 22 3/4

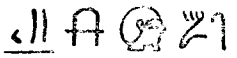
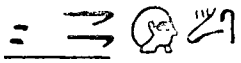
Total Flour *8 1/2* 
Come kyllestis bread 1460 *Remainder* 70
Remainder lost for cooking 139 *Total* 209 3/8.

The final summary total slips in an error for the loss in cooking and therefore the grand total is off as well : the first should read 139 5/8 and the second 209 5/8. There are even more serious problems with this section as well as the one following which hitherto have baffled scholars. Before I justify my readings on the hieratic signs for the fractions 2 1/8 and the summary, let us first turn to the previously accepted interpretation of 2 1/4 . If this were true, then 2 1/4 × 720 = 1620. 1/8 (1620) = 202.5. 7/8 is 1417.5 and the latter divided by 3.5 is 405. Hence, the final ideal output should be 405 kyllestis breads per man with 50 5/8 breads lost in baking (a. 4 deben apiece). However, the first two figures in these examples add up to 382.5, leading to the conclusion that the presupposition of 2 1/4 must be in error. (The only other possible mistake would be the equivalence of 1  = 720 but this is not the case). Turning to the final sum of 382.5, this must be 7/8 × (3.5 × another figure). 382.5 × 3.5 is 1338.75, which is 7/8 of 1530. 1530 deben must be equal to 720 × an unknown number. It is 2 1/8.

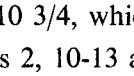
Now a close check on the plate of Spiegelberg reveals that instead of 2 1/4  we actually have the desired 2 1/8; the arithmetic fits perfectly. That is to say, 2 1/8 × 720 is 1530; 1/8 (1530) = 191.25; 7/8 (1530) = 1338.75; 1338.75 / 3.5 = 382.5; 382.5 = 350 + 17.5. QED.

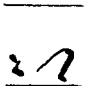
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The calculations fit, as does the hieratic (see Plate VIII of Spiegelberg) :

The baker *D3d3*	Flour	
The baker *H3rw*	Flour	
The baker *Nw-Imn*	Flour	
The baker *ʿnḫ·tw*	Flour	
Total	Flour	 (The is missing!)

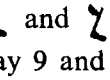
Note that the total itself is, indeed, 8 1/2 (= 4 × 2 1/8). Except for the entry of *Nw-Imn*, each sign following the hieratic for « 2 » is not a dot : i.e., it is not 1/4 sack (○). Rather, it is ◂ : i.e., a 1/2 of the quadruple hekat. That is to say : 1/8. The scribe has made a slip in *Nw-Imn*'s account as there — and only there — can 2 1/4 be read. As a solace to Egyptologists it may be worthwhile to note the parallel mistakes of ancient and modern scholarship.

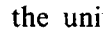
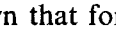
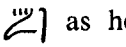
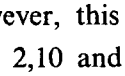
There is a final grand summary that should help us in these matters. Lines 2,9 - 2,13 present the final totals for the four bakers (K*RI* I, 255, 2-6). The sums are divided into two sections but let us look only to those that total the above day entries. According to the recent edition of Kitchen, we have 10 3/4, which would fit a 2 1/4  for day 9. Is this correct? The first half of lines 2, 10-13 actually reads (omitting the number of breads baked, lost, or otherwise) :

The baker *D3d3*	Flour	
The baker *H3rw*	Flour	
The baker *Nw-Imn*	Flour	
The baker *ʿnḫ·tw*	Flour	

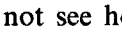
These figures represent the sum of the deliveries for the first four days (1 *3ḫt* 5, 6, 7 and 9). The next group of figures deals with 1 *3ḫt* 10 and they will be covered below. For *ʿnḫ·tw* there is 2 1/8 again. The first for *D3d3* is 10 1/2 plus 1/8 or, 10 1/2 + 1/2 quadruple hekat (= 10 5/8). The accounts of *H3rw* and *Nw-Imn* seem to come to 10 3/4. This is where the error of modern scholars has crept in : one should expect as, indeed, in Louvre

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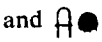
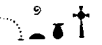
E 3226 (Megally, *Considerations sur les variations ...*, Pl. XXXIII) [1]. Clear hieratic forms for 3/4 are given in the second half of these total lines (2, 10-13) where the variants of  and  may be noted. In conclusion, we must read 2 1/8  for the accounts on day 9 and in the summary totals of the first half of lines 2,10 - 2,12 10 5/8; for line 2,13 read again 2 1/8.

We have now reached the point where it becomes imperative to understand more correctly the unit of measure . From the previous arithmetic correlations it was shown that for flour, 1  = 720 deben. It was therefore 3 times the sack () of emmer, itself appraised at c. 245 deben. Unfortunately, this measure is known from only one other papyrus, which is also dated to the reign of Seti I. Gunn preferred to leave the meaning aside, a choice followed also by Barns, although in one place he calls the  a quadruple sack, albeit with no justification [2]. One might translate  as hekat, sack-head, following a train of thought parallel in English to the « hogshead ». As the fractions following the measure are the same as those employed with the normal sack (), this has some justification in Egyptian as well as in English. However, this leaves open the real significance of . From the final summaries in lines 2,10 and the subsequent accounts, a second similar measure, the , occurs. As in this case the  clearly replaces the , it is reasonable to see the as an adjective modifying the first words (« hekat-head ») or joined as a substantive to the following . I do not see how a translation of « quadruple hekat » can be proved. Therefore, I will follow the method of Barns and leave the phrase in hieratic; fortunately, its significance in deben is secure.

The next section opens with the new measure :

1 *ꜣḫt* day 10
The baker *Dꜣdꜣ* Flour [1 3/4]  [.....]
The baker *Ḥꜣrw* Flour [1 3/4] " [.....]

[1] On the hieratic of this papyrus and of a similar time : Peet, *The Rhind Mathematical Papyrus*, 26; Megally, *Notions*, 101-8; and Gardiner, *The Wilbour Papyrus* II, p. 60-5.

[2] *JEA* 34, 40. He reads a quadruple sack for : ; a quadruple hekat for and  ... ; and ...  with hekat. I have preferred to leave the translation open, following Gunn.

The following discussion is speculative; see pages 339-430 below. Do the different measures reflect the different grades of flour? I.e., is a. 720 deben worse than a. 800 deben? See Moritz, *Grain-Mills*, 168-76 on varying grades. Good flour depends upon the quality of the grains, the removal of the bran coat, and on the homogeneity of the product. Fine meal produces a better cooked loaf and one that is of better texture as well.

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[The baker *Nw-Imn* Flour 1 3/4 ◄ .....]
The bake[r *ʿnḫ·tw* Flour 1 3/4 ◄ .....]

I have left off the restorations in lines 2,4 - 2,7 for the moment. The first question is whether the 1 3/4  is = 720 or another figure, and the second is the correct reading of the hieratic. From a look at Spiegelberg's plates there is little doubt that  does not match ○, the difference being ○ = ○ for ● = . This crucial difference has been overlooked by previous researchers. Finally, one must keep in mind that the accounts of *Ḥr³w* and *D³d³* contain errors in lines 1,9-10. Hence, it would be best to turn to a complete entry with this new measure (2,15) :

1 *³ḫt* day 11
The baker *D³d³* Flour *1 3/4*
Come kyllestis bread 350.

I have chosen this example because no remainder occurred : i.e., *D³d³* delivered the correct number of loaves (350), each of the correct weight. By the previous computations we have 350 × 3.5 = 1225. 1225 = 7/8 (1400). 1/8 lost in baking = 75 deben or 75/4 = 43 3/4 loaves. In other words, 1 3/4 = 1400 deben; therefore, 1 = 800 deben. The measure is thus different from the earlier one. This is in fact why in the summary lines of 2,10-13 the 1 3/4 is listed separately and after the 10 5/8 : the two being different, they cannot be totaled together.

We are now ready to begin the restorations in lines 2,4-7. *Nw-Imn* is impossible to fill in, owing to a further loss in line 1,6; *ʿnḫ·tw* is the easiest, so he will be chosen. The final summary of line 2,13 reads :

The baker *ʿnḫ·tw* Flour *2 1/8*
Flour *1 3/4* ◄ (=)
Come kyllestis bread 715 *Remainder* 17 1/2
Remainder lost to baking 46 1/2 *Total* 64.

Line 2,1 has for *ʿnḫ·tw* :

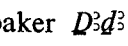
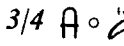
The baker *ʿnḫ·tw* Flour *2 1/8*
Come kyllestis bread 365 *Remainder* 17 1/2
Remainder lost to baking 22 3/4.

Hence, for the missing line 2,7 the restoration is :

The bak[er *ʿnḫ·tw* Flour *1 2/4* (=) ◄
Come kyllestis bread 350
Remainder lost to baking 23 3/4].

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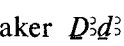
For *Dʒdʒ* the totals are (line 2,11) :

The baker *Dʒdʒ* Flour *10 5/8* 
1 3/4 
Come kyllestis bread 2177 *Remainder* 85 1/2
Remainder lost to baking 260 7/8 *Total* 350 3/8.

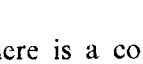
The total of the first two figures is 2262.5. The individual entries of *Dʒdʒ* are :

602	Remainder 28	Remainder lost to baking 78 3/4
430	Remainder 10 (sic = 20)	Remainder lost to baking 53 1/4
430	Remainder 20	Remainder lost to baking 59
365	Remainder 17 1/2	Remainder lost to baking 52 3/8

The sum of column one is 1912.5. 2262.5 — 1912.5 — 350. This holds, as was noted on page 331. Column two adds up to 75.5 which, with the 10 from the error of 10, gives 85.5. 85.5 — 85.5 = 0. Regarding the final column : the sum is 243 3/8. 260 7/8 — 243 3/8 = 17 1/2. Therefore, line 2,4 must read as follows :

The baker *Dʒdʒ* Flour [*1 3/4*] 
[*Come* kyllestis bread 350
Remainder lost to baking 17 1/2].

For *Ḥʒrw* there is a correction to be made. The summary of line 2,11 reads :

The baker *Ḥʒrw* Flour *10 5/8*  
Flour *1 3/4*
Come kyllestis bread 3075 (sic = 2075)
Remainder 137 1/2 *Remainder* lost to baking
251 3/4 *Total* 389 1/4

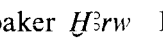
For the complete entries of *Ḥʒrw* :

605	Remainder 25	Remainder lost to baking 77
450	Remainder 10 (sic)	Remainder lost to baking 67
430	Remainder 20	Remainder lost to baking ⟨5⟩7 3/4
365	Remainder 17 1/2	Remainder lost to baking 28

The total of the first two columns (without the 10) adds up to 1912.5. We therefore would expect 2262.5 minus 1912.5 to be contained in the lost entry of line 2,5 : i.e., 350

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kyllestis breads as with the others. Is this the case? Clearly not, as the scribe has entered a too high figure of 3075 in the total line. Altering 3075 to 2075 (not a major problem) leads to 2075 + 137.5 (remainder) = 2212.5. This is 50 short of the expected figure. The 50 may be found in line 1,15 where it was omitted (see page above). Unfortunately, this figure is from the « remainder lost to baking » section and should be added in the third column above. Regarding the remainder loss through baking, column three totals 229 3/4 (if the missing 50 is not entered). The total being 251 3/4, this leads to 22. Hence, the 50 belongs to the regular remainder column as it cannot be entered into the total of the unexpected baking losses. Line 2,5 can be restored :

The baker *Ḥ3rw* Flour *1 3/4*  =)
[*Come* kyllestis bread 350
Remainder lost to baking 22].

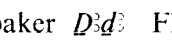
As the summary entries have already been covered, I will translate only the introduction to them in lines 2,8 - 2,9 :

Come as these kyllestis [breads] x *Remainder* x + 108
Remainder lost to baking 788 + x
Remainder ..... Small bread 160 + x ..... 2.
Their specification Total for the baker according to his name.

The list totals then follow; the previous two lines are too fragmentary for analysis.

The next has :

1 3ḫt day 11

The baker *Ḏ3ḏ3* Flour *1 3/4* 
Come kyllestis bread 350

The baker *Ḥ3rw* Flour *1 3/4*
Come kyllestis bread 350
Remainder lost to baking 17 1/2

The baker *Nw-Imn* Flour *1 3/4*
Come kyllestis bread 350
Remainder lost to baking 8 3/4

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The baker *ʿnḫ·tw* Flour *1 3/4*  ‹

Come kyllestis bread 350

Remainder lost to baking 17 1/2

Total Flour *7* 

Come kyllestis bread 1400

Remainder lost to baking 43 3/4.

The correct numbers of breads were delivered by all four men : no bread remainder number is recorded. The next account is :

1 ꜣḫt day 12

The baker *Dꜣdꜣ* Flour [*1*] *3/4* 

Come kyllestis bread 350

Remainder lost to baking 15 (1)

The baker *Ḥꜣrw* Flour [*1*] *3/4*  ‹

Come kyllestis bread 350

Remainder lost to baking 25 1/2

The baker *Nw-Imn* Flour [*1 3/4*  ‹]

Come kyllestis bread 350

Remainder lost to baking 15

[The baker *ʿn*]*ḫ·tw* [Flour *1 3/4*  ‹

Come kyllestis bread 350

Remainder lost to baking x]

Total Fl[our *7* 

Come kyllestis bread 1400

Remainder lost to baking 55 1/2 + x].

Here the entries are easy to restore. Note that the first loss remainder for *Dꜣdꜣ* has been subsequently crossed out and entered above and next to the figure of 250 as in account III. The next group also follows the same format :

1 ꜣḫt day 14

The baker *Dꜣdꜣ* Flour *1 3/4* 

Come kyllestis bread 350

Remainder lost to baking 20

(1) K*RI* I, 255, 14 : kyllestis bread.

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The baker *Ḥ³rw* Flour *1 3/4*  «
Come kyllestis bread 350
Remainder lost to baking 6

The baker *Nw-Imn* Flour *1 3/4*  «
Come kyllestis bread 350
Remainder lost to baking 10

The baker *ʿnḫ·tw* Flour *1 3/4*  «
Come kyllestis bread 350
Remainder lost to baking 6

Total Flour *7*
Come kyllestis bread 1400
Remainder lost to baking 42.

The next sequence :

1 ³ḫt day 15

1 ³ḫt day 16

The baker *D³d³* Flour *2 1/4* 
Come kyllestis bread 360 *Each one* 4 deben
when coming forth baked

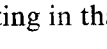
The baker *Ḥ³rw* Flour *1 3/4*  «
Come kyllestis bread 255 (sic = 250) *Each one*
4 deben when coming forth baked *Remainder* 30

The baker *Nw-Imn* Flour *1 3/4*  «
Come kyllestis bread 280 *Each one* 4 deben
when coming forth baked

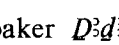
The baker *ʿnḫ·tw* Flour *1 3/4*  «
Come kyllestis bread 280 *Each one* 4 deben
when coming forth baked

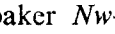
Total Flour *7 [1/2]* 
Come kyllestis bread 1175 *Each one* 4 deben
when coming forth baked *Remainder* 30.

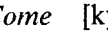
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The hieratic in the total line (1,19) is clear : 30 instead of 10 [1]. This figure as well as the remainder of 30 in the entry of *Ḥ3rw* has been crossed out in checking. This day's entry is interesting in that the measure of  is employed with 2 1/4 as well as 1 3/4; the arithmetic supports the value of 800 deben = 1 . 2 1/4 × 800 = 1800. If each bread for *D3ḏ3* was baked at 4 deben apiece, this would mean 1440 deben, leaving 360 lost in the process. The per cent loss would be 20 (= 1/5). Hence, the original unbaked breads must have weighed 5 deben apiece at the start. For the others let us take the easier accounts (*Nw-Imn* and *ʿnḫ·tw*) : 1 3/4 × 800 = 1400. 280 × 4 = 1120. The result is 280. 280 / 1400 = 1/5 or 20 per cent. Again, the original breads were 5 deben apiece. The entry for *Ḥ3rw* is therefore inaccurate and we must read 250 instead of 255. Perhaps the red ink used for the « ditto » after the figure of 255 indicates a check here. Note that there was no delivery on 1 *3ḫt* 15.

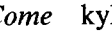
1 3ḫt day 17

The baker *D3ḏ3* Flour *2 1/4* 
Come kyllestis bread 120 *Each one* 4 deben
when coming forth baked
Again (?) kyllestis bread 313 *Each one*
3 1/2 deben when coming forth baked

The baker *Nw-Imn* Flour *2 1/2* 
Come kyllestis bread 130 *Each one* 4 deben
Again (?) kyllestis bread 210 *Each one*
3 1/2 deben when coming forth baked

The baker *ʿnḫ·tw* [Flour ... ]
Come [kyllestis bread ... *Each one* 4 deben
Again (?) kyllestis bread] 50 *Each one*
3 1/2 deben when coming forth baked

Remainder 50

[*Total* Flour 4 3/4 + x 
Come kyllestis bread 250 + x *Each one* 4 deben
Again (?) kyllestis bread 575 *Each one*
3 1/2 deben when coming forth baked

Remainder 50].

[1] K*RI* I, 256, 12 (line 1,16) and 15 (line 1,19).

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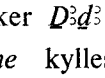
The sign employed by the scribe for Kitchen's *wḥm*, « again », is certainly not a poorly made *wḏ3t*. In fact, a typical *wḏ3t* can be seen in the entry for *ʿnḫ·tw* in line 2,4 close to the end of this entry [1].

In line 2,2 the calculation of (120 × 5) + (313 × 4) = 1852. (I am working on the figures for breads before baking). 2 1/4 × 800 = 1800. The two do not match. However, (120 × 4.5) + (313 × 4) = 1792 is close to the desired figure of 1800 deben. Can we alter the 313 breads a. 3 1/2 after cooking (but 4 before) to 315? If so, the equation becomes (120 × 4.5) + (315 × 4) = ? 1800. It does. QED. With this minor correction I would conclude that the first breads were 4.5 deben apiece unbaked and 4 baked (loss 1/9); the second incurred a 1/8 loss going from 4 deben unbaked to 3.5 baked.

For the entry of *Nw-Imn* there is a greater error. If 2 1/2 be given, then we must look for 2000 deben at the start. (130 × 4.5) + (210 × 4) = 1425 deben. Was the remainder of 575 not entered or are the figures inaccurate?

The account for lines 2,6 - 2,11 is easy to restore :

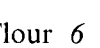
[*1 3ḫt day 18/19/20*]

[The baker *D3ḏ3* Flour *1 1/2* 
Come kyllestis bread 300
Remainder lost to baking 42 1/2]

The baker *Ḫ3rw* Flour [*1 3/4*] 
Come kyllestis bread 350

The baker *Nw-Imn* Flour *1 3/4* 
Come kyllestis bread 350
Remainder lost to baking 20

The baker *ʿnḫ·tw* Flour *1 1/2* 
Come kyllestis bread 300

Total Flour *6 1/2* 
Come kyllestis bread 1300
Remainder lost to baking 60 1/2.

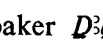
The restorations follow on the given 1  = 800 deben. Each bread is again 3.5 deben after baking and 4 before.

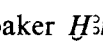
[1] In hieratic : *wḏ3t* –  ; *wḥm* – .

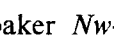
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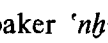
The next entry also poses no problems :

1 ꜣḫt day 21

The baker *Ḏ*ꜣ*d*ꜣ Flour *2* 
Come kyllestis bread 400

The baker *Ḥ*ꜣ*rw* Flour *1 1/4* 
Come kyllestis bread 250

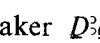
The baker *Nw-Imn* Flour *1 3/4* 
Come kyllestis bread 350

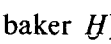
The baker *ʿnḫ·tw* Flour *1 1/2* 
Come kyllestis bread 300

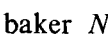
Total Flour *6 1/2* 
Come kyllestis bread 1300.

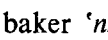
The following :

1 ꜣḫt day 22

The baker *Ḏ*ꜣ*d*ꜣ ⟨Flour⟩ *2* 
Come kyllestis bread .....

[The baker *Ḥ*]ꜣ*rw* Flour *1 3/4* 
Come kyllestis bread .....

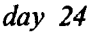
[The baker *Nw*]-*Imn* Flour *1 3/4* 
Come kyllestis bread .....

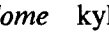
[The baker *ʿnḫ·tw* Flour ..... 
Come kyllsetis bread .....

Total Flour 5 1/2 + x .....]

If there was no remainder then the first three entries may be restored with the number of kyllestis breads at 400, 350, and 350 respectively; the total would be 1100 + x.

1 ꜣḫt day 24

The baker *Ḏ*ꜣ*d*ꜣ Flour *2* 
Come kyll[estis bread .....]

The baker *Ḥ*ꜣ*rw* Flour *1 1/4* 
Come [kyllestis bread .....]

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The baker *Nw-Imn* Flour *1 1/2*  
Come [kyllestis bread .....]

The baker *ʿnḫ·tw* Flour *1 1/2*  
Come [kyllestis bread .....]

Total F[lour *6 1/4*]
Come kyllestis bread [.....]

Restorations for the number of kyllestis breads probably are : 400, 250, 300, 300, 1250 (total). The remainder accounts are too fragmentary for consideration.

I have not covered the intricate percentages dealing with the remainder « lost to baking » as these would have been too complex. In essence, this last figure covers the amount of weight lost, the measure being the number of breads. The Egyptians simply weighed the final product (breads) and converted the weight loss, if any, to number. Hence, the second column gives the number lacking and the third likewise the weight. A simple example can be seen in line 2,15 (K*RI* I, 255, 8). *Dꜣḏꜣ* delivered the required number of 350 loaves from 1 3/4  = 1800 deben's weight. All of the prescribed loaves were of the correct weight; they amounted to the correct number as well. His companion *Ḥꜣrw*, however, produced less weight at the end although delivering the correct number of kyllestis loaves (line 2,16). The scribe has made a note that there was a remainder lost in baking of 17 1/2 loaves. This is probably to be calculated = 3.5 deben apiece since the regular remaining figure, normally preceding the baking loss figure, is rated a. 3.5 deben per unit measure and it is added to the last : i.e., both should be rated with the same measure. In addition, as the final amount was weighed in at the end, a rate of 3.5 must have been applicable since the original unbaked rate of 4 deben per loaf has significance only at the outset of the cooking process. Finally, in a previous entry, *Dꜣḏꜣ* delivered 430 breads instead of the demanded 450 (line 1,14 = K*RI* I, 253, 1). This meant that the second column had to list the missing 20. Unfortunately for him the product had a further loss and this was entered as a remainder loss to baking of 59 loaves (or 206.5 deben total); per unit this comes to 206.5/1505 (430 × 3.5) or a 13.7 per cent loss.

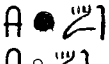
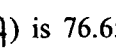
The reasons why the number of breads could vary in the cooking as to final sum and weight per item are not difficult to envisage [1]. The amount of water used and its

[1] In general, Moritz, *Grain-Mills*, p. 151-8 and 177-83. He stresses the use of the sieve (in Classical Antiquity) as the sole means of producing better grades of flour; the grinding process does not enter into any consideration of flour grading. It was sifting that raised the standards of the flour sacks : see his comments on p. 156 in particular.

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concomitant evaporation through cooking must be one cause. However, this factor should have been easy to determine arithmetically and I suspect that the expected loss through the cooking process was empirically well enough understood by the Egyptians : their baking losses of 1/8 and 1/10 bear witness to this [1]. An even more significant factor may have been the varying quality of the flour itself. Indeed, this factor would affect the rate of water retention : i.e., finely ground flour absorbs more water than one of a coarsely ground character, thereby weighing more. Similarly, a volume measure of coarsely ground emmer wheat would actually possess less wheat than the same measure of a finer brand. Some indications that these may have been determining factors can be observed in the accounts of this section. One case points out that dough was left over although the original weight was the same. In summary, using physical terminology, the mass of the prepared mixture varied even though the same amount of flour in weight was always added. Modern second grade ice cream poses a good parallel : the volume is increased through aeration. Likewise, an increase in the water content would extend the number of loaves.

In view of the last paragraph it might be useful to turn to the absolute determination of the various measures of wheat and flour employed in these accounts. The three are :

(1) 1  of emmer = 245 deben = 22.295 kg;
(2) 1  of flour = 720 deben = 65.52 kg;
(3) 1  of flour = 800 deben = 72.80 kg.

As a sack ( ) is 76.65 liters we arrive at 1 liter of emmer = .29 kg or 291 grams. This is considerably lighter than what one would expect; because of this I checked my readings with the unpublished notes of Gunn located in the Griffith Institute only to find that he, too, arrived at identical conclusions [2]. From the standard modern study of Percival the following is recorded [3] : for wheat, taking the lightest weight per 100 grains (mealy wheat) and the equivalent smallest volume per 100 grains (also mealy wheat). the equation is :

100 grains = 3.1 cc; 100 grains = 4.04 grams.

Or 3.1 cc = 4.04 grams. 1 gram = .7673 cc and as a liter is 1000 cc, this means that there

[1] For varying weight losses and their reasons : Moritz, *o.c.*, p. 197 (Tables X and XI : weight absorption and bread yield). Also, see his chart on p. 222 : wholemeal versus 70 % flour.

[2] These were checked with his unpublished notes. I am frankly still surprised at the weight of 245 deben per .

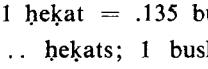
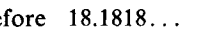
[3] John Percival, *The Wheat Plant*, London (1921), p. 19. Note that I am using wheat at this point.

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are 767.3 grams per liter; per sack this is 58744.488 grams or 58.74 kg, more than twice the 1  of emmer as calculated from Seti's accounts. Notwithstanding the more heterogeneous character of the emmer in the Ramesside Period than the wheat of today (i.e., the greater air spaces among the grains in antiquity as compared to today), the two figures remain quite distinct. However, if the emmer in the  was composed of thrashed ears, i.e., the « husked » grain (or Wesen), itself consisting of 73-75 % of caryopses and 21-25 % of chaff (botanically defined as glumes plus the rachis, not the stalk), the weight would be 40-49 kg per hectoliter or .4 to .49 kg per liter [1]. This leads to 400-490 grams/liter

[1] *Ibidem*, p. 191. In his notebooks Gunn listed his observations on the varying weights : (a) 1 liter of wheat grain (this I suspect is emmer but Gunn does not specify) weighs 895 grams; (b) 1 liter of flour ground by natives in a native mill weighs 725 grams; and (c) 1 liter of barley weighs 673 grams. Converting to an Egyptian sack, the , which I take to be 76.56 liters (yet see Janssen, *Commodity Prices*, p. 109 with Reineke, *MIO* 9, 159 and 162 on the sack as 76.88 liters), we have : (a) 1 Egyptian sack of wheat = 68.52 kg; (b) 1 Egyptian sack of flour = 55.506 kg; and (c) 1 Egyptian sack of barley = 51.53 kg. (Note that Černý, in *Cahiers d'histoire mondiale* 1 (1953/54), 914 ff. also employs the lower estimate). I also follow the standard 1 deben = 91 grams (Gardiner, *Eg. Gr.*[3], § 266, 4).

Percival's estimates of emmer weight clearly do not equate with Gunn's observations. Baer's estimate in *JARCE* 1, 42-3 comes to 1 Egyptian sack = 39.27 kg. (Insofar as he uses American measures, for which there is no justification, the conversions are : 1 ḥeḳat = 4.78 liters; 1 bushel of emmer = 40 lbs.; 1 ḥeḳat = .135 bushels; 1 bushel = 7.407407... ḥeḳats; 1 bushel = 18.1818... kg.; therefore 18.1818... kg. = 7.407407... ḥeḳats. The result is 1 ḥeḳat = 2.4545... kg.; or 1 Egyptian sack = 39.27 kg.). This result, based on H. Wilson's *Grain Crops*, New York (1955), p. 201 and 235, is close to Percival and further away from Gunn. A third estimate can be drawn from Moritz, *Grain-Mills*, p. 185. There, we are given the weight of modern wheat as 47-50 lb./foot^3 and that of flour as 30-35 lb./foot^3. Making the necessary conversions, the results are : 1 Egyptian sack of wheat weighs 57.73 kg. and 1 Egyptian sack of flour weighs 36.90 kg.

The conclusion regarding these differing results is hard to find. I suspect that the variation in wheats is partly to blame but perhaps the method of packing (i.e., storing) may be at fault as well. I.e., wheats, but especially flour, when packed tightly increase in weight per unit measure. This is known to all cooks, who handle flour when measuring in a very careful manner lest more flour be added to the batter. In essence, Percival's emmer estimate is closest to our measure with Baer's next. Moritz is not employing emmer wheat; nor is Percival in his first estimate. This leaves Gunn's empirical observations to be reconciled. Must we therefore regard the  of emmer as equal to a quadruple sack? : Barns, *JEA* 34, 40, line 4 to text. If so then the  would = 89.18 kg. It is for these reasons that I believe the two measures  and  must be separated from the word for « sack ». I.e., they must represent something else. Clearly, they are not a quadruple of the sack () as they are not 4 × 245 deben. In the text I tentatively assume that they refer to varying degrees of flour, perhaps caused by better sifting.

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and 30.624 kg per sack, taking the lower figure. This is roughly the same as in our accounts, again taking into consideration the considerably greater homogeneity of wheat in our age. I think, then, there can be no difficulty in presupposing the presence of the glumes in the sacks under consideration; when baked they would make the final product a bit crunchier; the same may be said regarding the rachis although the results would have been even rougher.

Regarding the second and third measures, it will be shown in the subsequent account that 1  of flour is to 1  of emmer as 1 : 2.5. Given the above two weights this means that 1  of emmer weighs 320 deben. Hence, we have further confirmation that the sack measure () is not that same as the , even though both were used with emmer. Can one assume that in these accounts the of emmer was the more unprocessed product and the a later more processed one, with flour being the final product? i.e., were the and the employed as measures for processed grains such as emmer? However, this moves us into the realm of speculation and it is perhaps best to stop here [1].

V. — P. B.N. 205, 1,1 ff. (= K*RI* I, 259, 6 ff.) [2].

This short albeit interesting entry presents at the beginning fifteen lines dealing with the equation of amounts of flour with amounts of emmer wheat. The basic pattern is repeated in every line although an error has crept into line 1,10. The days run from 3 *ꜣḫt* 21 to 4 *ꜣḫt* 5 in one day intervals. The first line (1,1 = K*RI* I, 259, 6) may be taken as a paradigm for all :

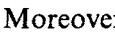
3 ꜣḫt day 21
Which was given to the bakers Flour *7 1/2*
Making emmer wheat *18 3/4*

The ratio of flour to emmer is 1 to 2 1/2, i.e., this line gives the equivalence of emmer and flour in their separate measures. (Note that the copies of Spiegelberg and Kitchen are in error). Since 1 of flour = 800 deben, 1 of flour = 720 deben, and 1 sack () of emmer = 245 deben, some equivalences may be made. Following the equation from this account : 800 deben = 2.5 × of emmer; 1 of emmer = 320 deben. Now as 1 sack () of emmer = 245 deben, it is readily clear that the ,

[1] See the previous note.

[2] Helck, *Materialien*, 638 and Spiegelberg, *Rechnungen*, p. 12-3 and 49. There is a mistake in line 1, 10 (= K*RI* I, 259, 15) wherein 5 1/2 is written for 7 1/2.

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which I understand as the normal « sack » (i.e., 4 quadruple hekat), is not the same as the . Moreover, the latter is clearly not a multiple by four of the former : i.e., it is not a quadruple sack. The ratio between the two is :  to as 230/245 or 1.31 (1 15/49, approximately 4/3). Also, if 1 of emmer = 320 deben and 1 of flour is 720 deben, then the ratio between these two measures per item measured is 32/72 or 4/9 (.44.....). These varying ratios are dependent upon the fact that the weights of all three are mutually different and vary also as to the thing weighed.

VI. — P. B.N. 205, 1,16 ff. (K*RI* I, 260, 5 ff.)[1].

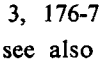
In the following lines is an account that has hitherto been only partially explained.

Year 2 *4 ʒḫt day 7.*
King of Upper and Lower Egypt, *Mn-mꜣʿt-Rʿ*, l.p.h.,
son of Re, Seti Merenptah, l.p.h., who lives forever
and ever like his father Re every day.
This day. One travelled in the Northern Region.
Account of payments (*tp n ḥtrw*)[2] for the Nubians on
the new land from (*n* = *m* ?) the impost (*inw*)
which is under the authority of
the royal scribe, *Nn-nfr,* from the bakeries in
order to make for them breads (*ʿḳw*).
Nubians men 85 *Each one ʿkk* bread in cooking
(*m* ) 15 from a sack () *1*
Making large breads 85 Making one day
Grain 1/4 (?) () *5 2/3* Making ten days
1 1/2 *4 2/3* (??).

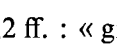
The first calculations follow : 85/15 is (from one sack) 5 2/3. Each man receives one 15 deben bread per day. In line 1,14 (K*RI* I, 260, 13) I can discern a large dot after the sign for sack : i.e., . Subsequent to this dot is a red number, 5 2/3[3]. The first dot cannot be overlooked and it is standard in this section for all entries to be followed by a number in black; then follows a further red figure as here. Good examples may be seen

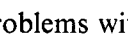
[1] Helck, *Materialien,* 638-9 and Spiegelberg, *Rechnungen,* p. 14-5 and 49-51.

[2] The latest discussion of *ḥtrw* will be found in Janssen, *SAK* 3, 176-7 and his *Commodity Prices,* p. 456-7; see also Lesko, *A Dictionary of Late Egyptian* II, p. 148-9; and *ALex* I, 264 and III, 207. Clearly, the Nubians are soldiers in the pay of the Egyptian state.

[3] The text reads : .

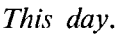
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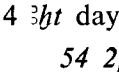
in lines 2,2 ff. : « grain 2 1/2  *54 2/3* ». As the dot represents 1/4, ten days would represent 2 1/2. This is what we have in the lists from lines 2,1 ff. (K*RI* I, 260, 14 ff.).

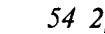
The problems with the final two figures in line 1,24, i.e., 1 1/2 4 2/3 cannot be resolved. 10 × 5 2/3 = 56 2/3 and 1/4 × 10 = 2 1/2. For the first, I assume that a 1 has been incorrectly omitted [1]. Regarding the other, it is reasonable to read ⟨5⟩4 2/3, following the subsequent entries (lines 2,2 ff. : see below) wherein each decade coincides with 2 1/2  *54 2/3*. I cannot resolve why the accounts have switched by 2. However, as the 54 2/3 is connected to the preceding 2 1/2 in a ratio of 21 13/15, I can only think that the smaller number (not the more correct ratio 22 2/3 : per day 2 14/75, 2.1866..... instead of 2 4/15, 2.266.....) was reasonable. Perhaps the accountants wished to have a number as close to 56 2/3 as possible, but one that, when divided by the 2 1/2, left no fraction. By an upward rounding off of 54 2/3 this was obtained. Note that the overseer of the granary could alter the ratio as line 2,13 (K*RI* I, 261, 10) states : « ... day of fixing the ratio by the overseer of the double granary 2 1/2 *50* » [2]. This ratio can only be the *psw* ratio and therefore the account gives the cooking ratio for each interval of ten days. Since the *psw* ratio could only be a whole number, the idea of rounding off to 55 and reducing the 56 2/3 by 2 makes some sense (56/2.5 or 57/2.5 do not produce an integer).

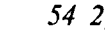
The first sequence of decades begins with the same day as the previous account. Each delivery matters for the subsequent days :

Year 2 *4 ʒḫt day 7.*
Day of extracting emmer from the granary Abundance-is-in-Memphis in order t[o make it into breads.]

This day. *Grain* 2 1/2 
54 2/3

4 ʒḫt day 14 Grain 2 1/2 
54 2/3

4 ʒḫt day 24 Grain 2 1/2 
54 2/3

1 *prt* day 4 Grain 2 1/2 
54 2/3

[1] If not, the text is insoluable as recognized by all previous scholars.

[2] For the term « value », « ratio », see n. 1, p. 313 above.

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1 *prt* day 14 Grain 2 1/2  
54 2/3

1 *prt* day 24 Grain 3/4
16 1/2

1 *prt* day 27 Grain 2 1/2 
54 2/3

2 *prt* day 7 Grain 2 1/2
54 2/3

2 *prt* day 17 *Grain* 2 1/2
54 2/3

2 *prt* day 27 *Grain* 2 1/2
54 2/3

3 *prt* day 7 *Grain* 2 1/2
54 2/3

Let us stop here for a moment. Note that the intervals are the expected decade with one exception, line 2,7 (K*RI* I, 261, 4), and that 93 days have passed. That the two figures of 54 2/3 and 2 1/2 form a ratio is clear : 54 2/3 over 2 1/2 gives 21 13/15. A three day ratio should then be 3/10 of 54 2/3. 3/10 × (54 2/3) = 16 2/5, very close to the 16 1/2 in the text. In fact, I would argue that the 16 1/2 derives from the upward rounding off of 54 2/3 to 55, a point that will bear upon the subsequent analysis. A second way to check is to determine the ratio 16 1/2 to 3/4. It is 22, close to the 21 13/15 for the higher numbers, the difference coming from the rounding off (downwards) of 16 2/5 to 16 1/2. With the former number, 16 2/5 divided by 3/4 = 21 13/15.

Further support for our understanding of the two given numbers as a ratio and not as a list of barley and emmer is presented in the following line, 2,13 :

3 *prt* 17 Day of fixing the ratio by the overseer of the double granary 2 1/2 
50

In this case the  must represent the . Note that another decade has passed. The text continues :

3 *prt* day 27 Grain 2 1/2
50

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4 *prt* day 7 Grain 2 1/2  «
50

4 *prt* day 17 Grain 2 1/2  «
50

4 *prt* day 27 Grain 2 1/2  «
50

1 *šmw* day 7 Grain 2 1/2  «
50

1 *šmw* day 17 Grain 2 1/2  «
50

1 *šmw* day 27 Grain 2 1/2 «
50

2 *šmw* day 7 Grain 2 1/2 «
50

2 *šmw* day 17 Grain 2 1/2 «
50

2 *šmw* day 27 Grain 2 1/2 «
50

3 *šmw* day 7 Grain 2 1/2 «
50

3 *šmw* day 17 Grain 2 1/2 «
50

3 *šmw* day X Grain X «
X

Total 56 *1170* (?)

The last figure underlined in red shows 1170 in Spiegelberg's plate; others argue for 1175 [1].

The sums, excluding the broken last line (2,25 = K*RI* I, 261, 8), come to 55 3/4. Therefore, we restore 1/4 as the first figure. We want 1/4 to X as 1 to 20 (20 being 50/2.5).

[1] See K*RI* I, 262, 8 and Helck, *Materialien*, 639. Spiegelberg, *Rechnungen*, 15, has 117 4 2/3 with flour at 11 1/2 (?). On his Plate IV no 5 is present after 1170; however, the papyrus is cut off at this point.

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X must be 1/4 of 20 or 5. The missing day must be one day later than the previous entry of 3 *šmw* 7 as 1/4 is 1/10 of 2 1/2. Unfortunately, the grand sum then becomes 1168 1/6 instead of 1170. Where is the error?

Turning to the first account of 2 *3ḫt* 7, the interval between that date and the following (2 *3ḫt* 14) is only 7 days. Hence, the figures must be changed to 7/10 × (2 1/2) and 7/10 × (54 2/3). They are : 1 3/4 and 38 4/15. The latter would probably have been written as 38 1/2 since, in line 2,7, 16 2/5 (= 16 6/15) was reduced to 16 1/2. As the latter figure is exactly 3/10 of 55 and not of 54 2/3, 7/10 of 55 is exactly 38 1/2 [1]. With this in mind, the grand sum in the first column comes to 55 [i.e., 21 × (2 1/2) + (3/4) + (1 3/4)]. The missing day must be 3 *šmw* 11, 11 being 4 days later than the previous entry. That this is so is determined by the ratio : 1 is to 2 1/2 as X is to 10; X = 4/10 or 4 days later. Finally, for the second column we must have 4/10 of 50 or 20. Restore in line 2,25 :

3 *šmw* day [11] Grain [1  
20]

The second column can be checked from the preserved grand sum of 1170. Do the remaining entries add up to the latter figure? 600 (50 × 12) + 16 1/2 (instead of the more correct 16 2/5) + 492 (54 2/3 × 9) + 38 1/2 = 1147. Clearly, 1147 + 20 does add up to 1170, or any higher figure. We are therefore left with a dilemma : if either entry is chosen for the first delivery on 4 *3ḫt* 7, the final amount in column two does not match the preserved traces on the plate. Even if it is granted that the restoration of 117[5] by Kitchen, Helck, etc., is correct, this only makes the situation worse [2]. Certainly, the proposal to read 31 1/2 cannot be accepted since the addition of column one to 56 precludes such a possibility.

However, at this point the earlier comment on the rounding off of 16 2/5 for the 3 day interval enters. There, it was indicated that the fraction 16 1/2 was derived from 3/10 of 55 and not of 54 2/3. With this in mind the following sums can be computed to arrive at the desired figure of 1170 :

50 × 12 (normal)
55 × 9 (instead of 54 2/3; this implies a rounding up to 55)
16 1/2 × 1 (for the 3 day interval; derived from 55)
38 1/2 × 1 (for the 4 day interval; also derived from 55)

[1] The argument assumes that this is the correct rounding off for all of the decade intervals.

[2] The final sum becomes too great : see n. 1, p. 346 above.

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The total becomes 1170 as on Spiegelberg's plate. If the earlier interpretation be chosen, i.e., taking the first interval as ten days as is written instead of seven, the sum becomes 1171 1/2 : (50 × 12) + (55 × 10) + (16 1/2 × 1) + (5 × 1). Unfortunately, the plate is cut at this point and it is impossible to verify if the figure was higher as, indeed, Spiegelberg has written in his text; Kitchen and Helck chose 1175 but the text will not allow for the addition of 5 units.

VII. — P. B.N. 209 (K*RI* I, 262 ff.)[1].

This fragmentary reckoning concerns women and then follows with some of the bakers that were met on previous occasions.

2 prt day 18

Delivery via ...-*Mwt* Women 10 ..... 6 1/2 making flour 3 1/4 
Delivery via *T*ꜣ-*nfrt* Women 8 1 making flour 2
Delivery via *Ii-ḥtp·ti* Women 8 3 making flour 2 
Total 20 + x (= 24) heads.

The first group may represent the of emmer as it is equated with flour. The ratio of the first is : emmer to flour as 2 : 1; the second 1 : 2 (a mistake?); and the third 3 : 2. Unfortunately, it is not a consistent 2.5 and I doubt if the equivalence of 1  of flour = 2.5 of emmer applies here.

The following lines deal with the input of the bakers :

.....

[The bake]r *D*ꜣ*d*ꜣ 3

[The baker] *Rʿ-ms* 1 3/4

[The baker *ʿnḫ·]tw* 3

[The baker *D*ꜣ*d*ꜣ Flour *X*  (?)
Come kyllestis] bread 214 *Remainder* 1
Each one 12 deben

[The baker *Rʿ-ms* Flour *X*
Come kyllestis] bread 280 *Remainder* 10

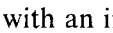
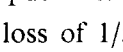
[1] Helck, *Materialien*, p. 639 and Spiegelberg, *Rechnungen*, p. 20 and 53 with Pl. IX.

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Each one 10 deben *Remainder* 360 deben

[The baker *'nḫ·tw* Flour *X*  «
Come kyllestis bread 2]44 *Remainder* 75
Each one 11 deben 1 kite *Remainder* 213 deben

Total 738.

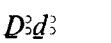
The final figure is equal to the sum of breads actually delivered. I cannot resolve any of the computations except to note that in the entry for *Dꜣḏꜣ* if we read « kyllestis bread 214 Remainder 2 », with an input of 4 1/2  the figures match : 216 × 12 = 2592; 2592 = 4/5 of the input which is 3240. (15 deben at the start becoming 12 deben means a standard cooking loss of 1/5). As 720 (the expected input for 1 ) × 4 1/2 is 3240, 3240 — (1/5 × 3240) = 2592. This slight alteration in the figures might just be supported by the somewhat poorly written hieratic « 1 » in the remainder column [1]. The other entries are impossible to solve.

VIII. — **P. B.N. 209** (K*RI* I, 268, 10 ff.) [2].

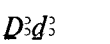
This is the final significant baking account in the *Seti Rechnungen*. It deals with the standard deliveries of three bakers :

2 *prt* day 21

Account of instructions (*tp n ḥnw*) to the bakers

The baker *Dꜣḏꜣ* Flour 3 
The baker *Rʿ-ms* Flour 2 3/4  «
The baker *'nḫ·tw* Flour 3  «

2 *prt* day 22

The baker *Dꜣḏꜣ* Flour 3 
The baker *Rʿ-ms* Flour 2 3/4 
The baker *'nḫ·tw* Flour 3 
[.....] [3]

[1] This is a very tentative supposition; the text reads : .

[2] Helck, *Materialien*, p. 639-40 and Spiegelberg, *Rechnungen*, p. 22, 66 and Pl. X.

[3] This is probably a sub-total.

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2 *prt* day 23

The baker *Ḏ*^{3}*ḏ*^{3} Flour 3 
The baker *R*^{ʿ}*-ms* Flour 3 
The baker *ʿnḫ·tw* Flour 3 

Total 25 3/4 Making 51 3/4 Remainder 25 1/4 Total 77

The grand total for the three men ought to be 26 1/2 instead of 25 3/4. In addition, there remains the problem of the 51 3/4 which minus 25 3/4 = 26. I assume that this is a running total and incorporates the previous grand total.

2 *prt* day 24

The baker *Ḏ*^{3}*ḏ*^{3} Flour 3
The baker *R*^{ʿ}*-ms* Flour 2 3/4
The baker *ʿnḫ·tw* Flour 3

Total [3]4 1/2 Making ... + 9 Remainder 8.

The first total entry might have been derived from a grid such as :

Ḏ^{3}*ḏ*^{3}	3	3	3
R^{ʿ}*-ms*	2 3/4	2 3/4	2 3/4
ʿnḫ·tw	3	3	3

This grid adds up to 26 1/4, which is also different from the desired first entry in the total line (25 3/4) even though I have altered one of *R*^{ʿ}*-ms*'s deliveries from 3 to 2 3/4. Unfortunately, another 3/4 must be removed from this grid to satisfy the first figure of the summary.

For the second preserved summary it seems better to restore thirty instead of forty in the opening figure. 34 1/2 is 8 3/4 more than 25 3/4, the last input in the previous total line (for day 23 of 2 *prt*). Anything more regarding this section moves us even further into the realm of speculation.

Column three of the same papyrus presents the final baking account (K*RI* I, 269, 15-270, 4) :

2 prt day 28

Received from the bakery
Grain *75* 

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which is via the bakers Flour 14 3/4
Large (?) bread *'kk* 1000 *g³y*-vessels [1]

2 pr[t day 2]8

Received f[rom the] storehouse of the Residence
Large bread 1740 ..... (= *'kk* bread?) [.....
making?] deben 570 Each one 11 deben 4 kite
Making 1916 + x deben.

Here the large (?) loaves weighed 11.4 deben apiece. The measure at the beginning is ; i.e., 1 = 720 deben.
Therefore, the total in deben is 10620 (720 × 14 3/4).

IX. — CONCLUSIONS.

The reader, having followed Seti I's baking accounts through to this point, must realize by now the detailed and intricate nature of these reckonings. The Egyptian scribes who stood by their sacks of grain used many complex formulae, the result of which gave them the exact weight (per volume) of their product. Every stage in the baking process, from delivery of emmer wheat to the single baked loaf, was subject to rather precise arithmetical analysis. Such a precise and determined survey cannot but impress the modern viewer — whether he be Egyptologist or not — with the sophisticated nature of ancient Egyptian mathematics and the related problem of actual cooking of these breads. Such arithmetical ability is, of course, witnessed by the extant mathematical papyri. However, for this study the most outstanding conclusion is that relating to measure. By measure I mean the exact determination of volume and weight, both related in this case. Such a precise determination was naturally based on an exact system of measure (deben, sack, etc.) as well as a bureaucracy capable of doing the required work. Solely from these accounts I find no indication of the naive economic and mathematical approach common to those civilizations that one lables « primitive ». By this I mean that, given such developed scientific methods of reckoning simple breads (albeit empirically based), it is difficult to establish an analogy between the economy of ancient Egypt and elementary economic societies. As I stated at the beginning of this study, it has become commonplace for recent scholars on Pharaonic economics to borrow ideas

[1] Janssen, *Two Ancient Egyptian Ship's Logs*, p. 25; *ALex* I, 402; III, 312; and a more detailed study in Janssen's *Commodity Prices*, p. 426-8.

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from economic anthropology. However, most of those societies, the study of which has given rise to theories of economic anthropology, lack the specifics of ancient Egypt : i.e., a precise system of measurement (in our case dry measure a. volume and weight). My own feeling is that when one deals with economics the best method is to turn to that field itself, remembering Plato's comments on doctors and politicians — In this light I cannot pass by a recent comment concerning the lack of inflation in Egypt by a scholar well versed in economics without noting that his supposed example proves the contrary of what he is actually proposing. — It must not be forgotten that economics at least has a system of measure and rational evaluation, although granting that there are problems with a theory of value. Anthropology has yet to agree on specific terms and no science can exist without a proper system of definitions [1]. Hence, I prefer to let the above detailed and intricate accounts speak for themselves for in my opinion they lay bare the highly developed nature of Egyptian economics.

One further comment : it is necessary to separate accounting practices from a study of economy no matter how interesting the former may be. Bookworms of themselves do not make literature nor sapless aesthetes art. Whether or not the accountants and scribes of Seti's baking accounts were drudges is not the question. Rather, what one must ask is how such accounts reveal the system of Egyptian measuring and how the latter is connected to a rational system of prediction. Considering the complications of baking with its inputs of grain of various types, differing in volume and weight, and its outputs of cooked items, also with its varying results, I think it clear that the ancient Egyptians performed a quite sophisticated and high level technology for their time. Neither rude farmers nor hunter gathers were they.

[1] M. Harris, *The Rise of Anthropological Theory*, New York (1968).

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