

Seminar SAW: History of Mathematics, History of Economical and Financial Practices
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Land registers and surveyors: Measuring lengths and areas

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*The mathematical knowledge during the 3rd dynasty of Ur
in the light of land surveying texts: Measurement techniques and officials in charge*

The administrative activities of the III Dynasty of Ur (2112-2004 BC) is documented by a large number of textual records, especially of economic nature, as result of the primary role which bureaucracy played in the administration of every level of the State. In fact, more than the 95% of the documentation is of administrative nature and records all the aspects linked with the management and the organization of the Empire: productive units (mills, fields, orchards, etc), account of cattle, labour-force and goods, food assignments to workers, letter-orders and so on. This large bureaucratic organization needed advanced computational knowledge, but surprisingly enough, only a few school mathematical texts can be dated to the Ur III period.

The conspicuous absence of preserved mathematical cuneiform texts from the Ur III period does not mean of course that mathematics did not exist as an important item in the *curriculum* of the Ur III scribe schools. Moreover, it must be highlighted that several Old-Babylonian mathematical problem texts are written in Sumerian, some even with grammatical prefixes and suffixes of the verbs. In particular a substantial part of the preserved corpus of Old-Babylonian mathematical cuneiform texts is devoted to "practical exercises" (building of walls, dams, canals, bricks, sowing of agricultural fields, etc.), problems which involved the inhabitants of south Mesopotamia of course also during the Ur III period. The paper is aimed at studying the administrative texts of the Ur III period trying to detect the specific mathematical knowledge in wide sense which is needed in order to manage a specific administrative sector and the people in charge of it: the measurement of agricultural field in the city of Ĝirsu/Lagaš.

The administrative practice of measurement of fields is ancient and it is date back at pre-literate period as shown in a recent article by S. F. Monaco (see Monaco, S. F. (in press), "Archaic field measurements texts", in *Rivista degli Studi Orientali, Nuova Serie*).

Information on the measurement of fields is attested, during Third Dynasty of Ur, in two kind of documents:

- plans of fields drawn on tablets accompanied by captions and measurements;
- texts which measure the surface of agricultural fields and their production; at this typology of texts belong also the so-called "Round Tablets": it is a group of texts which were drawn up shortly before the harvest to record the production of every field and they were singled out on the basis of their circular shape (even if some of them are rectangular).

From the Neo-Sumerian period more or less thirty plans of fields exists coming from the province of Umma, Ĝirsu and Nippur. These documents record, on the obverse, the plan of the field: since the fields are often irregular, their shape is divided in regular figure (rectangular or triangle) in order to make the calculation of the surface easier. On the reverse the scribe recorded the total surface (resulting by adding or subtracting the figures in which the field was divided) and sometimes other information such as the name of the field, the date of the tablet or the officials which had measured it. The texts show us that the fields have often an irregular shape and that it was divided in three sectors: a regular rectangle (called, in Sumerian, "temen"), three sectors inside this rectangle (Sumerian "ki") and a sector (further divided in triangles and trapezoids) outside the rectangle (Sumerian "bar").

The measurement of fields, both regarding their sizes and their production, seems to be performed, at Ĝirsu, by two kind of officials: šar₂-ra-ab-du and sag-du₅; the activity of sag-du₅ seems to regard the sizes of the fields, whilst the šar₂-ra-ab-du quantify the production. The sag-du₅ in particular were high level officials, testified by the presence of seals which record their name and title and they performed their activities not only in the measurement of field but also in economics transactions of the agricultural products. Moreover the sag-du₅

needed advanced geometrical knowledge which allowed him to measure the surface of plan figures such as rectangle, triangle and trapezoids, that is the figures in which a field of irregular shape was divided in order to calculate its total surface. It is logical to assume that a part of their training was carried out in the edubba (the school) but the total absence of school texts regarding the measurement of fields (that are documented, instead, before, during Sargonic and Pre-Sargonic period, and after, during Old-Babylonian period) make possible the hypothesis that great part of their training was carried out directly on the field, following older and more expert officials which showed and taught them to measure a field continuing a tradition which was dated back to the pre-literate period; but the sources, at the best of my knowledge, do not say anything about this last question.