by 1 cubit, or one khet by one cubit, 100 of which cubit-strips would make one setat.

HEKAT:

A hekat was a half-peck dry measure for barley, wheat, corn, and grain generally. It was thus $^1/_8$ bushel, or 4 quarts, or 8 pints dry measure. Chace gives it as 292.24 cubic inches,* while half a peck in British measure was 277.36 cubic inches, so that a hekat was slightly more than half a peck. Eisenlohr, Sethe, and Struve call it the *scheffel*, Gunn uses *gallon*, and Peet *bushel*. For stating the contents of larger grain vessels, the units might be double-hekats or more commonly quadruple-hekats, which would therefore be $^1/_4$ and $^1/_2$ of a modern bushel, respectively. For storage granaries an even larger unit was needed, and use was made then of "*100 quadruple hekat*" units. One cubic cubit contains 30 hekats of grain.

HINU:

The hinu was a smaller unit for grain, being one-tenth of a hekat.

KHAR:

This was two-thirds of a cubic cubit, or 20 hekats of grain. Or we can say 1 $\overline{2}$ khar make a cubic cubit.

RO:

The smallest named unit for grain was the ro, which was $^1/_{320}$ part of the hekat. It would be between a dessertspoon and a tablespoon full of grain. The only fractions of a hekat used were $\overline{2}$, $\overline{4}$, $\overline{8}$, $\overline{16}$, $\overline{32}$, $\overline{64}$, and these were written in a special way, quite unlike ordinary fractions. They were called *Horus-eye* fractions, and were used solely for grain (see Figure 20.2). Then $\overline{64}$ of a hekat contained 5 ro, and for any fraction of a hekat less than $\overline{64}$, ro and sometimes fractions of a ro had to be used. Horus was the son of Osiris, who was treacherously slain by his brother Seth. In revenge, Horus sought out his uncle and slew him, but in the fight lost an eye, the broken parts of which were later restored by the god Thoth. Isis was the mother of Horus, and the wife and sister of Osiris.

* A. B. Chace; L. Bull; H. P. Manning; and R. C. Archibald, *The Rhind Mathematical Papyrus*, Vol. 1, Mathematical Association of America, Oberlin, Ohio, 1927, p. 31.

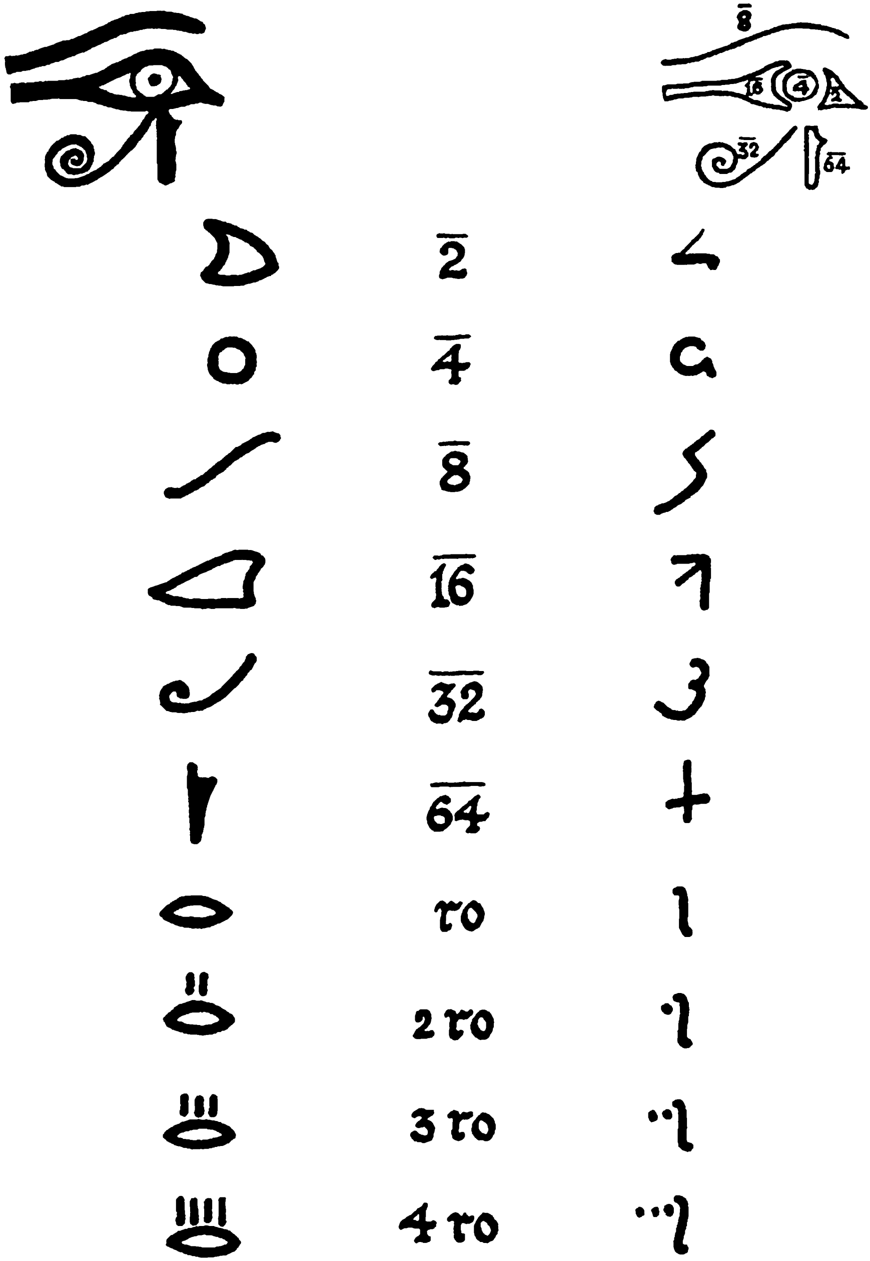

FIGURE 20.2
Horus-eye fractions.

APPENDIX 2
THE EGYPTIAN CALENDAR

The Egyptian year consisted of 12 months of 30 days each, or 36 decades of 10 days each, with 5 "year-end" (*epagomenal*) days that were dedicated to the gods Osiris, Horus, Seth, Isis, and Nephthys; the year-end days were their gods' birthdays. The 12 months were divided into 3 seasons of 4 months each, which were the *inundation* or sowing period, the *coming-forth* or growing period, and the *summer* or harvest period. This civil year of 365 days was retained because there was no break in its continuity, and was still used in later Hellenistic times; indeed, it was used in the Middle Ages by Copernicus and other astronomers. "This calendar," writes Neugebauer, "is indeed the only intelligent calendar which ever existed in human history."* It is simpler even than the "perpetual calendar,"† which, though recommended for worldwide use by astronomers, seems condemned to remain forever in some official pigeon-holes in all countries. Now, the true length of the year (the solar year) is $365\frac{1}{4}$ days,‡ as the Egyptians knew. This meant that their civil year slipped steadily backwards through the solar year, 1 day every 4 years, 30 days or 1 month every 120 years, and thus 12 months or 1 year every 1,440 years,§ and the seasons therefore were very slowly changing, though not specially noticeably in one man's lifetime. What did it matter? There were few worries in the ordinary affairs of daily life.

The most important event in Egyptian life was the annual flooding of the Nile River, the inundation period, which coincided pretty closely with the heliacal rising (just before dawn) of Sirius, the Dog Star, the brightest star in either hemisphere. Thus the solar year became also the Sirius year, by which sowing and agriculture generally was controlled. The first brief appearance of Sirius in the eastern sky was an important event in the Egyptian year. The next morning Sirius would appear some minutes earlier, and so on, so that before long, Sirius would no longer herald the dawn, and some other bright star would serve this purpose. This measuring of the days by

* O. Neugebauer, *The Exact Sciences in Antiquity*, Harper, New York, 1962, p. 81.

† "ANZAAS Committee on Calendar Reform," *Australian Journal of Science*, December, 1943; R. J. Gillings, "Perpetual World Calendar," *Australian Mathematics Teacher*, Vol. 1, No. 1, (April, 1945), p. 24.

‡ Less 11 minutes.

§ Approximately of course. The cycle would then start again.

the heliacal rising of stars gave rise to the system of *decans*, in which each chosen star would serve its duty of noting the last hour of night for 10 days (or nights), so that there would be 36 decans distributed through the mornings of the year. Of course, not all decans would be visible through any given night. At the time of the inundation, when Sirius rises heliacally, 12 decans rise during the night, and thus the "hours" of the summer night were determined. In winter there would be more decans visible; thus the length of hours varied slightly, both for the seasons and for nighttime and daytime. We see here the origin of the division of the *day* into 24 hours that is now universally adopted. These two calendars (of 365 and 365¼ days) existing side by side from, it is thought, the time of the first pharaoh of Upper and Lower Egypt, was "the most scientific organisation of calendars which has yet been used by man."*

* J. W. S. Sewell, "The Calendars and Chronology," in *The Legacy of Egypt*, S. R. K. Glanville, editor, Oxford University Press, London, 1963, p. 7.