THE OLDEST RECORDS OF THE NILE FLOODS

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BECAUSE RAINFALL over all but the northern Delta has long been rare and irregular, Egyptian farmers have depended for at least some 5000 years upon the annual flood of the Nile River to water their fields and prepare the soil for cultivation. The amount of any particular inundation—at least before the building of the modern system of dams and barrages—determined whether that year would bring plenty or famine or something intermediate. These annual floods are the direct consequence of the summer monsoon rainfall over the catchment basin of the Blue Nile and the Atbara in the highlands of Ethiopia. The maximum level of the flood waters in Egypt thus provides a measure of the amount of this rainfall.

From early historic times the Ancient Egyptians regularly measured the maximum height of the yearly flood and recorded the level in their royal annals. Of these records only fragments have come to light, and it has proved impossible to extract information on the relative magnitude of the floods in different eras because the various measures quite obviously do not use the same zero point, and perhaps not even the same scale (Kees, 1961, p. 50).

However, there is one quite long series of measurements that, although surviving only in fragments, seems capable of yielding more information than has yet been extracted from it. This record was carved on a large stone stele during the Fifth Dynasty in the twenty-fifth century BC, and includes the level of the inundation for every year back to the reign of King Zer (Djer) early in the First Dynasty—about 3050 BC according to the chronology used by the revised *Cambridge Ancient History* (Edwards, 1964; Smith, 1962) and in this note. The most valuable surviving fragment, known as the Palermo Stone (Gardiner, 1961, plate III, p. 62f) from its location in the Palermo Museum, was originally published and translated by Schäfer (1902). Additional fragments have since been discovered (Gauthier, 1915; Petrie, 1916; Cenival, 1965). All the flood heights preserved in these annals have been listed and discussed by Helck (1966), who points out an apparent decline in flood level after Dynasty I. His paper is concerned mainly with possible relations between certain festivals and the recorded flood levels, however, and he even suggests that the largest value—from year 30(?) of King Den (Wedimu)—may be a fiction created for religious purposes. As Helck does not discuss the data fully from the paleoclimatological point of view, the possibility remains of extracting more information from a different emphasis in the study of these ancient records.

To faciliatate comparison with modern flood levels—in respect to their dispersion about the mean—I have converted all the measurements to metres, according to the relation: 0·524 metre = 1 cubit = 7 hands/palms = 28 fingers = 2 spans. The value of the 'span' is only a guess, the true value being unknown as the unit was not used except in very early times. The resulting flood levels in metres are plotted against time in Figure 1, on the left. On the right are plotted some modern values measured at the Roda gauge near Cairo (Toussoun, 1925), with an arbitrary relation between the zero points of the two scales, the true relation being unknown. Table I gives

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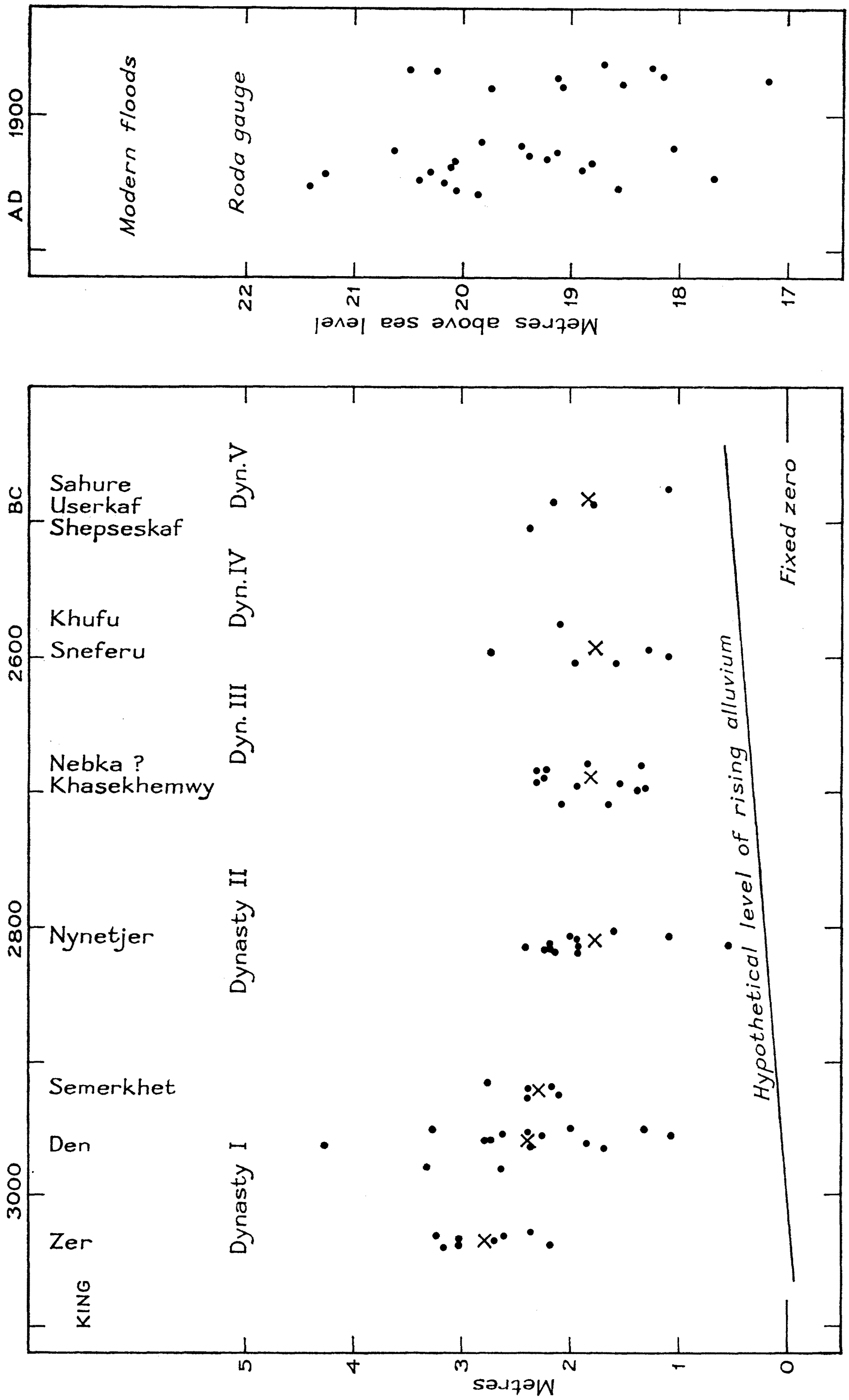

Fig. 1. Height of ancient Nile floods in metres above arbitrary zero (left): black dots = individual floods, X = averages; and (right) height of modern floods measured at Roda, in metres above sea level

the average values for each reign or pair of adjacent reigns, according to two different assumptions about the zero-point of the ancient scale. The table also identifies the source of the data entering each average, since in a few cases Helck's values differ from those in the original publications.

TABLE I: AVERAGE HEIGHT OF ANCIENT NILE FLOODS IN METRES, ACCORDING TO TWO ASSUMPTIONS ABOUT THE ZERO OF THE SCALE: (*a*) ZERO RISES WITH ALLUVIUM; (*b*) FIXED ZERO, WITH ALLUVIUM ASSUMED TO RISE AT UNIFORM RATE OF 10 CM PER CENTURY

	King	*Years data*	*Average flood (a)*	*(b)*	*Range (c)*	*Source*
DYNASTY I	Aha	5	no heights recorded			4, 1
c. 3100–	Zer	8	2·78	2·82	1·06	1
		9	± illegible			3h
	Zet	—				none
	Den (Wedimu)	15	2·41	2·35	3·21	4, 1
	Enezib	—				none
	Semerkhet	5	2·34	2·25	0·66	3h
		4	± illegible			3h
	Qaa	—				none
Dynasty I, Average		28	2·50			
DYNASTY II	Hetepsekhemwy	—				none
c. 2900–	Raneb	—				none
	Nynetjer	13	1·77	1·58	1·88	1
	....					
	Khasekhemwy	8 }	1·83	1·50	1·01	2, 1
DYNASTY III	Nebka(?)	4 }				1
c. 2700–	......					
DYNASTY IV	Sneferu	5 }	1·78	1·36	1·63	3, 1
c. 2600–	Khufu (Cheops)	1 }				3s, h
	....					
	Shepseskaf	1 }				1, 3s
DYNASTY V	Userkaf	2 }	1·83	1·30	1·05	3, 1
c. 2490–	Sahure	1 }				1
Dynasties II–V, Average		35	1·80			

Sources: 1 Palermo Stone: Schäfer (1902), Breasted (1906)
2 London fragment: Petrie (1916)
3 Cairo Annals, poorly preserved: 3h Helck (1966); 3s Sethe (1932)
4 Fragment of Cenival (1965)

The problem of the zero-point is complicated by the aggradation of the river bed and floodplain throughout historic times, as a consequence of the annual deposit, by each flood, of a thin layer of silt. A value of 10 cm per century is often quoted as the average rate of rise, but Butzer (1959a, b) has convincingly argued that the rate of deposition, depending as it does on both the sea level and the flood volume and load of the river, varies substantially from one era to another. Since the value for the early historic period is not known with any precision, I have used the conventional value of 10 cm per century or 50 cm for the 500 years covered by the data.

About the Memphis Nilometer, with which the ancient measurements were taken, nothing is really known, but we have two plausible alternatives. Toussoun (1925, p. 302) mentions a tradition that, at least in Greco-Roman times, the actual measuring device was portable and kept, when not in use, in the temple of Serapis; in the flood season it was taken out and set up, perhaps in a well-shaft. On the other hand, most ancient Nilometers of which traces have survived—also generally from Greco-Roman times—were staircases built into a quay or wall, with a scale carved on a face of the wall (see Toussoun, 1925, p. 265ff). In this latter case, we would have a fixed zero, around which the level of the fields and the river-bed would be rising slowly, and any given Nilometer reading would indicate progressively less water actually covering the fields as the centuries passed. The averages in column (*b*) of Table I were calculated on this assumption of a fixed zero and a rising alluvium.

The averages in column (*a*) are simple averages of the measures, and would be proportional to the amount of water on the fields only if the zero point of the scale rose with the alluvium, as might or might not be the case with a portable Nilometer, depending upon whether it was set out on the surface of an official standard field at flood time, or set out in a well-shaft which could give it a fixed zero.

Under either of these assumptions about the zero-point of the scale, however, it is clear that the height of the inundation, and thus the amount of the summer monsoon rainfall over East Africa, averaged less from Dynasty II onward than in Dynasty I. The difference between the average flood-height for Dynasty I and for Dynasties II–V is 0·7 metres, under the assumption of a zero-point that rose at a uniform rate with the alluvium. Under the assumption of a fixed zero for the Nilometer, the decline in flood height is greater, and is also progressive with time. If the alluvium actually rose more rapidly than the rate I have assumed for Table I, an even larger decline in the flood volume would be indicated.

The dispersion of the individual points about their respective means looks entirely plausible when compared with modern values of the flood heights recorded from the Roda Nilometer. Column (*c*) of Table I gives the range between the highest and the lowest flood entering into each average. Within the period AD 1871–1902, the flood heights measured by the Roda Nilometer varied from a low of about 17·6 metres (1877, 1899) to a high of 21·4 metres (1874), for a range of 3·8 metres. Thus I see little reason to be sceptical of the large flood range, or of the high flood recorded for year 30(?), of the reign of King Den. Moreover, according to Sethe's interpretation of the Annals, this high Nile was followed by a 'flooding of all the western and eastern(?) nomes' (Kees, 1961, p. 50). The fluctuation in the ancient levels is actually rather less for most groups than that of recent times, when the floods appear to have been uncommonly variable. According to Popper (1951, p. 173), a range of 1·5 metres (around means of subperiods of 42 to 210 years) would include 93 per cent of the flood levels recorded between AD 641 and 1522, but only 74 per cent of those recorded between 1587 and 1890, and 68 per cent of those between 1841 and 1890.

We may note also (Table I, line 1) the absence of inscriptions in the line reserved for flood-heights in the five surviving years belonging to Aha, the predecessor of Zer, and in year 2 of Zer himself. These blanks testify, as Cenival (1965) points out, to the objectivity of those who compiled the text.

It may be objected that the surviving data points are too few for any firm conclusions, and indeed any inferences about the flood levels occurring in the years not covered by the surviving sample must be tentative. However, the present evidence for a diminution in the average flood volume after Dynasty I is in accord with Butzer's (1959a) conclusion, from study of evidence for ancient Egyptian flora and fauna, that the floodplain-based fauna as well as the desert fauna and flora were substantially decimated at some time between the Early Dynastic and the Pyramid Age (Dynasty IV), resulting in the disappearance from Egypt of many savanna-type species that had inhabited the area in Neolithic times. It agrees also with recent investigations in Lower Nubia, where the Nile floodplain was 6 or 7 metres higher during A-group times (*c.* 3100–3000 BC), after which flood discharge declined with temporary floodplain dissection (Butzer and Hansen, 1968, p. 276ff).

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