A SURVIVAL OF BABYLONIAN ARITHMETIC IN NEW GUINEA?

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The Kapauku Papuans of West New Guinea, already known for their enthusiasm for counting and numbers, have been identified as possessors of what seems to be a sexagesimal arithmetic. Such sexagesimal systems are well known to the historian of science because of the most important Old Babylonian mathematical and astronomical computation. We, therefore, suggest this may be a second survival to add to that attested by Warren in 1825 from an informant in Pondicherry, who gave a mathematical method of eclipse prediction based on a long verbal tradition, which is known to be Babylonian in origin.

The Kapauku Papuans, a tribe of about 60,000 isolated mountain people inhabiting the Central Highlands of West New Guinea, have already been noted by one of us[1] for their intense preoccupation with numbers and with a quantitative approach to the universe which lends their culture an orientation that seems to be unique in modern times. When shown a magazine picture of a smiling girl, the people failed completely to react to the person, but immediately fell to an enthusiastic counting of her teeth. In the picture of downtown Los Angeles, they counted cars. A navy carrier was considered magnificent because its deck was covered by numerous airplanes. A football match with crowds of spectators was the thrill of the day. Two of the Papuans almost started a fight over a discrepancy in the numbers of spectators counted. More significantly, the dominance of counting practices in the social and trade institutions has made it possible[2] to give an unusual, full and quantitative picture of the economy of the tribe.

This peculiar interest in numbers has a particular significance for the historian of science, for it is now generally recognized that a large part of the success of the Greek and later Western Science was founded upon the huge achievements of Babylonian mathematics and mathematical astronomy in the periods from about the beginning of the second millennium B.C. up to

Alexandrian times.[3] The intense Babylonian concern and efficiency in dealing with numbers has not hitherto been known amongst any other peoples, and has, at best, only been exhibited by such remarkable geniuses as Ramanujan[4] and a few calculating prodigies.[5]

We shall now present evidence to indicate that htere may be some actual link between the Kapauku and Babylonian arithmetical methods in particular in the use by both of a sexagesimal counting system which is known otherwise only in those cultures where direct transmission of Babylonian methods is attested.[6] The Kapauku words for the numbers (*see* table) show no great peculiarities for 1 through 19. The forms from 6–9 are apparently borrowings from Malay, while those from 1–5 seem unrelated, though perhaps 1 and 2 bear some similarity to the Sanskrit *eka* and *dvi* but the absence of any further links reduces this to probable coincidence. The numbers 11–19 and 21–29, 31–39, etc., are formed in the normal way by

TABLE

ena	= one	*ena ma gaati*	= eleven (one and ten)
wija	= two	*wija ma gaati*	= twelve
wido	= three	*wido ma gaati*	= thirteen
wii	= four	*mepiina*	= twenty (*mepi* one)
idibi	= five	*pituwo ma mepiina*	= twenty-seven
benumi	= six	*jokagaati*	= thirty (child of ten)
pituwo	= seven	or *amonaato*	= thirty (a half)
waguwo	= eight	*mepiija*	= forty (*mepi* two)
ijee	= nine	*gaatibeu*	= fifty (ten without)
gaati	= ten	*muto*	= sixty
		or *bado*	= sixty (foot, base)

the addition of the first nine numerals to the words for ten, twenty, etc. Most striking is the fact that the words for 60 mean alternatively 'thigh' (*muta*) and 'foot, base' (*bado*), and those for 30 mean 'half' and 'child of ten'. Similarly 50 is denoted as 'without ten' (i.e. 60 minus 10) and for large numbers all handling is by groups of 60, so that 70 becomes 'sixty and ten' and, for example, 263 is referred to as 4-sixties-and-3-and-20. For larger units only compounds are used, thus 600 becomes 'sixty-ten' (as distinct from 'sixty-and-ten') and 3600 is 'sixty-sixty'. There can be no doubt that what is involved here is a perfectly ordinary sexagesimal arithmetic of the Babylonian variety, counting to base sixty, and even considering it natural that half and thirty are denoted by the same word. Curiously, too, in the words for 20 (*mepiina* = *mepi*+*ena* = one *mepi*) and 40 (*mepiija* = *mepi*+*wija* = two *mepi*) one might have survivals of a comparable reckoning of these numbers as 1/3 and 2/3, though it is quite common for a unit of twenty (one score) to appear in primitive arithmetics.

Elsewhere in their arithmetical habits the Kapauku do not appear to be so distinguished. They show great facility in the processes of halving and doubling, but having no multiplication tables at their finger-tips are slow at other processes of multiplication and division. Numbers are added and subtracted in their lots of sixty in the normal sexagesimal fashion, and there exists a set of finger and toe signs derived from the usual primitive counting with which numbers can be expressed in sign language. In folk astronomy,[7] medicine, mensuration and such other things that might be indicative of other links, there is, unfortunately, nothing significant to report. All that we have is the clear evidence for sexagesimal arithmetic, otherwise unknown in modern or historic times outside the regions of direct Babylonian influence.

If this case were completely isolated, it might be reckoned as a mere curiosity, but there happens to be further striking evidence for the survival of even more sophisticated Babylonian methods amongst an illiterate people. Moreover, that evidence comes from South India which is sufficiently near the known trade routes to New Guinea for such a relation to be due to migration and trade contacts.

In 1825, Lieutenant-Colonel John Warren published a huge collection of Tamil and other South Indian astronomical methods and tables, taken from manuscript materials.[8] To this he appended a statement by an informant, Sami Naden Sashia of Pondicherry, giving a method of eclipse prediction which was based upon calculations by black and white sea shells, laid out to ritual patterns and employing tables which were memorized using nonsense syllables to represent long numbers for the complete set of tables employed.[9] It was remarkable that the informant had no understanding of the process, of the complex theories underlying, or of anything but the (accurate) result derived. Since Warren's time it has been shown that this method, surviving outside any written tradition and in purely oral form, preserves with remarkable exactness parameters and entire methods which are clearly Babylonian in origin.[10] From elsewhere we know now that much of Indian astronomy derives from a transmission that must have come from the Greek cultural area at some time before the Babylonian methods and roots had been so overlaid with later Greek geometrical thinking and new parameters.[11]

Do we now have therefore a second instance in which Babylonian sexagesimal methods seem to have survived for some two thousand years at least by transmissions and cultures unknown, in what seems to be an oral tradition in South India and in New Guinea?

References

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