

(inclusive) moves. The latter classes are stored as a bitmap, which is economical because they contain a rather limited number of initial positions.

Thus, the playing database compresses to some 160 Kbytes. Allowing for bootstrap, etc., 120 Kbytes on the floppy are free for other uses. The playing program consults the floppy, addressing it by block, and displays the message 'drawn' or 'mate-in-n', followed, if won, by the optimal white moves and their optimal black countermoves.

### THE KBBKN STATISTICS: NEW DATA FROM KEN THOMPSON

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Elsewhere in this issue (p. 4), Michie and Bratko exhibit a histogram showing their count of the KBBKN positions by distance-to-win. While their histogram is enlightening, a database result by Ken Thompson allows even stronger quantification. In Table 2 below, *wfreq* counts the number of legal WTM positions starting from which a mate is obtained *or* conversion into a proper subgame is enforced. Each proper subgame (KBBK or KBKN) is known to be won, provided it has arisen from KBBKN. [Note that the general KBKN endgame is not won, but instances arising by optimal play out of a won KBBKN *do* enjoy this property.]

In the subsidiary Table 1, *mfreq* counts the number of positions with the stated distance-to-mate for all proper subgames in the sense defined above. It is not directly comparable to statistics published elsewhere, because it runs over both proper subgames only and therefore fails to be complete for KBBK. Moreover, it also is suspected of containing an unknown proportion of KBKN positions. However, Ken Thompson assures us that the latter are isolated positions not leading to an extended sequence of moves. Furthermore, we note that the results of Table 2, when referring to conversion rather than to direct mate, are silent on the point of entry into Table 1. Specifically, by way of example, a distance of  $m$  in Table 2 implies, if conversion is its endpoint, that the distance-to-mate is  $m + n$  with  $n \leq 19$ , but unspecified otherwise.

Finally, we beg readers to note that Table 1 requires most careful interpretation : apart from being possibly contaminated with KBKN, Table 1 is known to be deficient, because it fails to enumerate all KBBK positions, merely counting those which legally and optimally arise out of KBBKN.

Proper subgames of KBBKN won in # of moves	# of positions <i>mfreq</i>	Proper subgames of KBBKN won in # of moves	# of positions <i>mfreq</i>
1	1580	11	62414
2	652	12	73646
3	3734	13	88690
4	4608	14	90134
5	7668	15	79014
6	9378	16	61518
7	14202	17	27340
8	21554	18	3362
9	31066	19	30
10	45314		

Table 1: *mfreq* counts the number of positions in the proper subgames of KBBKN with their distance-to-mate

KBBKN positions won in # of moves	# of positions <i>wfreq</i>	KBBKN positions won in # of moves	# of positions <i>wfreq</i>
1	11642102	34	253160
2	1643300	35	243250
3	1956612	36	217750
4	981564	37	186492
5	650824	38	147468
6	548594	39	120278
7	471194	40	105624
8	405244	41	99356
9	341974	42	100906
10	297426	43	108608
11	264432	44	135884
12	241638	45	195826
13	231814	46	289670
14	224488	47	392776
15	233084	48	486966
16	245486	49	581756
17	255044	50	684892
18	260242	51	788752
19	261164	52	920868
20	257792	53	1016772
21	253790	54	1037140
22	240404	55	981394
23	228990	56	859132
24	222536	57	721244
25	227280	58	579930
26	240616	59	430142
27	268216	60	269286
28	299594	61	115298
29	323922	62	26052
30	333916	63	2804
31	318030	64	904
32	296328	65	284
33	275448	66	64

Table 2 : *wfreq* counts the number of legal WTM-won-KBBKN positions with their distance-to-win