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A GAUGE OF ENDGAMES

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The last few issues of the Journal have seen the publication of some results about the properties of certain endgames, deriving from a data-base approach. The present contribution will tabulate some known results as well as list some data bases which the authors suspect must have been constructed but for which results could not be readily traced.

Such a tabulation, simple though it may seen, presents some difficulties that derive from the imperfect state of knowledge in the endgame field. Even under our universal assumption, which is that White is to move (WTM), the result is not easy to classify unambigously as a win or a draw. For some endgames, the very possibility of forcing a win is not only a function of the material strength, but also depends on the initial configuration (IC), as is only too well-known to any practical chess-player. It is perhaps not redundant to point out here that a properly constructed data base covers all legitimate initial configurations and, we add as an aside, must even consider some illegitimate ones during construction.

It turns out that only KQK and KRK are unambiguously classifiable as wins under WTM. It follows that for these two endgames there is an unambiguous maximin, which is the number of moves necessary and sufficient for White to mate from the worst initial configuration under our explicit assumption of optimal counterplay throughout. For less simple endgames, the content of the notion 'maximin' loses some of its sharpness. This is best demonstrated by the endgames KBBK and KBNK, where maximin has meaning only for those positions which are won and obviously is not applicable to those exceptional initial configurations which are known to be drawn. In the particular instances cited, the drawn ICs are relatively few and might even be classified as bizarre, at least by a human observer.

In all four instances cited so far the maximin still has the advantage of being expressible and interpretable as a worst-case mating distance. Due to the current state of ignorance in this research area the notion 'maximin' is even further diluted in the instance of KQKR. In this fifth instance, the maximin known should be interpreted as a worst-case distance too, but must not be read to indicate a distance-to-mate. It merely records the worst-case distance to the conversion to a different endgame, KQK in this case. It must not be concluded that

(a) KQKR is always a won endgame;
(b) the worst-case mating distance equals 31 + 10 = 41, i.e., worst-case distance to conversion added to worst-case distance of the converted endgame.

Conclusion (a) is invalidated by examples in endgame books showing the existence of ICs that are definitely drawn, where it should be amplified that at least some of these ICs would not be considered bizarre by human players. Conclusion (b) is invalidated by our ignorance: it simply is not known whether the converted endgame is one where the maximin of KQK applies or whether the converted configurations form a subset of the KQK to which a lesser maximin applies.

Next, consider KRKN and KRKB; the maximins known refer to distances-to-conversion as noted. The distinction from the previous case lies in the circumstance that the positions leading to a draw (hence not to the conversion into KRK) are relatively far more numerous, so that wins are the exception rather than the rule. At the risk of confusing the issue, we should state that the known maximins to conversion are not necessarily indicative of the unknown maximins to mate, as acutely pointed out for KPK by Van Bergen in this issue of the Journal.

After these cautionary remarks, the table below should not require further annotation, except that our notions won* and drawn* should ideally be replaced by a more quantitative characteristic, say q, standing for a quantifier, defined to be a fraction up to 1.0, being the number of all legitimate won configurations divided by the number of all legitimate configurations. [Constructors of data bases, please note: q as derived from the canonical subset of positions need not coincide with q as defined above because of the different multiplicities of positions with pieces on symmetry axes. The difference, though, is likely to be slight.]

Thus, won* is a crude notation for q being close to 1, drawn* for q being close to 0. As an extension, we introduce $\overline{q}$ for those endgames which may be lost by White in some cases, such as KPKP, the definition of $\overline{q}$ being as that of q with 'won' replaced by 'lost'. The quantity q, when known to us, has been published in the Table. KBBK and even KBNK provide excellent examples of the notion of won*, KPK's q (a result by Clarke) is still far from won* and, of course, not at all near to drawn*.

In passing we note again that for KPK it is definitely not true that the worst-case distance to conversion plus the worst-case distance of the converted endgame sum to the worst-case distance to mate (see pp. 216-218) as shown by the table below: $28 < 19 + 10$.

ENDGAME	RESULT	MAXIMIN
KQK	won	10 to mate
KRK	won	16 to mate
KPK	q = 0.765	28 to mate
KPK	q = 0.765	19 to conversion into KQK
KBBK	q = 0.9997	19 to mate
KBNK	q = 0.995	33 to mate
KQKR	won*	31 to conversion into KQK
KRKN	drawn*	27 to conversion into KRK
KRKB	drawn*	18 to conversion into KRK
KRNKR	drawn*	33 to conversion into KRK
KRBKR	drawn*	59 to conversion into KRK
KBBKN	won*	66 to conversion into KBBK

Table: The Known Gauge of Endgames

The above table exhausts the authors' definite data; the rest is conjecture, word-of-mouth and, at best, reporting at second hand. On these, admittedly weak grounds we surmise the following endgames to have been investigated by constructing their data bases.

FOUR-PIECE ENDGAMES

KPPK: reported by Newborn to have been constructed by Ken Thompson, result believed to be won*.

KPKP: reported by Newborn to have been constructed by Ken Thompson, result unrevealed though it can be argued that some ICs may allow Black to force a win.

KQKN: constructed by Ken Thompson, the result may be won for White.

KQKB: constructed by Ken Thompson, the result is believed to be won*.

FIVE-PIECE ENDGAMES

KRPKR : published and constructed by Arlazarov and Futer.

KQP(g7)KQ: published and constructed by Komissarchik and Futer.

KQPKQ : under construction by Ken Thompson; this construction is liable to lead to the conversion into at least any of KQQKQ, KQRKQ and KQNKQ, which have a similar status. The authors conjecture that KQBKQ, another potential conversion, may also be involved.

It will not have gone unremarked that even some results (won, won*, drawn*) are only available to us by rumour, intuition or inspired guesswork. The authors take this opportunity to repeat their invitation to the computer-chess community to publish any and all results they may have and which comply with the aims as published in Vol. 8, No. 2, pp. 45-46. Needless to say, the authors would also appreciate having extant relevant publications brought to their attention. We also venture to suggest that, for endgames not tabulated here, results and specified maximins would be most welcome. This applies even more forcibly to verifiable statements about q and $\bar{q}$, the quantifiers proposed above.

There is an obvious, immediate aim of such publications, namely to share knowledge which is likely to benefit the computer-chess community. Yet, this call for endgame results has another, derived aim, namely the refinement of essential notions. Just as extant research has brought to light refinements such as ulti-mate, swap-cap, swap-prom and keep-it-on, there is little doubt in our minds that studying more complex endgames will lead to even further distinctions in our set of applicable notions, thus extending the intellectual apparatus of chess analysis for computers no less than for human beings.

[For technical reasons, bibliographical references to chess-endgame database constructions in general and to this article in particular will be published in the next issue of this Journal, supplemented by such material as readers will, we hope, bring to our attention.]

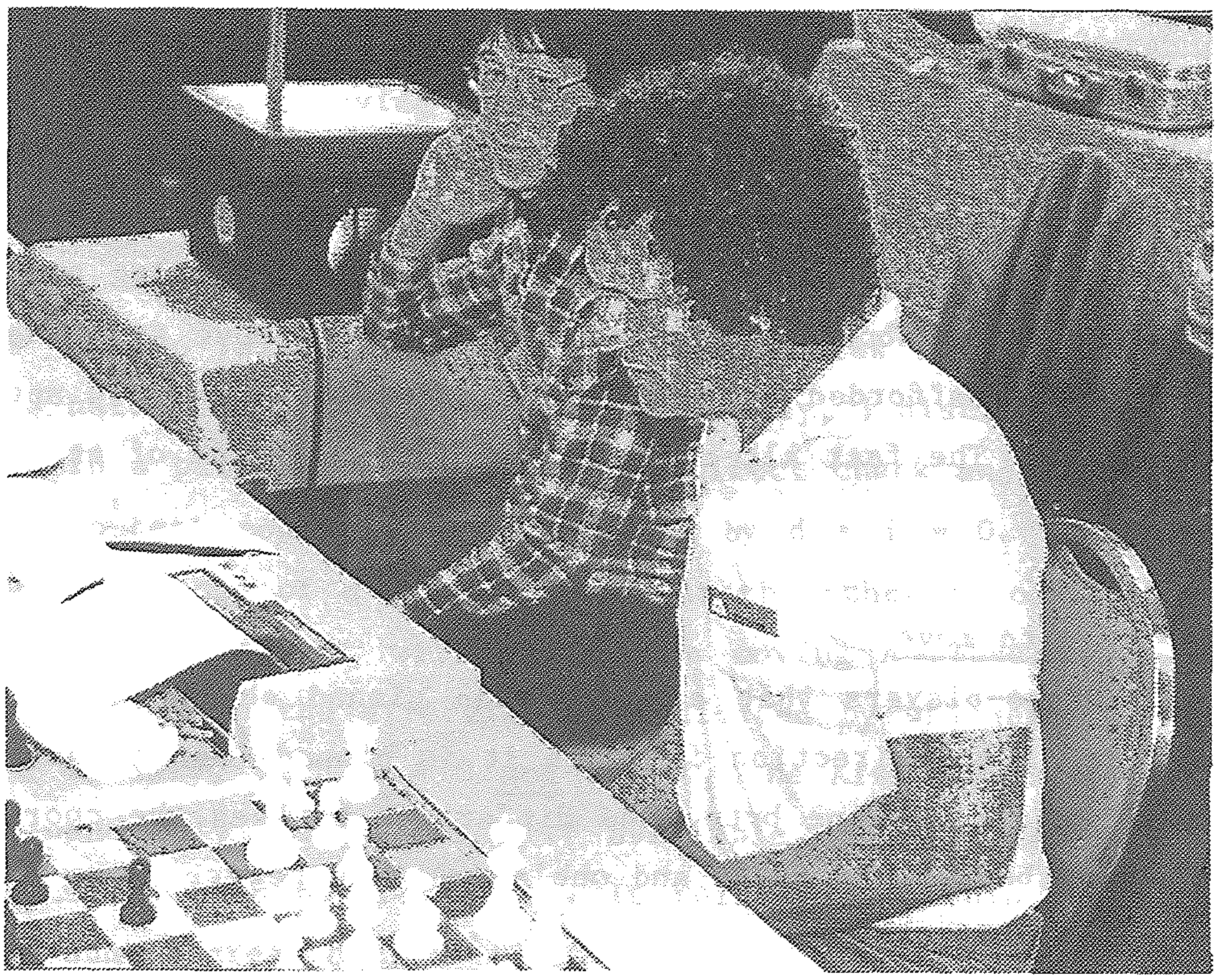

Photo by
David Welsh

The young Doctor rising from the ashes of Academe.
Dr. Jonathan Schaeffer of PHOENIX fame.