Table 1 Rate of reduction of the weight average, single-strand molecular weight of calf thymus DNA, and of poly(rA), at 50 °C and 80 °C, pH 7.0, with and without 2 Zn per nucleotide residue

	Slope (h^{-1}) of M_0/M_t against t*		Approximate time (h) for reduction of M_0†			
			to 1/2 M_0		to 1/10 M_0	
	+Zn	−Zn	+Zn	−Zn	+Zn	−Zn
DNA						
50 °C	0.016±0.002	0.014±0.003	62	71	560	640
80 °C	2.1±0.6	1.6±0.2	0.48	0.62	4.3	5.6
Poly(rA)						
50 °C	72±4	0.20±0.04	0.014	5.0	0.12	45
80 °C	1,400±400	6.2±0.6	0.00064	0.16	0.0062	1.4

* Evaluated from the plots of Fig. 1 (the mean deviation for fit to the experimental points are appended). M_0, initial weight average molecular weight; M_t, values at times t.

† Calculated from the slope of M_0/M_t against t; $M_0/M_t = 1 + (\text{slope})t$.

ions is generally unlikely during *in vitro* manipulations of DNA, although it must be taken into account with polyribonucleotides. Figure 1 and Table 1 can serve as a guide to the amount of damage to be expected under various conditions.

The great difference in the susceptibility of polyribonucleotides, compared with polydeoxynucleotides, to zinc cleavage makes possible the quantitative removal of RNA from a DNA–RNA mixture. This becomes evident when one calculates from the data of Table 1 that, at 50° C with zinc, about 5,000 breaks occur in a poly(rA) strand for one break in a DNA strand. Selective zinc degradation of RNA has already been utilised[10] in connection with chromatin reconstitution studies; our results indicate that the DNA components remain intact during such degradation.

Our results suggest also that DNA should be much less susceptible than RNA to deleterious action by metal ions *in vivo*. Thus the question arises whether these effects may be part of the reason for the predominant evolutionary selection of DNA, instead of RNA, as the bearer of the primary genetic information.

Obviously, any attempt to answer this question, as any question involving evolutionary hypotheses, must be speculative. It has been suggested[1] that the relatively small difference in thermal stability of DNA and RNA can account for the choice of the DNA duplex as the repository of genetic information. But this difference in thermal stability is only about one three-hundredth the difference in stability to metal ions. Moreover, metal ion degradation of polyribonucleotides proceeds[5] through a mechanism that involves the 2′ OH group, the presence of which in RNA and absence in DNA constitutes the only primary structural difference between the two types of nucleic acid. For both of these reasons, if stability of the primary genetic material is a criterion of its evolutionary selection, susceptibility towards metal ions seems much more important than susceptibility towards heat. It is of course possible that evolutionary selection of the structure was in response to pressures other than stability and coincidentally resulted in DNA with high stability to metal ion degradation.

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Amounts of isoaccepting lysine tRNAs change with the proliferative state of cells

VARIATIONS in isoaccepting tRNA populations occur in mammalian cells during development, neoplasia, and virus infection, and such changes may reflect the involvement of tRNA in regulatory processes[1,2], although firm evidence to that effect is not available. Ortwerth and Liu[3] have shown that in normal or neoplastic cells an isoaccepting species of lysine tRNA, $tRNA_4^{Lys}$, is present in dividing cells but absent from non-dividing cells. Ortwerth *et al.*[4] determined some of the functional properties of $tRNA_4^{Lys}$ from various tissues and obtained evidence that the species is a real isoacceptor of $tRNA^{Lys}$ rather than an artefact. Normal, proliferating cells that were examined had only relatively small amounts of $tRNA_4^{Lys}$; however, a larger proportion of the isoacceptor was found in neoplastic cells such as mouse leukaemia and Morris hepatoma cells. It is desirable, therefore, to establish whether the large amount of $tRNA_4^{Lys}$ is peculiar to the neoplastic state or whether normal cells may also have large amounts of that isoacceptor under some growth conditions. Therefore, we studied isoaccepting lysyl-tRNA profiles from mouse cells in different states of proliferation: adult liver, embryo and growing and quiescent primary cultures of embryonic cells. We found that normal growing cells also have an appreciable amount of $tRNA_4^{Lys}$.

Ten-day-old mouse embryos, with heads and extremities removed, were prepared for monolayer tissue culture by dispersing cells with trypsin and seeding in roller bottles in Eagle's MEM[5] containing penicillin G (100 U ml^{-1}), streptomycin (100 μg ml^{-1}) and 10% foetal calf serum. tRNA and aminoacyl-tRNA ligases were isolated from primary cells, embryo and liver as previously described[6] and tRNA was purifed further by DEAE-cellulose chromatography[7]. tRNA was aminoacylated with lysine as before[8].

In mouse leukaemia cells in suspension culture, $tRNA_4^{Lys}$ is 47% of the total $tRNA^{Lys}$, and this amount decreases to 16% as cell density increases and proliferation stops[3]. Comparable data on the amount of $tRNA_4^{Lys}$ in a uniform population of rapidly dividing normal cells and the effect of increasing cell density were not available. We have compared the Lys-$tRNA^{Lys}$ profiles of growing and density-inhibited quiescent primary cultures of embryonic cells. The results (Fig. 1*a*) indicate a much larger amount of $tRNA_4^{Lys}$ in growing cells than in resting cells. Consistent with these results is the finding of an appreciable amount of $tRNA_4^{Lys}$ in embryonic cells which were not in tissue culture (Fig. 1*b*). These results also indicate that placing the cells in tissue culture does not in itself lead to an altered $tRNA^{Lys}$ profile. In contrast to results with proliferating cells, $tRNA_4^{Lys}$ is present only in a very small amount in adult mouse liver (Fig. 1*c*).

The results are summarised in a quantitative manner in Table 1. $tRNA_4^{Lys}$ varies from 3% in adult mouse liver to 24% in proliferating monolayer culture. Similar results with cultured murine sarcoma virus-transformed cells (H. J., D. J., and C. H., unpublished) and SV40-transformed cells (J. Katze, personal communication) have been obtained. In both cases, $tRNA_{5a}^{Lys}$ (ref. 8) seems to be present in addition to $tRNA_4^{Lys}$ in rapidly proliferating cells and decreases as the cell population becomes

Table 1 Effect of state of growth of cells on chromatographic distribution of isoacceptors of lysine tRNA

Cells	Growth state	Distribution of lysine tRNA isoacceptors			
		1	2	4	5
Adult mouse liver	Quiescent	–	58	3	38
Primary mouse embryo	Quiescent	2	50	9	40
Mouse embryo	Growing	4	37	15	44
Primary mouse embryo	Growing	2	35	24	38

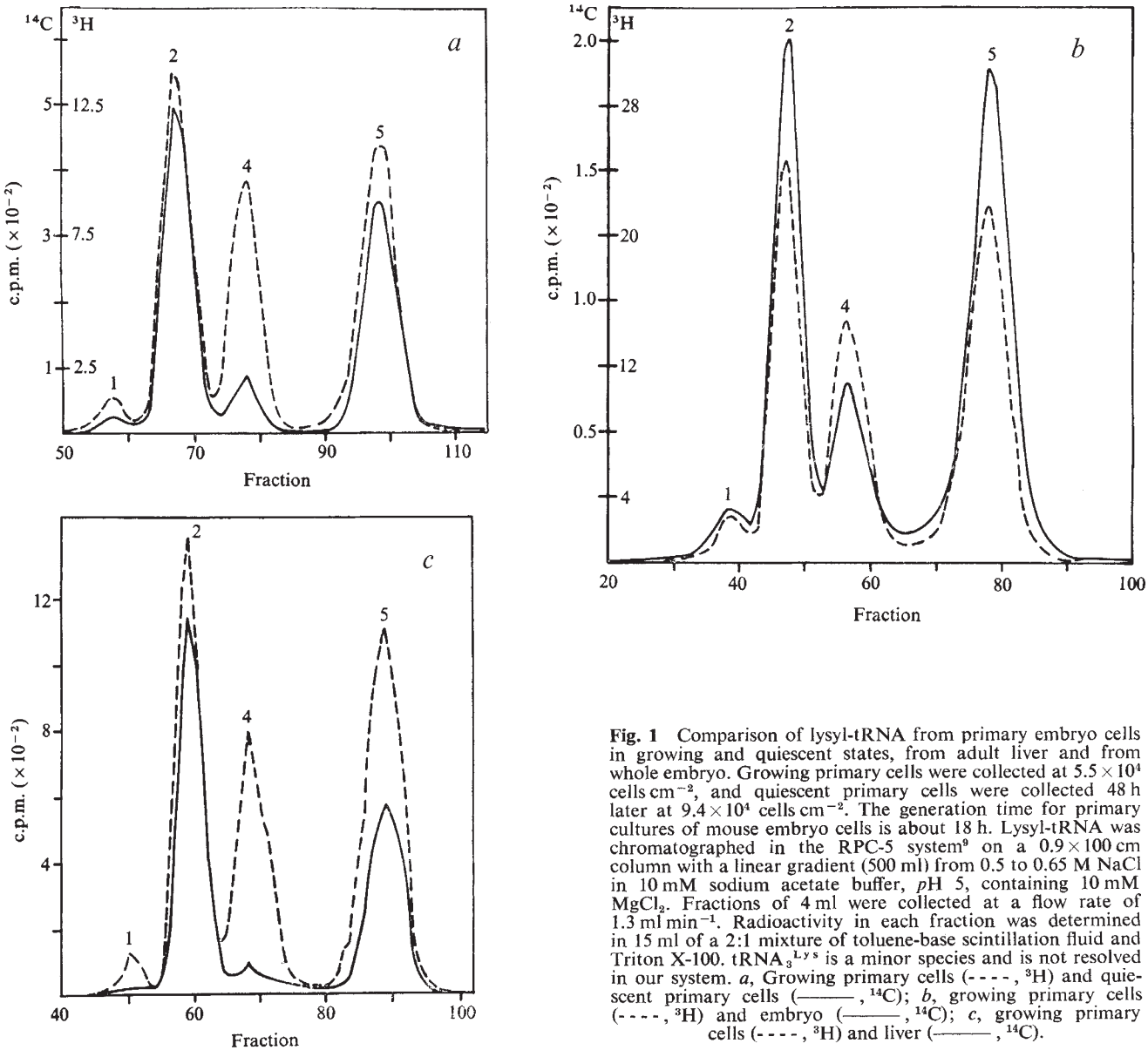

Fig. 1 Comparison of lysyl-tRNA from primary embryo cells in growing and quiescent states, from adult liver and from whole embryo. Growing primary cells were collected at 5.5×10^4 cells cm^{-2}, and quiescent primary cells were collected 48 h later at 9.4×10^4 cells cm^{-2}. The generation time for primary cultures of mouse embryo cells is about 18 h. Lysyl-tRNA was chromatographed in the RPC-5 system[9] on a 0.9×100 cm column with a linear gradient (500 ml) from 0.5 to 0.65 M NaCl in 10 mM sodium acetate buffer, *p*H 5, containing 10 mM $MgCl_2$. Fractions of 4 ml were collected at a flow rate of 1.3 ml min^{-1}. Radioactivity in each fraction was determined in 15 ml of a 2:1 mixture of toluene-base scintillation fluid and Triton X-100. $tRNA_3^{Lys}$ is a minor species and is not resolved in our system. *a*, Growing primary cells (- - - -, ^3H) and quiescent primary cells (———, ^{14}C); *b*, growing primary cells (- - - -, ^3H) and embryo (———, ^{14}C); *c*, growing primary cells (- - - -, ^3H) and liver (———, ^{14}C).

dense. (The presence of $tRNA_{5a}^{Lys}$ is not always detected by RPC-5 chromatography, but benzoylated DEAE-cellulose chromatography provides resolution[8].) The effect of cell density on profiles of other isoaccepting tRNAs has been noted[10].

It is now clear that the distribution of isoaccepting species of $tRNA^{Lys}$ in both normal and neoplastic cells varies with the proliferative state of cells. The constancy of the sum of percentages of $tRNA_2^{Lys}$ and $tRNA_4^{Lys}$ suggests that species 2 and 4 are structurally related with differences attributed to the degree of modification[4]. Confirmation of that possibility and investigations into functional differences are the subjects of continuing investigations.

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Errata

In the article "An ancient lunar magnetic dipole field" by S. K. Runcorn (*Nature*, **253**, 701; 1975) the legends to Fig. 2*a* and *b* were transposed.

In the article "A gene cluster in *Aspergillus nidulans* with an internally located *cis*-acting regulatory region" by H. N. Arst and D. W. MacDonald (*Nature*, **254**, 26; 1975) there was an error in Fig. 1. The two arrows linking L-proline and L-Δ^1-pyrroline-5-carboxylate should be reversed—so that the top arrow points to the right and the bottom to the left.