homeodomain is sufficient for the binding to cad mRNA; other regions of the protein, or other homeodomain proteins such as cad, orthodenticle and the homeodomain of antennapedia, did not bind. That the bcd homeodomain interacts with cad mRNA in vitro is consistent with the in vivo observation, suggesting that the homeodomain of bcd is necessary for the formation of the cad gradient (Fig. 1f, g). The failure of other homeodomain proteins to bind cad mRNA does not rule out the possibility that they possess RNA-binding properties as preceded by zinc-finger-type transcription factors¹⁰

To assess the functional significance of the *in vitro* interaction between bcd and cad mRNA, we performed co-transfection experiments with Drosophila Schneider cells11. We used chloramphenicol acetyl transferase (CAT) reporter gene constructs¹¹ containing different 3' UTR sequences (Fig. 3). The reporter gene constructs were set under the control of the bcd-responsive, cis-acting element of the zygotic hunchback promoter¹². After cotransfection with bcd, we determined the stimulated transcription of CAT mRNA by reverse transcription-polymerase chain reaction (RT-PCR)¹³, and the translation of the CAT mRNAs with the different 3' UTRs by assaying CAT activity11

CAT mRNAs containing the Drosophila cad 3' UTR sequences or the regions including the BBR produced about sevenfold less CAT activity than CAT mRNA containing the cad 3' UTR sequences of Clogmia or the 3' half of the 3' UTR of Drosophila cad (Fig. 3a-c). CAT mRNA containing the BBR within the simian virus 40 (SV40) 3' UTR¹¹ were also translated less efficiently than those containing only the SV40 3' UTR. These results suggest that bcd may not only act as a transcriptional activator in the assay system, but also reduce the translation efficiency of the BBR-containing mRNAs.

To show that bcd does indeed suppress the translation of BBRcontaining mRNA, we examined reporter gene constructs containing the SV40 3' UTR with or without the BBR that were transcriptionally activated by the yeast GAL4 transcriptional activator¹⁴. In the absence of bcd, the GAL4-stimulated CAT mRNAs were translated with similar efficiency (Fig. 4). In the presence of bcd, however, the translation of the BBR-containing CAT mRNA was significantly reduced, but the translation of CAT mRNA without the BBR was not significantly affected. This shows that bcd suppresses the translation of BBR-containing mRNA.

Our results are consistent with the argument that the anterior determinant bcd acts not only as a transcriptional activator but also functions in a manner analogous to the key components of the posterior maternal pattern-organizer system^{15–20}, which acts by translational repression through the activities of nanos and pumilio 15-20. After binding the pumilio protein and a 55K protein to the nanos-response element within the 3' UTR of hunchback mRNA^{17,20}, the nanos protein is thought to interact with this 'landing pad' to provide region-specific translational repression of the evenly distributed maternal hunchback mRNA¹⁵⁻¹⁹. This allows for the activation of the posterior gap genes knirps and giant in response to cad⁵. Thus, while in the posterior region of the embryo translational and transcriptional control are conducted through separate components, the anterior determinant bcd can exert both regulatory functions. Our findings also imply that the asymmetric distribution of the key components of the anterior and posterior maternal pattern-forming systems, which was thought to be set up independently^{1,2}, is linked through the dual function of bcd.

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ADDENDUM

Identification of the breast cancer susceptibility gene BRCA2

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THE sequence for the BRCA2 gene is now available at the web page of the Institute of Cancer Research, address http:// www.icr.ac.uk/molcarc/brca2.htm, as well as from Genbank.

ERRATUM

Mechanosensory signalling in C. elegans mediated by the **GLR-1** glutamate receptor

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FIGURES 3 and 4 of this Letter were inadvertently transposed during the production process; the legend to Fig. 3 therefore describes the figure published as Fig. 4 and vice versa.