

insect populations (M. Begon).

Stenseth's papers in the collection are peppered with epigrammatic quotations. My favourite is "Mathematics without natural history is sterile, but natural history without mathematics is muddled"<sup>13</sup>. More crudely, "Sound naturalism is to ecology what legs are to a runner; but anti-theoretical naturalists are, quite naturally, like headless runners"<sup>14</sup>. This collection walks tall, from head to toe. □

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1. Elton, C. S. *J. Exp. Biol.* **2**, 119–163 (1924).

2. Elton, C. S. *Voles, Mice and Lemmings* (Clarendon, Oxford, 1942).
3. Stenseth, N. C. & Saitoh, T. (eds) *Res. Pop. Ecol.* **40**, 1–158 (1998).
4. Kinoshita, E. *Res. Bull. College Expt. Forests, Hokkaido University* (Sapporo) **5**, 1–5 (1928) (in Japanese).
5. May, R. M. *Stability and Complexity in Model Ecosystems* (Princeton Univ. Press, 1973).
6. May, R. M. *Nature* **261**, 459–467 (1976).
7. Turchin, P. in *Population Dynamics* (eds Cappuccino, N. & Price, P.) 14–40 (Academic, New York, 1995).
8. Sugihara, G. & May, R. M. *Nature* **344**, 734–741 (1990).
9. Sugihara, G. *Phil. Trans. R. Soc. Lond. A* **348**, 477–495 (1994).
10. Tong, H. *Scand. J. Stats* **22**, 399–421 (1995).
11. Stenseth, N. C. *et al. Proc. Natl Acad. Sci. USA* **94**, 5147–5152 (1997).
12. Lloyd, A. L. & May, R. M. *J. Theor. Biol.* **179**, 1–11 (1996).
13. Maynard Smith, J. *New York Review of Books* 41–42, 13 May (1983).
14. Haila, Y. & Jarvinen, O. in *Conceptual Issues in Ecology* (ed. Saareinen, E.) 261–278 (Reidel, Dordrecht, 1982).

## Transcription

# A lesson in sharing?

Patrick A. Grant and Jerry L. Workman

The TATA-binding protein (TBP) is pivotal to transcription — it recognizes a specific DNA sequence, the TATA element, found in the control region of many genes, and is required for other proteins to assemble there and initiate transcription. A topic of much discussion has been to what degree the TAFs (TBP-associated factors) are required for TBP to do this. Initially TAFs were thought to be essential, but this idea was challenged by the observation that,

in yeast, some TAFs are not generally required for transcription<sup>1,2</sup>. Moreover, a subset of the TAFs also contribute to the activities of other transcriptional regulatory complexes<sup>3–6</sup>. Now, four papers in *Molecular Cell*<sup>7–10</sup> and one report in *Cell*<sup>11</sup> fuel this debate by showing that a sub-group of TAF proteins, histone-like TAFs, may have a much broader role in gene expression.

Considerable work over the past decade led to the conclusion that TFIID — an evolu-

tionarily conserved complex consisting of TBP and eight to twelve associated TAFs — rather than TBP alone is required for activation of protein-coding genes. Consistent with this, almost all TAFs were found to be essential for yeast viability. However, this model seemed all but destroyed when experiments to inactivate or deplete certain TAFs in yeast cells did not lead to the expected broad loss of activated transcription<sup>1,2</sup>. Moreover, TAF145/130, which was thought to be central to the assembly of TFIID, was found to regulate only a subset of genes, further deflating enthusiasm for a model of general TAF function<sup>12</sup>.

Now, in one of the new papers, Holstege *et al.*<sup>11</sup> describe a transcriptional analysis of most of the yeast genome. They find that TAF145 is required for transcription of about 16% of the genes studied. Surprisingly, parallel analyses of another TFIID component, TAF17 (a histone-like TAF), by Apone *et al.*<sup>7</sup>, Michel *et al.*<sup>8</sup> and Moqtaderi *et al.*<sup>9</sup> indicate that it is broadly required, regulating the expression of at least 67% of all yeast genes<sup>7,11</sup>.

So what distinguishes TAF17 from TAF145? Sequence analysis reveals some similarity between TAF17, TAF60 and TAF68/61, and the histones H3, H4 and H2B, respectively. Perhaps these histone-like TAFs are important structurally, in a complex, through mutual interactions of their histone-fold motifs. Michel *et al.*<sup>8</sup>

## Zoology

# A saola poses for the camera

As wildlife photographs go, it will not win any prizes for artistry, but as a wildlife self-portrait it is unique. This is the first picture of a wild saola (*Pseudoryx nghetinhensis*, also known as the Vu Quang bovid), a creature which caused a stir five years ago as the first large land vertebrate to be discovered for over 50 years (V. V. Dung *et al. Nature* **363**, 443–445; 1993).

The saola was originally described from skulls, teeth and skins alone, the hunting trophies of local inhabitants collected by a survey team working in the mountainous forests along the Vietnam–Laos border. The form of the adult animal was pieced together from fragments of 20 specimens, from which it was surmised that saolas weigh about 100 kg, and stand one metre tall.

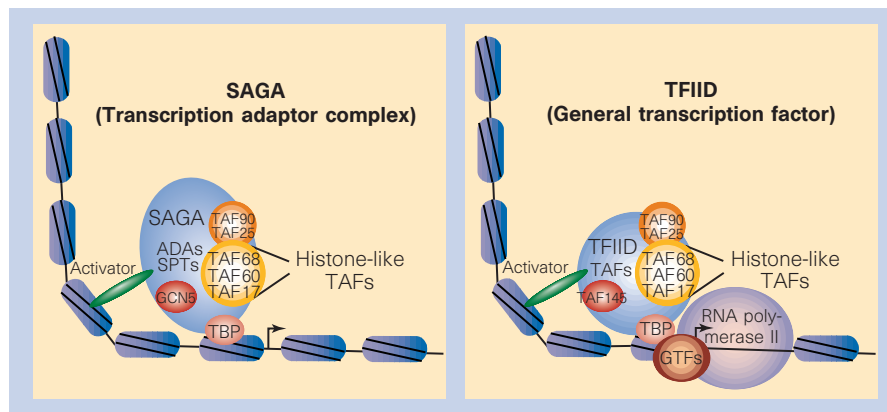
As the artist's reconstruction by Karen Phillipps shows, the saola is an unusual antelope. Its long, straight horns and coloration make it difficult to group with other species, but based on anatomical and DNA evidence it was assigned to a new genus in the bovine group containing the oxen and the eland. Since then, however, a study based on skull form and dentition



has sought to place it with the goats (H. Thomas, *Mammalia* **58**, 453–481; 1994).

Scientific eyes have still to gaze upon a live, wild saola in the flesh. This picture was taken when an obliging animal triggered a camera trap laid by a team led by Mike Baltzer of Flora and Fauna International, which is surveying the forest as part of an EU-funded project to halt its

degradation and destruction. Based on rough calculations of the amount of habitat needed to support an animal of this size, it is thought that probably only a few hundred saola survive in the region. Under attack as it is from hunters and shrinking forests, this odd, elusive creature may well become extinct before any researcher sees one or learns its habits. **John Whitfield**



**Figure 1** Transcriptional complexes bound to an array of nucleosomes. Both SAGA (SPT–ADA–GCN5 acetyltransferase) and TFIID contain the histone-like TAFs (yellow) and two additional TAFs, TAF25 and TAF90. Each complex contains a subunit with histone acetyltransferase activity (GCN5 in SAGA and TAF145 in TFIID) that is thought to lead to acetylation of histones in promoter proximal nucleosomes (purple). TFIID also contains additional TAFs, whereas SAGA contains ADA and SPT proteins. Both SAGA and TFIID can interact with transcriptional activators, and they bind or contain the TATA-binding protein, TBP. TFIID is also crucial in the formation of transcription complexes, including additional general transcription factors (GTFs) and RNA polymerase II.

examined the importance of histone-like TAFs by inactivating each of these proteins in yeast. These studies, along with inactivation of TAF68 by Natarajan *et al.*<sup>10</sup>, point to very general defects in transcription when histone-like TAFs are lost in yeast cells, and provide genetic evidence for interactions between these TAFs<sup>8</sup>. Although previous studies indicate that TAF60 and TAF68 do not have such broad effects<sup>12</sup>, the new studies imply that the histone-like TAFs are critical for the expression of most protein-coding genes.

These observations raise a dilemma — why are certain TAFs required for the transcription of more genes than others, if they are all subunits of the same TFIID complex? A possible explanation has come from studies of the yeast SAGA histone acetyltransferase complex, which contains a subset of TAF proteins including all three histone-like TAFs<sup>3</sup> (Fig. 1). This arrangement seems to be conserved in homologous human acetyltransferase complexes<sup>4,6</sup>. SAGA is a large complex of around 20 different proteins, and it interacts directly with gene-specific activators and TBP<sup>3,10,13–15</sup>. Thus, a logical explanation for the broader transcriptional defect when histone-like TAFs (such as TAF17) are lost, but not when others (such as TAF145) are inactivated, is that the histone-like TAFs occur in other transcriptional regulatory complexes as well as TFIID.

It seems unlikely that the broad transcriptional defect observed when TAF17 is inactivated is simply due to a loss of SAGA activity. For example, GCN5, the catalytic subunit of SAGA, is required for the expression of only about 5% of all yeast genes<sup>11</sup>. Moreover, inactivation of another component of SAGA does not cause a general decrease in gene expression<sup>8</sup>. However, it is possible that the functions of TFIID and

SAGA in transcription are redundant. So, only when shared components are lost is there a deficiency in both complexes, resulting in broad transcriptional defects. Loss of subunits unique to either TFIID or SAGA would then affect only specific subsets of genes<sup>11</sup>. This ‘redundancy’ theory is intriguing, because both TAF145 and GCN5 contain histone acetyltransferase activity. However, histone-like TAFs could exist in a third, as-yet-unidentified complex that is distinct from SAGA and TFIID. Or, perhaps the histone-like TAFs have a specific, essential function that is not shared by the other components of SAGA and TFIID. It remains to be seen whether functional redundancy exists, or whether the other, equally plausible, hypotheses hold true<sup>12</sup>. □

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1. Moqtaderi, Z., Bai, Y., Poon, D., Weil, P. A. & Struhl, K. *Nature* **383**, 188–191 (1996).
2. Walker, S. S., Reese, J. C., Apone, L. M. & Green, M. R. *Nature* **383**, 185–188 (1996).
3. Grant, P. A. *et al.* *Cell* **94**, 45–53 (1998).
4. Ogryzko, V. V. *et al.* *Cell* **94**, 35–44 (1998).
5. Wicczorek, E., Brand, M., Jacq, X. & Tora, L. *Nature* **393**, 187–191 (1998).
6. Martinez, E., Kundu, T. K., Fu, J. & Roeder, R. G. *J. Biol. Chem.* **273**, 23781–23785 (1998).
7. Apone, L. M. *et al.* *Mol. Cell* **2**, 653–661 (1998).
8. Michel, B., Komarnitsky, P. & Buratowski, S. *Mol. Cell* **2**, 663–673 (1998).
9. Moqtaderi, Z., Keaveney, M. & Struhl, K. *Mol. Cell* **2**, 675–682 (1998).
10. Natarajan, K., Jackson, B. M., Rhee, E. & Hinnebusch, A. G. *Mol. Cell* **2**, 683–692 (1998).
11. Holstege, F. C. P. *et al.* *Cell* **95**, 717–728 (1998).
12. Hahn, S. *Cell* **95**, 579–582 (1998).
13. Saleh, A., Lang, V., Cook, R. & Brandl, C. J. *J. Biol. Chem.* **272**, 5571–5578 (1997).
14. Utley, R. T. *et al.* *Nature* **394**, 498–502 (1998).
15. Sterner, D. E. *et al.* *Mol. Cell. Biol.* (in the press).



#### 100 YEARS AGO

For eight years I have had a large plant of *Atropa* growing here in my garden amongst currants and gooseberries; close by it is a mountain-ash, and at a short distance a large cherry-tree. Birds, including the blackbird, build in the garden; but although the cherries, currants, gooseberries and raspberries are annually stripped, the *Belladonna* berries are never touched. The birds are encouraged, and the fruit can be spared. The *Belladonna* berries are conspicuous objects from July to November; there are hundreds on my plant every year, long after other fruits have vanished — black, lustrous, luscious-looking — but no bird ever touches them.

From *Nature* 1 December 1898.

#### 50 YEARS AGO

One of the paradoxes of civilised life is the lowly position occupied among the sciences by the study of living things. There seems, in Great Britain at least, to be a general disposition to regard biology as something in the nature of a pastime, while the physicist and the chemist are held in respect as serious practitioners. Only in the treatment and, to a modest degree, the prevention of disease, and in agriculture, has biological science a recognized position. That the well-being of the human race is closely bound up with the equilibrium of Nature, is not generally recognized. It was therefore, with special interest that we studied the presidential address of Sir Henry Tizard at the recent meeting in Brighton of the British Association, and especially his conclusion that “Whatever new comforts and luxuries may be provided in future by the advancement of physical science, it is on the development of the biological sciences that the peace and prosperity of the world will largely depend”. With this view we are in hearty agreement, though we should prefer to substitute for the word “largely” the word “ultimately”... But, if biology is to play the part required of it, it must be recognized as a profession, not as a hobby. It must be placed on the same professional level as chemistry, physics, engineering and medicine, with a corresponding prestige. For this reason we welcome the announcement of the proposal to establish an Institute of Biology.

From *Nature* 4 December 1948.