m7GpppG^{m}poly(A,U) derivative, which should contain molecules with the . . . UAAU . . . sequence complementary to the 3′ end of 18S ribosomal RNA, showed significant interaction with 80S ribosomes.

Several observations must be mentioned which are in apparent conflict with the appealing idea that eukaryotic ribosomes only start at ends because they interact with 7mG. Hunt mentioned evidence from TMV and M. Pränger (University of Utrecht) and Kääriäinen gave evidence from Semliki Forest virus, that there is more than one initiation site in the 5′ terminal portion of their respective mRNAs. R. Gesteland (Cold Spring Harbor), in discussing elegant experiments showing that yeast suppressor tRNAs work in mammalian cell-free systems, reconfirmed the observation that an internal cistron of bacteriophage Qβ RNA is translated accurately by eukaryotic ribosomes and initiation factors. Moreover, to return finally to the picornaviruses, these RNAs can be translated *in vitro* although, as discussd by P. Fellner (Searle, High Wycombe), 7mG cannot be detected at their 5′ ends.

Insectiverous grouse

from our Animal Ecology Correspondent

THE traditional management of heather moorland for red grouse production centres on regular burning of the vegetation so as to encourage sprouting of new green shoots. Such new growth is rich in nitrogen and phosphorus, elements now known to be correlated with performance of grouse populations (Moss, *J. Anim. Ecol.*, **38,** 103; 1969). The practice of burning seems right and proper since heather forms the bulk of the diet of adult grouse. But most species of animals are opportunist feeders—the grouse is no exception—and adherence to too rigid a management creed may deny some moors the extra grouse they could produce.

Different grouse moors do not have identical vegetation. About two-thirds of the total acreage in Britain is low lying and fairly dry. The remaining one-third lies at high altitude and the high annual rainfall it sustains keeps its deep peaty surface waterlogged almost the whole year through. Recent studies by Butterfield and Coulson on one such blanket bog moor reveal that adult grouse supplement their diet with quite considerable amounts of insect food (*J. Anim. Ecol.*, **44,** 601; 1975). The habitat is just right for craneflies, chiefly *Tipula subnodicornis* and *Molophilus ater*, and at the peak of emergence their densities may reach 15 m^{-2} and 400 m^{-2} respectively. Adult male craneflies do not fly strongly and the females have no wings at all. They represent to the grouse an additional source of food almost as easy to harvest as the heather tips upon which they spend most of their adult lives. That adult grouse can develop a specific search image for craneflies is clear from the observation that one grouse shot in October 1970 had the remains of 495 adults of the rare *T. gimmerthali* in its stomach. This is more than the total number of individuals caught by British entomologists since the end of the nineteenth century.

Observations during May, June and July of fresh droppings taken from established grouse territories on damp moor revealed that the percentage containing insect material varied from 98% at the time of maximum emergence to 8% at the end of the hatching season. Most droppings contained plant material but in a small number the amount fell to less than a half of the total contents. Both species of cranefly were eaten by adult grouse, but chicks took considerably more of the small *M. ater* than they did of the larger *T. subnodicornis*. For adult grouse the reverse was true. By contrast, droppings from a dry moor were almost totally devoid of insect remains.

What is of great interest is that weight for weight, *T. subnodicornis* contains nine times more nitrogen, seven times more phosphorus, six times more sodium and twice as much potassium as heather shoots. *M. ater* is richer, too, in these elements but less so than its larger relative. The importance of these elements in grouse nutrition is shown by the choice by breeding grouse of growing tips of heather which contain high levels of nitrogen and phosphorus (Moss, *J. Anim. Ecol.*, **41,** 411; 1972). Moss, Watson and Parr confirmed that maternal nutrition did affect breeding success but what was important was the length of time during which heather growth was possible prior to laying (*J. Anim. Ecol.*, **44,** 233; 1975). Management plans for grouse moors are aimed at creating conditions for maximum breeding success and standing crop of grouse. On wet moors craneflies are not available until after egg laying and so cannot directly influence pre-laying nutrition. Their peak in abundance comes shortly after clutches are completed when, it could be argued, female grouse are in a state of nutrient depletion. By offering an easily gathered, rich food source at this time, they could play a vital part in the maintenance of grouse populations. A full-scale investigation of the relationship between grouse and insects seems now to be overdue, for if these preliminary findings are generally substantiated the future management of the wet third of Britain's grouse habitat may well reflect the need to maintain suitable cranefly sites.

Tropomyosin in transition

from E. J. O'Brien

IN a resting muscle the level of Ca^{2+} is very low and interaction between the thick, myosin-containing and the thin, actin-containing filaments is inhibited. When the muscle is stimulated, Ca^{2+} is released from the sarcoplasmic reticulum so that its concentration around the filaments rises sharply. The inhibition is then removed and myosin and actin can interact, split ATP and produce contraction. The means by which inhibition and its removal are obtained has been extensively investigated, and, in the main, attention has been directed at the proteins troponin and tropomyosin which are combined with actin in the thin filaments of many types of muscle.

In the electron microscope actin resembles two strings of beads twisted slowly around each other. Much more difficult to see, because of its narrow width (2 nm), is tropomyosin, but from diffraction and other studies of the thin filament, it has been shown to lie end-to-end in each of the two grooves between the actin strings. Attached at intervals of about 40 nm along the actin–tropomyosin complex is troponin, which has three components: one, TN–T, which binds to tropomyosin, one, TN–C which binds Ca^{2+} and one, TN–I, which is responsible for inhibition.

With TN–C removed the thin filament is not Ca^{2+}-sensitive and remains permanently 'switched off', as in a resting muscle. Without any of the troponin components the actin–tropomyosin complex is also not Ca^{2+}-sensitive, but in this case it stimulates the splitting of ATP by myosin, that is, it is 'switched on'. Wakabayashi, Huxley, Amos and Klug (*J. molec. Biol.*, **93,** 477; 1975) have studied the nature of the structural change involved in the on–off transition. Since the required structural detail is at the limit of resolution provided by negatively stained material, their analysis has relied heavily on the use of sophisticated computer processing of electron micrographs. This involves densitometry of the micrographs to produce a digital scan, and from this, and a knowledge of actin's helical symmetry, three-dimensional reconstructions of the filaments can be obtained.

Wakabayashi *et al.* prepared fila-