this gene[13], and it is equally possible that decidual activin A does the same thing. Moreover it is maternal, and not zygotic, activin that is required for mesoderm formation in the teleost fish *Oryzias latipes* (the Japanese medaka)[14].

One way of asking whether maternal activin A might be responsible for mesoderm formation in the mouse is to interfere with the function of the activin receptor, as did Hemmati-Brivanlou and Melton in *Xenopus*[2]. Activin receptors fall into two classes, both of which are serine/threonine kinases[15]. By analogy with the TGF-β receptor system, it is likely that the type II activin receptor is a constitutively active kinase. This molecule binds activin and then associates with and phosphorylates a type I receptor which goes on to initiate intracellular signalling[16]. If decidual activin A is required for mesoderm formation, a mouse embryo lacking a type II activin receptor would not be able to bind activin and should not form mesoderm at all. On the other hand, if decidual activin is not involved in mesoderm formation, such embryos should show a phenotype similar to activin-deficient mice.

It may not have been a surprise to Bradley and his colleagues[7] to find that mouse embryos deficient in the type II receptor ActRcII form mesoderm perfectly well. But it *is* a surprise that defects in ActRcII-deficient mice show little resemblance to those of activin-deficient animals. Most individuals lacking ActRcII developed into adults whose only significant problem was the suppression of follicle-stimulating hormone (FSH) release. Activin stimulates FSH release[17] (that is why it is called activin), and the knockout result suggests that this function is mediated solely through ActRcII. The embryonic functions of activin, however, must involve different or additional receptors, including, perhaps, ActRcIIB as well as receptors yet to be isolated[7].

And what of follistatin? Do mice mutant for this gene lack a nervous system, as might be predicted from the work in *Xenopus*? The answer, to be found in the third paper[8] in this issue, is 'no'. Follistatin-deficient mice are small, their muscle mass is reduced, their skin is shiny, and there are a number of other defects, but their nervous systems remain defiantly normal. Overall, the defects are more widespread than those seen in activin-deficient mice, implying, in agreement with its expression pattern[11], that follistatin may bind and modulate the functions of other members of the TGF-β family, or perhaps even function independently.

So this work[6–8] counts against the view that activin and follistatin are involved in mesoderm formation and neural induction in the mouse, although activin addicts may still argue that decidual activin A does the business, and those with a more general allegiance to the TGF-β family may point out that genes such as *nodal* are definitely required if mesoderm is to form properly[18,19]. But what else do the new findings tell us?

First, they warn us that interpretation of experiments in *Xenopus* involving overexpression of gene products such as activin or follistatin or (especially) of truncated versions of activin receptors is fraught with difficulty. We need to know much more about what ligands and receptors are expressed at different stages of development and we need to know the biological specificities of the different molecules. As another warning, truncated type II activin receptors have been shown to block the action of the TGF-β family member Vg1 (ref. 20). In the case of follistatin, as well as this question of specificity, it is not even clear under what circumstances the protein binds to activin and inactivates it, and under what circumstances it 'presents' activin to a type II receptor.

But we should also be reminded that for all we learn from gene knockout experiments, what is lacking in the mouse is embryological data relating to mesoderm formation. In particular, we don't even know whether mesoderm in the mouse embryo really does arise through induction, still less when induction occurs and where the signal comes from. These embryological questions must be addressed at the same time as the analysis of mice mutant for putative 'mesoderm-inducing factors'. □

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DAEDALUS

Crème de gaz

MANY oils and lipids form an emulsion with water. Some biological lipids, such as lecithin, go further: they form an emulsion of tiny hollow spheres full of water. These liposomes, as they are called, consist of one or more concentric bilayers of lipid molecules around an aqueous core. They can encapsulate drugs for delivery to specific sites in the body. Daedalus now points out that by standard surface-tension theory, any bubble is pressurized by its curved surface. The smaller its diameter, the sharper the curvature, and the higher is the resulting internal pressure. A liposome is a bubble only about 0.1 micrometres across, pressurized by all its curved surfaces in series. Its interior could easily reach 300 atmospheres.

So Daedalus is now loading liposomes, not with drugs, but with compressed gases. DREADCO chemists are pumping pressurized oxygen, acetylene, butane and so on into lecithin suspensions, stirring them vigorously to form liposomes, relaxing the pressure and churning the resulting liposomal 'milk' into a cream or butter containing 50 per cent or more of trapped gas.

'Gascream' will transform the bottled-gas industry. Out will go those clumsy cylinders. Instead, glassblowers, welders, anaesthetists and campers will simply spoon the appropriate Gascream into a special syringe and draw off the gas as it is released by thermal or chemical degradation of the cream.

But Gascream is more than a mere improved gas cylinder. An edible version pressurized with oxygen could make an ideal food for victims of pneumonia or bronchitis. Oxygen delivered via the stomach would save them from having to breathe. A perfectly balanced formulation could be metabolized completely in its own oxygen, making it the first fully self-contained food. Sadly, by the same token it would also be a chemical high explosive.

The DREADCO team is also creating unstable liposomes pressurized almost to bursting point: tiny disturbances will set them off. Liposomes loaded with high-pressure carbon dioxide could be the basis of a ferociously fizzy drink; a high-pressure liposomal shaving cream would give an unprecedented tingling-fresh sensation. Even pharmacy could benefit. Gas-laden liposomes could be a new weapon against bacteria or parasites. They would be the biological equivalent of the limpet mine. Once the organism had ingested or adsorbed the liposome, the slightest biochemical weakening would set it off. The invader would be blown apart in a microscopic blast of expanding gas. David Jones