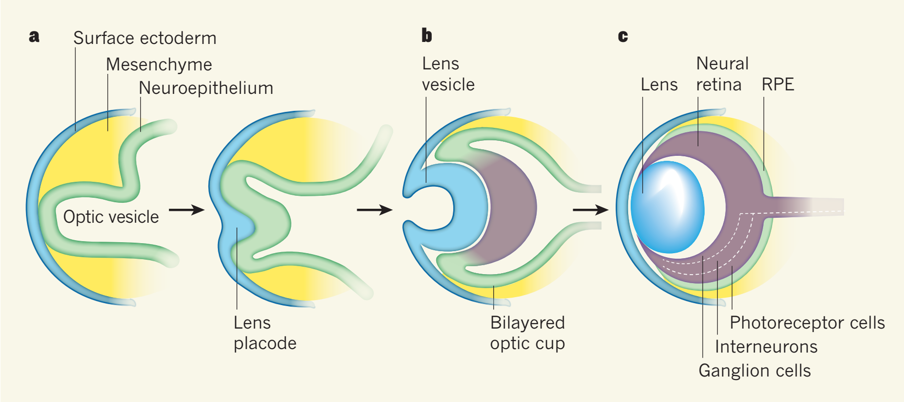

Figure 1 | Eye development. **a**, At early stages of eye development, the surface ectoderm thickens and invaginates together with the underlying neuroepithelium of the optic vesicle. **b**, The inner layer of the bilayered optic cup gives rise to neural retina and the outer layer gives rise to the retinal pigmented epithelium (RPE) (**c**). The mature neural retina (**c**) comprises three cellular layers: photoreceptors, interneurons (horizontal, amacrine and bipolar cells), and retinal ganglion cells. Eiraku *et al.*[1] generated optical cups *in vitro* from embryonic stem cells.

appropriately expressed the distinctive molecular markers of both the neural retina and the RPE, confirming their identity; another indicator was visible as RPE pigmentation.

An even more striking proof that these are genuine retinas is that, in culture, the synthetic optic cups undergo cell differentiation. Indeed, retinal progenitor cells — the multipotential cells of the neural retina — divided and differentiated into all the main retinal neuronal cell types, including photoreceptors. These events seem to follow the normal temporal sequence of retinal tissue formation, and the resulting cells were correctly organized in the appropriate cellular layer.

But even though optic cups can now be grown in culture from ES cells, we still don't fully understand the principles underlying their development. For instance, it is surprising that optic cups can form independently of any interaction of the neuroepithelial cells with surface ectoderm or mesenchymal tissue that would normally surround them in a developing embryo (Fig. 1). Eiraku *et al.*[1] propose that the ES-cell-derived retinal cells have a latent intrinsic order, and that collections of cells can self-pattern and undergo dynamic morphogenesis by obeying a sequential combination of local rules and internal forces within the epithelium.

However, Eiraku and colleagues' powerful *in vitro* system has great potential as it can be manipulated to define the molecular interactions that are essential for eye development. Moreover, if functional outer rod segments — where the protein complexes responsible for phototransduction are located — can be produced in longer-term cultures, this 3D system will be invaluable for functional studies examining the response of the retina to light.

What's more, development of an equivalent human 3D system could offer the prospect of disease modelling and drug testing using induced pluripotent stem cells generated from patients' tissues. Most forms of untreatable blindness result from the loss of photoreceptor cells, leaving other retinal neurons intact. In mice, transplantation of photoreceptor precursor cells isolated from the developing mouse retina can repair adult retinas[8]. A major challenge is to obtain sufficient numbers of photoreceptor precursors at the appropriate stage of development from a renewable cell source. This 3D system for culturing ES cells[1] may solve that problem by providing synthetic retinas at defined stages of development from which precursors can be isolated more readily for use in transplantation. ■

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OCEANOGRAPHY

When glacial giants roll over

The energy released by capsizing icebergs can be equal to that of small earthquakes — enough to create ocean waves of considerable magnitude. Should such 'glacial tsunamis' be added to the list of future global-warming hazards?

ANDERS LEVERMANN

About half of Greenland's annual ice loss occurs through solid-ice discharge; in Antarctica such calving processes account for almost all ice loss. The resulting icebergs come in various sizes and shapes, some several hundred metres high. Immediately after they break off, when their height exceeds their horizontal extent, these floating giants can be unstable and capsize. In a paper in the *Annals of Glaciology*, MacAyeal and colleagues[1] have estimated the energy that is released when icebergs roll over. They find that this can be as large as that of an earthquake of magnitude 5–6 on the Gutenberg–Richter scale, depending on the iceberg's dimensions.

As one of several possibilities, a proportion of this energy can generate a surface gravity wave — a tsunami. MacAyeal *et al.* provide a theoretical analysis of the potential of iceberg capsize to generate tsunamis. Assuming a simplified, but not completely unrealistic, rectangular geometry, they calculate the potential energy before and after capsizing. The difference is the energy released from the roll-over. Thin icebergs do not carry a lot of potential energy, whereas ice-cube-shaped icebergs, which are as thick as they are high, have the same potential energy before and after turning over. Thus the most energy is released by icebergs that are half as thick as they are high — and can be equivalent to the explosion of several thousand tonnes of TNT.

According to MacAyeal and colleagues[1], energy release increases with the fourth power of an iceberg's height (Box 1). But not all of

50 Years Ago

Hospital Infection: Causes and Prevention. A systematic approach to the causes and prevention of hospital infection is much to be welcomed. Accurate records are meagre and the problem is one which belongs to everybody and, consequently, to no one. Since streptococcal infections now cause no real difficulties—they still respond to penicillin and have acquired no resistance to the drug—the book is mainly concerned with the staphylococcal infections which, because of their resistant strains, are the main source of infection and worry in hospitals today... The text is clear and logically presented, and adds to the value of a book which should be useful not only to pathologists and bacteriologists but also to surgeons, paediatricians, sister tutors, hospital administrators, and equally important, hospital architects.

From *Nature* 8 April 1961

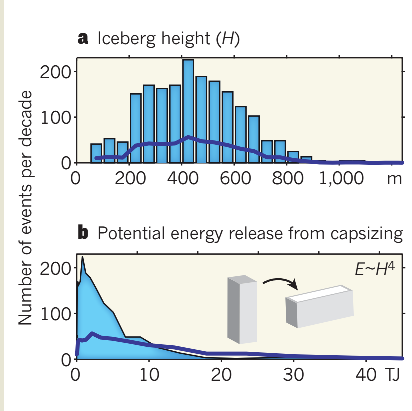
100 Years Ago

Dr. A. C. Johansen gives a summary account of the recent investigations on plaice and plaice fisheries in Danish waters... It includes an account both of the market statistics of plaice landed and of the special scientific investigations and experiments which have been carried out. The market conditions in Denmark are exceptional ... the chief demand is for fish that are landed alive... [As] there is a size limit (25.6 cm.) below which they are not allowed to be landed, and the fish under this size are returned to the sea, the actual destruction of small fish is insignificant. It appears that since the introduction of the size limit the Danish plaice fisheries in the North Sea have increased, and the report speaks in favour of an international size limit for plaice for all countries carrying on fisheries in the North Sea.

From *Nature* 6 April 1911

BOX 1

Iceberg height and capsize energy



These results come from simulations for the Antarctic made at my institute with the Potsdam Parallel Ice Sheet Model[3,4]. **a,** Frequency distribution of iceberg height, *H*, in discharge events per decade, assuming a quadratic ground area proportional to H^2. Iceberg discharge is computed from the vertical extent of the ice sheet and its velocity distribution in the present-day equilibrium state. The results show a peak in the abundance of icebergs with a height of around 400 metres. This differs from observations of icebergs that are freely floating in the ocean[5,6], and is probably due mainly to the assumption that icebergs break off only in whole slices. But it provides an indication of how much discharge occurs at various heights of the ice-sheet margin at which iceberg calving occurs. **b,** Potential energy, *E*, released from capsizing of these icebergs, with $E \sim H^4$. The shading depicts results for an aspect ratio (thickness/height) of ¼. Maximum energy is released for an aspect ratio of ½ (thick blue lines in both **a** and **b**). 1 TJ = 10^{12} J. For comparison, 4.2 TJ is the energy released by the explosion of one kilotonne of TNT. **A.L.**

this energy is available for tsunami generation. The authors suggest at least five other ways in which energy can be dissipated, ranging from the small rocking motion of the capsized icebergs themselves to mesoscale turbulent friction within the ocean. On the basis of a scaling analysis and by analogy with submarine landslides, however, the authors propose that several per cent of this energy can be translated into a tsunami wave. This is the crucial and most complicated part of the problem.

Once the energy transfer is known, the question arises of what height of tsunami is produced by an iceberg capsizing. The authors find that in typical iceberg regions located off the coast, but not yet over the deep ocean, the tsunami crest can reach up to 1% of the initial iceberg height — that is, 4 metres for an average iceberg from Antarctica (Box 1) but possibly up to 10 metres for the tallest icebergs on Earth. These numbers are comparable to the open-ocean crest heights of the devastating tsunami in the Indian Ocean in 2006 and the recent event in Japan. But they need to be understood as simple estimates — as ballpark values that show that capsizing icebergs may cause considerable tsunami waves. MacAyeal and colleagues provide a clean and beautifully simple theoretical framework for further studies of the subject. As stated by the authors, laboratory experiments, field observations and model simulations are essential to better understand the phenomenon.

Tsunamis generated by sudden iceberg motion have been reported to cause severe but localized damage in some Greenland fjords, where harbours have been destroyed by the wave[2]. Whether they pose a threat to more populated areas remote from their point of origin merits investigation. In principle, tsunamis pass across the deep ocean with practically no dissipation because friction there is low, and they are hardly disturbed by ocean currents such as the Antarctic Circumpolar Current or the North Atlantic Current.

We will need a great range of scientific insights — from iceberg-calving physics to wave generation from sudden iceberg motion — before we can say whether such glacial tsunamis will become more abundant in a world experiencing global warming. In principle, it is possible that iceberg-generated tsunamis could travel across the oceans and reach areas more populated than Antarctica. But as MacAyeal and colleagues speculate[1], even in the south polar region, explosive energy release might have wider effects by causing the collapse of floating ice shelves, thereby influencing global sea-level rise. ■

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