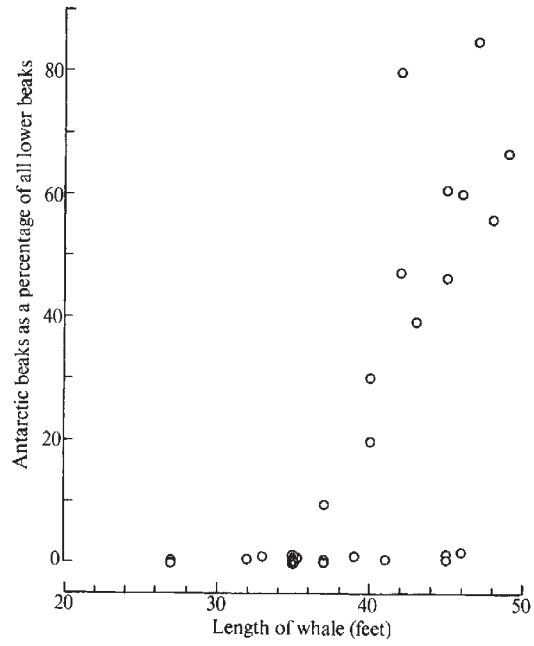

Fig. 1 Percentage of lower beaks belonging to Antarctic species in stomach contents of male sperm whales caught off Durban.

than 9% seems to increase with the size of the whale. If temperate and cold water species had a very broad overlap, this increase with size could result from larger whales migrating further south than smaller whales. Another possible explanation is that smaller whales take longer to travel to Durban from the Antarctic and therefore eat more on the way. Those whales with over 80% of Antarctic beaks must have eaten very little during the swim from the Antarctic. The distance from 40° S to the Durban area is 600 nautical miles and, as sperm whales cruise at 3–5 knots[12], they probably take less than 8 days; even so, such a long swim with little food is remarkable in such an active mammal.

Clearly the beak method has considerable potential for studying migration to and from Antarctic waters, but its extension to other areas and its use in the study of smaller scale movements rest upon a more detailed knowledge of cephalopod distribution. Study of the cephalopods in stomach contents from a broad geographical area may yield such detail. For example, analysis[8] of 117,519 lower beaks from 152 sperm whales caught off Donkergat and off Durban shows that one species of *Histioteuthis* (probably *H. meleagroteuthis*) contributes 14.34% of all lower beaks and some flesh at Donkergat but beaks are rare and flesh is absent at Durban. This is good evidence that sperm whales do not normally migrate from west to east round South Africa, and suggests that the breeding stocks of these two regions may be isolated. This agrees with Best's[5] conclusion based on mark returns and breeding seasons[15].

Table 1 Lower Beak Collections from Whales caught off Durban

Sex	Whale length (feet)	Month	No. lower beaks	Antarctic species %
Females	32	5	1,043	0.1
	34	2	7,855	0.2
	34	3	3,523	0.2
	34	3	2,410	0.3
	35	2	1,012	0.1
	35	3	4,447	1.3
	35	3	347	0.6
	37	3	1,610	0.1
Males	27	2	368	0.3
	32	2	2,545	0.3
	33	3	204	1.0
	35	4	1,031	0.1
	35	6	3,762	0.3
	35	7	876	0.6
	37	7	947	0.1
	37	9	313*	9.5
	39	6	1,105	1.0
	40	7	263	30.1
	40	7	1,692*	19.8
	41	2	237	0.4
	42	7	388	47.1
	42	8	120	80.0
	43	8	168	39.3
	45	9	161	46.5
	45	6	869	1.3
	45	5	189*	60.8
	45	9	426*	0.4
	46	6	1,634*	60.1
	46	10	783*	1.7
	47	6	40*	85.0
	48	5	1,911	56.1
	49	5	21*	66.7

* Samples from stomachs. The remainder were from collections of the complete stomach contents. Whales with no Antarctic species are not included.

I thank all the people who kindly collected samples, Dr R. Gambell, Mr P. B. Best and Mr S. G. Brown for reading the manuscript, Mr Neil Macleod who helped to identify the large number of beaks involved in the study.

MALCOLM R. CLARKE

Marine Biological Association, Plymouth PL1 2PB

Received April 4, 1972.

[1] Townsend, C. H., *Zoologica, New York*, **19**, 1 (1935).
[2] Matthews, L. H., *The Sperm Whale, Physeter catodon. Discovery Rep.*, **17**, 93 (1938).
[3] Slijper, E. J., Utrecht, W. L. van, and Naaktgeboren, C., *Bijdr. Dierk., Afl.*, **34**, 1 (1964).
[4] Brown, S. G., *Rep. Intern. Commun. Whal.*, **21**, 51 (1971).
[5] Best, P. B., *Invest. Rep. Div. Sea Fish. S. Afr.*, **78**, 1 (1969).
[6] Jonsgård, A., *Norsk Hvalfangsttid*, **49**, 289 (1960).
[7] Clarke, M. R., *Norsk Hvalfangsttid*, **51**, 173 (1962).
[8] Clarke, M. R., *Discovery Rep.* (in the press).
[9] Clarke, M. R., *Bull. Brit. Mus. Nat. Hist.*, **8**, 419 (1962).
[10] Deacon, G. E. R., *Discovery Rep.*, **15**, 1 (1937).
[11] Mackintosh, N. A., *Proc. Roy. Soc.*, B, **152**, 624 (1960).
[12] Gambell, R., *Norsk Hvalfangsttid*, **57**, 126 (1968).
[13] Best, P. B., *Invest. Rep. Div. Sea Fish S. Afr.*, **66**, 1 (1968).

Motion Stereoscopy

ON June 1 I saw the most exciting visual spectacle that I have ever known. With two or three others, I was watching water running down the spillway of the big new dam at Cow Green in Upper Teesdale. The main flow consisted of a continuous sheet, causing enough foam to make it easily seen, but it was a windy day and little waves in the reservoir were splashing over to give a series of extra water masses which formed themselves into broad pointed jets running down the spillway faster than did the main mass.

As I watched, the flat sheet quite gradually seemed to rearrange itself into a deep three-dimensional picture, with the jets standing out from the rest further and further as they ran down the face. This whole built up a fascinatingly beautiful appearance as of a series of great flat moving icicles, the better part of a hundred metres long, standing out, by what looked like tens of metres at their points from the main sheet, like the overlapping, ruffled feathers of an angry cock.

My distance from the spillway was far too great for there to be any detectable difference between the images on my two retinas, and the clear subjective stereoscopic picture was evidently derived from the interpretation by an intermediate

level in my brain of the differential movement of the water masses.

The physical basis of the phenomenon can be understood in terms of common experience on a train journey. Looking out of the window, parallax causes the nearer objects to fall behind at a greater apparent rate than the farther ones. If one's own speed were known, this observation could give an accurate measure of distance away. Small birds, with their eyes on the sides of their heads, must use this effect to give them the accurate three-dimensional image of the world which is required for flying through bushes and trees, but of course we have no way of knowing what, if any, is the subjective effect as seen by a bird.

The face of the spillway filled enough of my field of view for my mind to interpret the relative motion of the parts, as it would have done if I had been moving and they at rest. This again is an effect familiar to railway travellers; when one is standing in a station and a neighbouring train starts to move, it is easy to feel convinced that it is one's own train that is moving.

I expounded this view as we walked away from the dam, and suddenly realized that if my explanation was true, this three-dimensional effect should be just as clear when using one eye as it was with two. So I dragged the others back and we all solemnly gazed at the face of the dam with one eye only (each). The subjective picture was exactly as it had been before. For a few moments the water looked flat, and then gradually the jets seemed to stand out until we were seeing exactly the same awe-inspiring set of vast overlapping and slowly moving sheets that we had seen before.

This observation seems to me worth reporting, not only for its beauty and novelty, but because it gives an extra datum on the handling of visual information by the brain.

It seems likely that the delay—familiar to stereoscopists in other non-standard circumstances—is due to the fact that the section of the brain responsible for presenting the final subjective picture concerns itself first with the differences between the data presented by the two eyes. If these differences are available, other clues are rejected—hence the success of a stereoscopic pair of pictures when we know perfectly well that we are looking at a pair of flat cards. If they are not available, other clues will be accepted, but the processing takes a little longer. Anyone who has lost one eye must be well aware of this, but I have never seen it discussed, and have never before been able to prove that the subjective image presented on the basis of motion parallax can be qualitatively identical with that derived from normal binocular vision.

J. H. Fremlin

Department of Physics,
University of Birmingham,
PO Box 363,
*Birmingham B*15 2*TT*

Received June 14, 1972.

Do Membrane Filters prevent Cell Contacts?

Membrane filters have been used by experimental embryologists and immunologists to separate tissue components and cell populations in experiments designed to distinguish between cell mediated communicative systems and soluble messengers. Most commonly, 'Millipore' filters have been used both in the construction of diffusion chambers[1] and in *in vitro* studies with isolated and recombined tissue components[2]. Few systematic studies have been made into the completeness of separation and on the correlation between filter thickness and pore size with cytoplasmic ingrowth. Grobstein and Dalton[3] have reported that 'Millipore' filters with an average pore size of 0.1 μm prevented virtually all cytoplasmic ingrowth. Most experimentalists have used 'Millipore' filters with even larger pores (0.45 μm to 0.8 μm) in the belief that they prevent cell contacts (see ref. 4).

Table 1 Pore Size of 'Nucleopore' Filters

Nominal pore size (μm)	Mean pore size ± s.d. (μm)
0.1	0.15 ± 0.02
0.2	0.20 ± 0.04
0.5	0.68 ± 0.06

Even by light microscopy cytoplasmic material may be seen in such pores, suggesting ingrowth of filaments. The depth of ingrowth, the nature of the material and the development of cytoplasmic contacts in the filters are difficult to investigate because 'Millipore' filters have a three-dimensional spongy structure with dead-end pockets and whirling pores[5,6]. Also, the pore dimensions are variable within any given filter[6]. We report here studies with 'Nucleopore' filters which have cylindrical channels of even size and which have been used as a solid substrate for cultured cells[7]. 'Nucleopore' filters (General Electric Co., Vallecitos Nuclear Center, Pleasanton, California) with nominal pore sizes of 0.5, 0.2 and 0.1 μm respectively were used. The dimensions of the pores of different types of filters were determined from scanning electron micrographs by measuring the diameter of about 100 holes from enlarged negatives. Some slightly unexpected results were obtained (Table 1) as the pore mean size deviated from the nominal one.

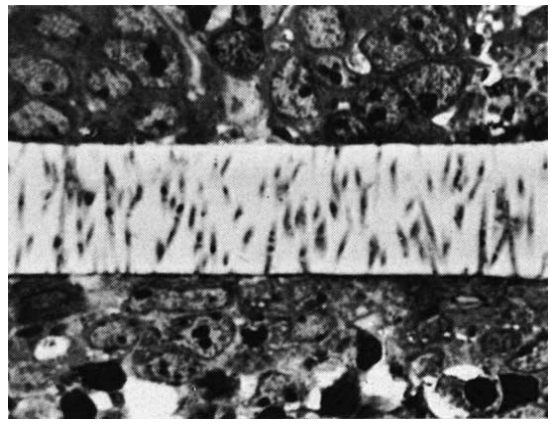

Fig. 1 Thick epon section of 48-h organ culture in which 'Nucleopore' filter with 0.5 μm pore size was used to separate mouse metanephric mesenchyme (above) from spinal cord tissue (below). A massive penetration of cytoplasmic processes from both tissues takes place in the filter. Toluidine blue staining. (×1,500.)

The experimental model system in which tissue separation was studied was a modification[8] of that devised by Grobstein[9]. Metanephric mesenchyme and spinal cord dissected from 11-day mouse embryos were cemented with 1% agar on opposite sides of 'Nucleopore' filters. The results are based on observations made after 48 h cultivation of these explants. Cytoplasmic penetration into filters with nominal pore sizes of 0.5 and 0.2 μm could be seen by high-resolution light microscopy of 1 μm thick sections (Fig. 1). The processes filled the pores throughout the filter. Electron microscopy of these transfilter cultures showed that in filters with 0.5 and