

Seeing Voices

DICK TAHTA, DAVID PIMM

DT: For various reasons, I have found myself unable to write anything about David Wheeler, who was not only one of the most important influences in my professional life but also one of my closest friends. What I can try to do is to send you some thoughts which I would normally have wanted to share with him.

We had corresponded intermittently after he left England nearly thirty years ago, but we began to do so much more regularly after we both discovered the delight and convenience of e-mail. We would normally exchange two or three messages about one thing or another each week, and I came to rely on his acute and often acerbic comments on any current reading, on plays and films and concerts we had been to, or on any writing I was currently struggling with, and even – sometimes – on mathematics education.

The bereaved are often angry with the dead for having left them, and indeed I was angry with David last year when my weekly e-mail fix suddenly stopped! I have been musing about the things I would have wanted to continue to discuss with him. And thought that I would inflict a conversation on you, or even on readers of FLM should you so decide

DT: Do you see what I mean? Or hear what I say? Probably both; though there are some extreme ways in which some people construe the world. For instance, Narcissus was so much in his eyes that he fell in love with his own image, whereas Echo was so much in her ears that she heard nothing but her own voice. 'She was a mouth as well as an ear, but he was only an eye' I came across this example last summer in *I See a Voice: a Philosophical History of Language, Deafness and the Senses* by Jonathan Rée [HarperCollins, 1999, p 71].

This book raised various interesting themes, among which was the idea that perhaps society in general had become over-reliant on visual experience. Certainly I was aware that when my wife and I used to read aloud to each other of an evening, she used to enjoy listening as such, but that I still needed text in front of me to be able to attend properly to the spoken word. She could talk for hours on the telephone; I often find it difficult to talk with people unless I can see them or have a mental picture of them and the room they are speaking from.

I didn't think this was what people often describe as a gender difference in ways of networking: it seemed more like a matter of a possible dominance of eye or ear (although I recognise that there are some who would associate this difference with gender). I was then taken by the question of

why this might have become so for each of us, and looked to early childhood experience for a clue

Inevitably, this was a theme I would have wanted to raise with David, partly because I knew it would fit into an on-going conversation about the effects of early experience. David himself was someone who had surmounted various handicaps in his childhood and was often impatient with any psychological explanations that might somehow be held to excuse choices – or the lack of them – that were made in later adult life.

Meanwhile, there were some issues about imagery in general that we had often discussed and often reverted to. Many years ago, he had enjoyed my telling him that when I had dared to suggest to a music teacher that I was tone deaf, she had upset this cosy assertion by starting to train my ear. Of course, David had an acute musical ear himself. On the other hand, he often expressed doubt about the vividness of the visual images that some people reported as having; he would claim that images were very blurry and often mentally conceived rather than actually seen. I would have enjoyed teasing him by identifying him with Echo, knowing that he would have riposted with the thought of me as Narcissus.

These are not, I think, just idle reflections, for I recently found these themes lurking in a number of articles in a recent issue of the journal *Mathematics Teaching*. One article described various examples of not only visual and aural but also kinaesthetic images that could be offered to children in order to suit what was called their 'preferred learning style'.

I am a bit cautious about that notion – as was my music teacher. I am still often told that people are non-visualisers. But this may be a lack that could be corrected – teaching geometry seems to me to have to involve some training in visualisation. Is it our responsibility to teach in a way that suits learners – or rather to increase the range of what they find suitable?

This issue also arose in another article that described some research which suggested that children with Downs' syndrome responded well to visual imagery, and invoked this finding to urge the use of structural apparatus ('manipulatives' such as Stern, Cuisenaire,). This was, however, contrasted somewhat disparagingly with alternative ways of approaching number that are more language-based, and so more aural.

The distinction here is connected to that between cardinal or ordinal number. The former is in some ways inherently visual – you have the objects being counted in front of you or in mind. The latter can be 'just' counting, that

is the relatively simple matter of reciting number names in order ('rite words in rote order', according to James Joyce), where the prevailing imagery is aural. Perhaps I have said enough to tickle a response – though I doubt you would ever be able to snort so derisively – though always effectively – as your namesake and editorial predecessor.

PS. There are lots of interesting things in Rée's book which I would also like to have pursued. For instance, a lot about working with deaf children who are not nowadays discouraged from 'signing' (seeing voices, . . .). Also the interesting, and new to me, information that the mathematician John Wallis wrote two books on language and is said to have trained a deaf boy to speak.

DP: I am with you (if not Narcissus) in terms of what I think of as my over-attunedness to print, to the extent that even in an art gallery I will regularly read the small white card first before really looking at the picture on the wall to which it refers (in a more or less oblique way, on occasions even being called 'Untitled'). When listening to a lecture, I take notes, even if the reality is that I seldom if ever go back to them – it feels like part of the way I listen, with my hands and eyes as well as my ears.

On the rare occasion I allow myself to be read aloud to (too many echoes of unwelcome dependency here), I somehow manage to manoeuvre myself around to where I can read the text myself, and then of course my eye takes over independently of the other who is reading, rather defeating both the purpose and the offering. (Contrariwise, I really enjoy reading aloud to others, as then I get to read and say and hear it all at the same time.)

Although I only bothered to speak quite late in life, just before two years of age (my older sister having started at eight months), I had started to teach myself to read by age three. My Echo self I started to train once again at 40 when I joined an adult choir and subsequently when I started to write and then read that poetry aloud – both ear and voice combined. But despite acknowledging its power, I am still reluctant to read my poems aloud as a way to improve them: it is the look of the words on the page (and the unarguable illusion that hearing them 'in my head' is the same as speaking them aloud) that I mostly work with.

Again these pairings have some relevance to mathematics. What goes with the eye in terms of language the way the ear and the throat/tongue/mouth do? Surely, it must be the hand, that 'exporter' of written language but which also exports 'images', through drawing and painting (I believe in Japanese the term for writing and drawing is the same).

I was also struck by your use of the term 'aural imagery' which has always sounded to me like an oxymoron. John Mason uses the term 'sense of', that seems nicely evocative of human senses, while also suggesting that the primary sense route (or balance among them) used to 'make sense' of something might have some effect on the actual sense made.

As for 'learning styles', it seems to me that rather like in David Wheeler's piece on mathematical ability [printed in this issue], we have a similar complaint that seeing either ability or learning style as fixed (the definitive definite arti-

cle *de of de Stijl*) renders a teacher powerless in the face of this, and provides students with unhelpful excuses – "Oh, I'm a visual learner, I can't do that" or "Oh, I just don't have the ability for that". And his quotation of Sartre leaves us in no doubt as to the sort of contemporary 'excuses' he had in mind.

Yet, that said, my step-daughter is in the unfortunate position of being in a sixth grade classroom which is almost devoid of visual stimulus and where virtually no public written messages or images exist: if she wants to refer back to something that was previously said, stepping out of the flow of time, she has only her own memory to return to (presuming she was attending in the first place). This classroom does not seem to acknowledge anything but the oral/aural and human memory, and without memory, it can only run in a continuous present. But isn't synaesthesia what might ideally be desired, a fluency in shifting among different sense balances, as well as a trained ability to focus acutely on one at a given moment for a particular end?

I was also thinking about this idea of revisiting or repeating an experience. Repetition of written language or drawn diagrams is usually unproblematic and can frequently re-occur unobserved by anyone, including the observer (as that curious research on eye movements can attest). Repetition aloud of spoken utterances (whether by self or someone else) has a whole other history in mathematics teaching.

I was very taken with your identification of intransitive (ordinal) counting with the aural and transitive (cardinal) counting with the visual (what is it I am counting, which take me away from the counting itself into the world of things, which for gaining arithmetic fluency may not be at all helpful). And so the ear/voice pairing needs to produce its own potential to repeat, to bring back what has passed before, which leads to repetition or chanting: to what in poetry is called 'the music of the language' (rhyme being a form of repetition of a particular grain size), to what in choral music is called 'unison singing', to what in religious worship is called 'chorus response by the congregation' and what in mathematics education is currently shunned as anathema.

For me, both choral and Greek theatrical contexts seem relevant. I think of the Greek chorus as a character that is polyvocal, but simply one character in the play, albeit a specialised one with a particular function (in that it often only addresses the audience directly – commenting on the action in the play – and I think sits as intermediary between characters in the play and audience). And it may be that classroom dialogue in some of these schools shifts between pupils being simply the audience to a monologue and their being allocated the role of the chorus at times.

In a church, there is often priest and congregation – and I am seeing 'gregarious' inside 'congregation' – that feels somewhat class-teacher-like, in that there is a master dialogue and allocated opportunities for the congregation to speak, to contribute, but in set ways and places and with set words. But there is also choral music with more than one melodic line, polyphony, where there is a greater equality among voice parts. (I heard a performance of Mozart's *Requiem* last week, where the soloists were also part of the choir and sang all through the piece.)

I don't think chorusing has anything inherently to do with repetition, whereas in some contexts, e.g. the chorus to a song, it does, marking it out as different from the verses. In Catholicism, I believe, the chorusing of the congregation's response is often of one or two set phrases that get uttered and interposed over and over, but that also gets us into 'chanting', a third related item which I think at times invokes repetition, but at others not. Which makes me wonder whether it is actually the repetition which is more worrying to some in a mathematics classroom setting or the plural-speaking.

There is something for me in a choir about community-building and being part of something larger than oneself, of 'speaking/singing with a single voice', about the agreement inherent in chorusing (e.g. the repeated finding/creating of a common time and pitch), as well as it simply being louder and co-ordinated through the rhythm.

So 'unison' I think requires all to be saying the same thing, whereas 'chorus' perhaps has more than one voice for sure, but not necessarily all. This is all very tentative for me. What seems of significance is asking what mathematical elements are worth chorusing in unison and why.

DT: As I should have realised, you sparked off a number of stimulating themes that I would like to explore further. But I thought it would be wisest to restrict myself to just one or two. For example, I was intrigued by your delicate 'or' when you wrote 'revisiting or repeating an experience'. It seems clear to me that revisited experiences can never be exactly the same as the original. A memory or a dream (or even perhaps an actual return to the scene of the crime) might be said to be condensations that preserve what has been important – invariants that capture what is the same in the difference.

At first, one might be tempted to suppose that you can repeat an experience. But what you have pointed to is that repetition is also a transformation that ignores some aspects of the original. Thus, Jonathan Rée – whom I quoted to you in my last e-mail – suggests that repetition is unlike recurrence – as in, for instance, the mechanical duplication of a document with a photocopier. He suggests that repeating speech is quite different from imitating – or trying to imitate – voice.

I am particularly interested in this because as you pointed out repetition in the musical form of it known as chanting has been out of favour in mathematics teaching for some time. How terrible to be chanting multiplication tables some people used to say in the early sixties. And I – craven as always – forbore to ask what was so terrible. The cowardice was related to the fact that I was otherwise aligned with these people in some of their objections to what then passed for mathematics teaching.

Similarly, when at school I was handed a Protestant line about the meaninglessness of the Catholic liturgy, I had my reservations. I noticed that we chanted the Lord's prayer at morning assembly at a rate that precluded making any sense of the words at the time. And I recalled Armenian church services in my youth that were chanted in a special

liturgical language that few of the adults understood in any detail, yet the music and some of the words stay meaningfully in my ears to this day. As, I am told, do verses of the Koran that are learned 'by rote' (or 'meaningless chant') by many children at a very early age.

You pointed out that a chorus might sometimes speak 'with one voice' and, at other times, polyphonically. The OED asserts that Shakespeare was one of the first English dramatists to reduce the chorus to a single personage who speaks the prologue and comments on the play as it develops. I was intrigued by a recent production of *The Tempest* which distributed Ariel's lines among a chorus of spirits. You suggested that there would be the same distinction in chanting. Certainly the Armenian liturgy I heard as a child was chanted in unison. But this was mainly because in what was a small immigrant community there wasn't enough experience to sing the traditional separate parts.

It seems, however, that the chanting of multiplication tables – or, for that matter, a standard prayer – is always intended to be performed in unison. And, as you wrote, this is often deplored nowadays. Of course, I have been in plenty of classrooms, past and present, where chanting persists and does indeed seem to be a pointless activity. It can often be accompanied by fear of what happens when you get the words wrong. I have, for example, been in township schools in South Africa where chanting arithmetical rules is common, but you could get your hand whipped hard for getting them wrong. I don't know whether a false chant of the Koran by an infant gets punished. The nice thing about the Armenian chants was that apparently no one was concerned whether I did or did not memorise them. The magic was of course that they were memorable: as is number counting, which luckily many children acquire before school.

Seven eights are fifty-six, seven nines are sixty-three,
seven tens are (and what a warm feeling as you hit the
cadence) se-ven-ty

I was amused to find when I was looking up some early memories of David Wheeler that in a radio talk he gave in 1962 he referred to attempts to break away from 'rote learning' and was disparaging of 'authoritarian instruction' and 'mindless imitation'. In his own work he illustrated, I always felt, the contrasting virtue of 'authoritative' teaching. I would now have wanted to have talked with him about the possibility of replacing the mindless imitation by 'meaningful repetition'. For I think that it is in this idea of repetition as a creative act involving finding the invariant in a transformation that we might find some clue as to why chanting can be so magically effective and personally significant. Caleb Gattegno invited us to wonder at the fact that if a child could say 'ah', it could also say 'ah, ah'. He saw this as a very early manifestation of algebra. According to Rée, "There is, you might say, *no repetition without abstraction*" (p. 69). So there you are, the magic turns out after all to be algebraic.

One hundred and twenty-two, one hundred and twenty-three, one hundred and twenty-four, ...

DP: I realised that my debating with myself over the past few days whether or not to get Rée from the library to read for myself was precisely an instance of what we were discussing at the outset, namely hearing about it from you versus accessing it myself with no intermediary (which took me to priests and a passing discussion you and I once had about a theological divide over whether God could be directly reached by all or only via one of these select intermediaries)

I don't know whether this is what David would have done, but I lost the battle with myself simply to let you read Rée to me and I went and got it from the Vancouver Public Library for myself. I've just finished reading it and am amazed at the territory covered and how some of the usual historical suspects (like Wallis) show up in less well-known guises. I've gone back to re-read your first two messages in the light of my reading of Rée, and want to pick up a couple of threads, as well as offer a new one: mathematisation.

The first is to emphasise a distinction between *chanting* as mostly being used to mean involving more than one person saying 'the same thing as each other' (though there is also something about *how* it is said, attending to rhythm and regularity) – and *repetition* as being the saying of 'the same thing' more than once (whether by one person or more). Which is your magic more wedded to? 'Meaningful repetition' suggests attention (at some level) to the abstracting that makes it possible.

And I want to recall Rée's possible Latin etymology of 'obedience', that is "obedience (*ob-audire*) appears as a kind of listening" (p 53). Because the authoritarian teacher is always requiring pupils to "listen to me", and then to "repeat after me" (that is, to follow in both a temporal and a hoped-for epistemic sense). Because in some cases the magic only works if the words are uttered according to the letter, *ad litteram*. In the wedding service for one (and a mathematical calculation for another) the injunction, the instruction, is to 'do as I do' and perhaps, obediently, to internalise the voice guiding the action.

Your telling observation about cardinal and ordinal number was again brought to mind by Rée's referring to Bishop Berkeley's writing about 'outness' ("objects dignified by that quality of impassivity and separateness from ourselves", p 34) and then claiming:

The fundamental difference between auditory and optical mistakes arises from the fact that we are less tempted to attribute 'outness' to what we hear than to what we see. (p 46)

So, I thought, a mistake in cardinal counting is a case of *doing* the wrong thing whereas a mistake in ordinal counting is a case of *saying* the wrong thing. I also wondered whether the eyes tend to look for an object more, and therefore have to find one, so in the case of mathematical notation the eyes make do with seeing the symbol as the object – you can see what you are about. But the illusion of seeing being unmediated perception carries over to electronic devices being used in the service of mathematics, as if calculators somehow give direct images of functions, say, so the eye has found its desired object. Perhaps the philosopher's search for mathematical objects is an ocular illusion.

With regard to repetition and Gattegno's 'ah-ah', Rée also writes: "In poetry, as in language, to exist is to be repeatable" (p. 360). It seems to me that this is one of the fantasies of the mathematician, that anything done once can be repeated as many times as you want without getting tired or bored or attention getting used up. I use the word 'fantasy', as it seems to take us out of the material world where such factors are always at play

Both of these last two paragraphs seem to relate to mathematisation, which David spent a lot of time thinking about, which seems to involve taking 'something' (a situation, an experience, a phenomenon) inside ourselves and transforming it – into 'in-ness' perhaps – so that human mental processes can directly go to work on it.

P.S. I enjoyed via Rée seeing 'surds' as deaf numbers, perhaps uncaring of and inattentive to rational pretensions

DT: Part of the magic in chanting might well be that the repetition of certain notes might trigger pleasurable (?) areas of the brain. But as you point out, chanting with others will also involve the pleasures of rhythm. I did once very much enjoy being part of a rowing eight where the physical exercise was enhanced by the sense of being a rhythmic unit. Of course, there are other aspects to the pleasures gained by repeated action in general. Childish pleasure in play can easily become repetition compulsion. But clearly we do enjoy repeating (actual or virtual) actions over and over again and the original source of pleasure may well have been transformed into some other magical gain.

This is where the idea of repetition involving an abstraction of sameness is helpful. Freud described the way his grandson would throw an object out of his cot. Each throw was accompanied by a long, drawn-out, satisfied noise that was understood to be saying *fort* (German for "gone"). All his toys seemed to be being used only to play 'gone'. When he threw a reel attached to a piece of string, he was able to pull the thing back, greeting it with a joyful *da* (meaning "there"). Freud interpreted the infant's repeated throwing and retrieving an object as marking the pleasure in achieving independence of mother who had hitherto returned the toys to the cot herself.

He also noted that the pleasure also involves that of conquering the pain of the loss that lurks within the independence. Now the infant could expel and return the mother in his mind: *fort – da*. Later, of course, repeatedly throwing and retrieving can become virtual – writing and reading, manipulating equations, differentiating and integrating, whatever – but the pleasurable invariant may be preserved. Moreover, as psychoanalysts have observed, a repetition of needs may be accompanied by a need for repetition

As you put it, the mathematical fantasy takes us out of the material world. And some would say, away from mother. The suggestion here would be that the ability to symbolise occurs fairly early in our lives. The inevitable move away from close identification with mother (when one becomes two ...) is often made less painful by the use of what Donald Winnicott called 'transitional objects': the rag doll,

the teddy bear, and so on. So two becomes three. But the third may become something less tangible, something abstract or symbolic. Winnicott suggested that the origins of much cultural – artistic or scientific, and certainly mathematical – activity was to be found in this ‘transitional space’. Whether – and in what way – we devote some of our energies to such pursuits in later life may be traced back to this period in our lives.

As an aside, I should add that I would prefer you to write ‘phantasy’, on the grounds that I think your intention might have been to link mathematical activity with imagination rather than whimsy. This is the distinction made by English psychoanalysts, though, according to Charles Rycroft, “few, if any, American writers have followed them in doing so”. But in any case, I am sure David Wheeler would have enjoyed your linking this to his interest in the notion of mathematisation. He thought about this sort of internalisation – turning something into in-ness was your felicitous phrase – over many years. But I don’t think I was able to convince him that our earliest experience of mathematisation might have served the same function as teddy bears!

When I first knew him, we and others would talk of replacing mathematics by ‘mathematical activity’. In the fifties, Caleb Gattegno had defined such activity as one in which the mind becomes peculiarly aware of relationships as such; but by 1960, he was referring to ‘mathematisation’ and defining this in the same way – i.e. “ignoring everything apart from the relationships in the situation with which one is faced”. I used to invoke this meaning when arguing with David about ethnomathematics. It did not seem to me helpful to label the activities of decorators, bell-ringers, crafts people in general, as *mathematical* in some way. The last thing a bell ringer was interested in was the decomposition of groups by their cosets. I thought in terms of proto-mathematics (and wanted to stick with the hyphen).

David was characteristically more generous towards the possible pedagogical and political programmes behind the increasing use of the word ‘ethnomathematics’. Meanwhile, he had begun to characterise mathematisation as a structuring of structure. I took this to mean a second-order awareness and as such found confirmation of my view that those who worked at the first level of awareness were not doing mathematics. (You suggested in an aside that structure arises from a sort of condensation through repetition. Yes. A fruitful theme we – or some other readers – might pursue another time?)

David asked whether there were some situations or materials which were more readily mathematisable than others. This seemed – and still seems – to me to be a fecund (and typically Wheeler) question. I don’t have any clear answers. Is the geoboard more structured than say a pebble on the beach? If so, then it would perhaps be more easy to find the structure of the structure in this case, so that might be why you would find geoboards more helpful than pebbles in your classroom.

I think I would still not want to think of geoboards or other mathematical materials as ‘more’ structured than natural objects like pebbles or trees (which are surely very structured?). I prefer to distinguish structures in terms of degree of ‘economy’ – thus, geoboards seem to be more

economically structured than trees. Christian theologians sometimes speak of God having inhabited the world ‘by economy’, and this notion also characterises, I think, the abstraction found in the act of repetition.

I seem to be moving round some themes in circles. Or seeking finer and finer definitions. Perhaps this would be a good time to be closing my part of this correspondence. I would not after all want to be like the guy whom the nineteenth-century French diarist Amiel scathingly described as forever *mathematising* morals, “Language was for him a system of fixed signs; a man, a people, a book, are so many geometrical figures of which we have only to discover the properties”.

I can’t resist a final observation. What sort of geometrical figures would Amiel have had in mind? Drawings? On paper or in the mind? Geometry, we might say with Caleb Gattegno, is an awareness of imagery. But would we agree with him that imagery need not now for us be just visual? The renewed academic interest in imagery over the last few decades (something that David first alerted me to) covers images from all the senses. I feel that the play on words you invoked with ‘a sense of’ loses some of the vividness with which people report their images. The distinction seems to me like that between ‘seeing’ as visualisation or as understanding. When asked to shut their eyes and imagine a particular geometrical figure, some people may report they can’t see anything. I then suggest that they see in the other sense, confident that if they agree to do so I will be able to help them become the visualisers they do not believe themselves to be.

I suppose it’s best to ‘see’ in both ways – to sense in both senses – and I think this may be how repetition may be meaningful and, indeed, magical. As you suggested, the vivid impact of the aural imagery (no oxymoron here!) may also be accompanied by attention to the abstraction involved. You carefully noted that such attention might be ‘at some level’ and I take this to mean that it may be sometimes at a threshold of consciousness, or even sometimes deeply unconscious. From another point of view, I might say that as soon as one becomes aware of the impact of a geometrical image, one is at the threshold of algebraicising.

You asked which mathematical elements are worth chorusing in unison and why. This connects – for me – with David’s asking which situations were more readily mathematisable than others. I would want to find answers to both questions in those tasks which start with powerful imagery which can very soon be accompanied by some level of awareness of the possible inherent relationships. I could go on to offer some specific examples. But I can hear David muttering that even then I might be keeping my cards close to my chest (which is the way he would describe what I would think of as condensed inarticulacy). So, if only to tease his ghost, I think this is probably the right moment to end my contribution here.

DP: It is remarkable how once certain things come to the forefront, instances relating to them seem to be all over the place

- At rehearsal last week, the choirmaster talked of some recent recordings of Bach's B minor Mass which have just one voice per choral line (it being mostly written in four or five part settings) as likely being historically accurate in terms of the vocal forces Bach might have had access to. And how the person who coaches an opera singer from the piano is called a *répétiteur*, which in French can simply mean "tutor" or "coach"
- I happened to look back at Tony Harrison's striking (actually, percussively alliterative and intensely rhythmic) version of Aeschylus' *Oresteia* trilogy to find the chorus there sometimes speaks with a 'we/us/our' voice and at others with an 'I/me/my' one. To assert something together as 'we' and to assert in unison as 'I' seem different things requiring different states of the knowledge of others
- I turned to Burton's *The Chorus in Sophocles' Tragedies* and read in the introduction how some of the chorus' words were actually sung, which for me linked the theatrical and choral contexts we have been discussing. He writes: "I have said that the chorus as singers are kept distinct from the other *dramatis personae* and that this distinction is due mainly to their being a group, not an individual. When we consider them as actors, we find that both in the spoken parts and in sung or partly sung dialogues they are drawn into the same dramatic orbit as the great figures on the stage. In the non-singing parts, the group is represented by its leader (*coryphaeus*), who converses with the actors, offering advice, warning, encouragement, instruction, and sympathy, according to the relationship of the group to the individual character" (p. 4)

However, in terms of trying to conclude this exchange rather than multiplying it, at least for now, here is a final observation in response to your words about structure. In a chapter entitled 'The social shaping of computing in mathematics education', Richard Noss writes about the features of *density* and *depth* (the relative value and accessibility respectively) of the potential mathematical structuring in any given object, which connected for me with your comments about the relative value of a geoboard over a pebble as a focal object for a mathematics class. The *density* of structure might well be high in both cases, but the *depth* of the structuring is quite different, that is in terms of its accessibility (Noss compares Logo with a washing machine).

The question of mathematisation seems to be related to this and I think an etymological-conceptual history of the

notion and the term 'mathematisation' would make an interesting study. In a psychodynamic context, while a projection can be made by one person onto any other (which is just as well for the potential success of psychotherapy), certain projections are better supported by some individuals than others. It is usually not a matter of chance onto whom the projection is made. I am interested in seeing mathematisation as a form of projection, the theory of vision Euclid promoted whereby seeing emerged from the eye rather than a result of something having entered into it.

Theatrical director Peter Brook, one who professionally is so attuned to the sense and art of listening, writes in a short essay-book entitled *Evoking Shakespeare*: "Even if a concept is something necessary in speech, it is a tragically pathetic portion of the amazing whole that speech can offer. Concept is that little thin intellectual strain that the whole of western civilisation has bowed down to excessively for so many centuries. Concept is there, but beyond concept is the 'concept brought into life by image', and beyond concept and image is music - and word music is the expression of what cannot be caught in conceptual speech." (p. 18) I think this word music, the density of which is present in mathematics as well as in poetry, is what repetition and choral ways of speaking and chanting might allow us to contact.

Brook also writes of how Shakespeare's plays were 'metaphysical' and "if one refuses to accept the reality of spirits it's much better to burn all the works of Shakespeare because they don't have any meaning any more" (p. 25). I was therefore struck by your reference to Wheeler's ghost alongside your preference for the term 'phantasy', because (for Webster's dictionary at least) a 'phantasm' is "a ghostly apparition, esp. of a person dead or alive". I have barely invoked David in my messages before now, as in some sense I felt I was acting in his stead for you, as an instead, a substitute supporting the projection at whatever level that has allowed this exchange to materialise. When I first assumed the editorship of *FLM*, my charge was described as 'maintaining the spirit of *FLM*'. And without a doubt, that very substantial spirit belongs to David Wheeler.

In conclusion, I recently realised how the word 'ritual' sits inside 'spiritual' and have begun wondering about links between inspiring spires, spirited breathing and rituals' rhythm. Coincidentally, given your earlier reference to Ariel and the distributed chorused voices of the spirits, Brook ends his piece with a discussion of the closing six lines of *The Tempest*, identifying them as possibly the last words Shakespeare ever wrote. I won't say anything more about them here, other than to note with Brook that the final line of the play reads: "Let your indulgence set me free" - and to request the same of *our* readers.