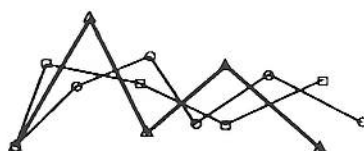


# Chroma



Newsletter of the Australian Computer Music Association, Inc.  
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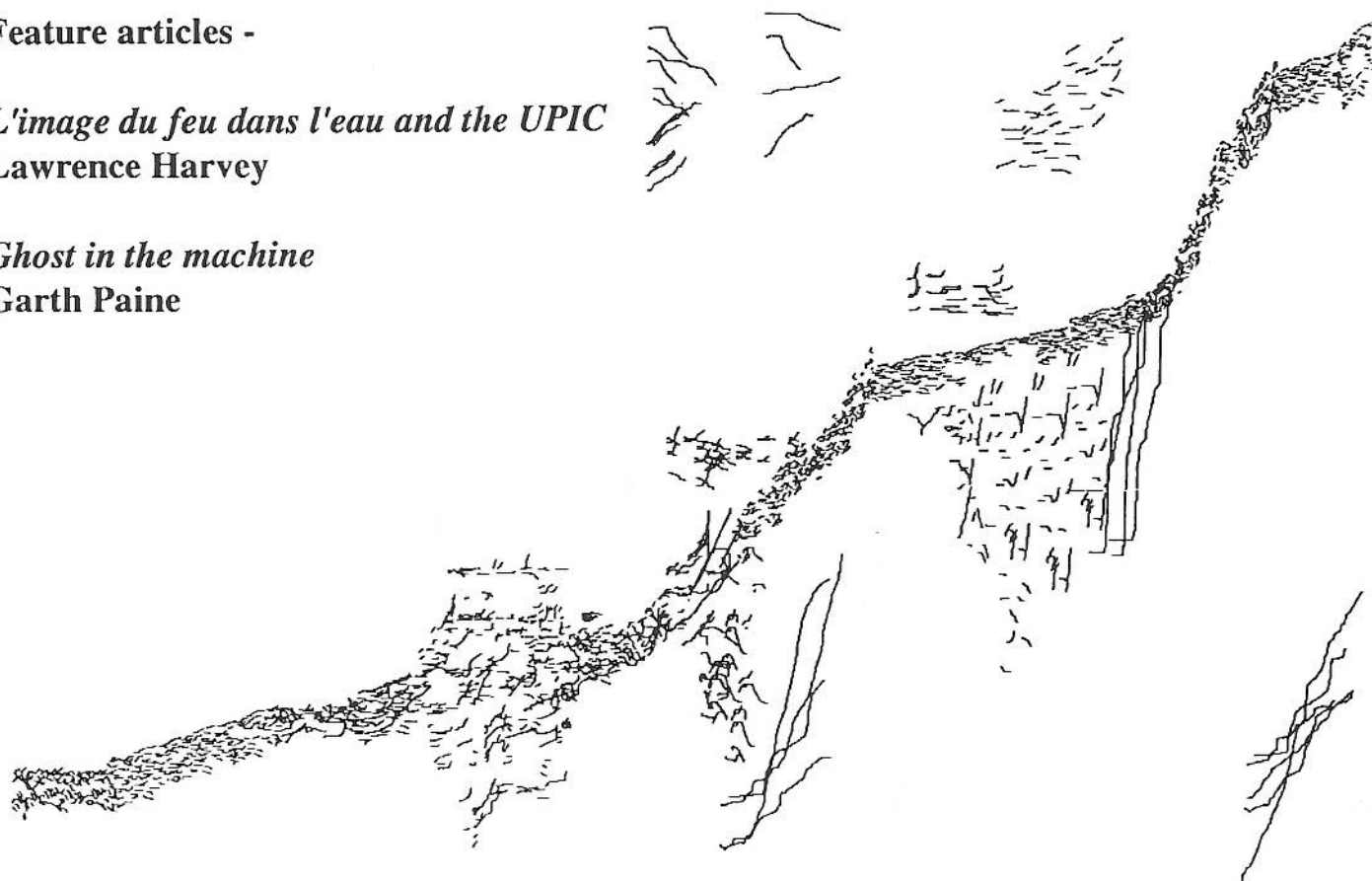
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This edition of *Chroma* was prepared by  
Lawrence Harvey, Jane Walker,  
Ebony Hack and Garth Paine.

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The views expressed within are not necessarily those of the  
Editors or of ACMA, Inc.

### Acknowledgments:

Thanks to Contemporary Music Events Inc. for the use of  
their computer in compiling this news letter.

## Composer Profile . . .

Cathie Travers

I love being a musician - playing and writing music; I don't prefer one activity over the other. I get a huge buzz out of a range of activities such as arranging, producing recordings, jamming with musicians who have a broad musical background - I'm constantly amazed by what 'untutored' musicians hear! And by the sophistication of good recording engineers' ears.

Having trained as a 'classical' pianist I'm very much in love with playing an instrument; at the moment I'm getting into the piano accordion, which offers an additional form of expression to my synthesizers/samplers and piano.

I guess the most important thing to me is that a piece of music (whether mine or someone else's) 'speaks' to me; as time passes I'm becoming more interested in the social context of my music and more disenchanted with political and institutional machinations.

I wish 'nostalgia' wasn't such a saleable item - even the major record companies are currently reissuing double-CDs of big name 'pop' acts; this is an alarming example of commercial interests being at odds with the concept of a constantly changing/fluctuating artistic culture.

I've been using digital equipment in my music making since 1987; prior to that I was into Hammond Organs, 4-track tape decks and Moog synthesizers . . .there's a history of technology, as a user and programmer. I've always tried to get the most from technological tools. So what I'd really like to know is: why the hell is so much tax-payer's money being spent on grants to create digital data bases eg. putting the collection of The Australian National Gallery on CD-ROM? The visual results will be poor, and it certainly isn't making the most of the technology in creative terms: any Joe Bloggs can scan images and reproduce them. In my opinion this money should be spent when the money is spare - and given our arts budget, it ain't spare at the moment! An interesting comparative statistic;

- Finland, with a population of 5 million, spends \$15 million per annum on music funding (from an article in a recent *Guardian Weekly*)
- Australia, with a population of around 18 million, spends \$22 million per annum on music funding (from The Cultural Minister's Council Statistics Working Group reports: Cultural Funding in Australia, 1993-94 Youth and the Arts Overseas Born Persons and Arts)

My dream is to own a performance venue where my friends and colleagues and I can present a constant stream of events . . . I guess I'd better start buying lotto tickets!



## Ghost in the Machine

Garth Paine

This installation will use animation/video and audio to create a three-dimensional virtual environment which is sensitive to human presence and movement patterns. Twenty sensors (floor pads and light beams) will transmit information about how many people (<bodies>) are in the room, their position, direction and speed of movement.

A Macintosh computer will act as the central controller, collecting the trigger input information, analysing that data and controlling, according to the behavioural patterns within the space, a network of 4 animation computers projecting their output into the environment through 4 LCD projectors. It will also control six CD-ROM drives providing interactive audio. A six speaker set up will be used with the addition of a sub-woofer. The trigger input will use a custom designed ADB interface and proprietary software developed by Garth Paine.

As people enter the room, the environment will be in a primitive, green, hushed state. Each dimensional plane will be constructed of a grid of individual images, that initially create one image. Each person (<body>) entering the room will act as an irritant to the space, triggering an evolution from the serene to the mechanised to the chaotic. However, to maintain the serene quiet state, people will need to move rapidly about the room. The more <bodies> in the room, the harder they will have to work to avoid a descent into chaos.

As the <bodies> move throughout the space individual image elements morph into other animated elements and evolve before making way for a transition to another world. In this way the inhabited environment will progress through serene to the mechanised to the chaotic. The environment will be soothed by movement. In order to maintain a serene state, the <bodies> must move more and more rapidly. The environment will revert to a serene state when uninhabited.

The sound will evolve and accentuate the visual environment in symbiosis with the animation, whilst also providing a sense of spatialisation within the room.

This installation is designed to reflect on the paradox of the human/machine relationship: we use technology to avoid the dangers of the natural world, but as life becomes less dangerous the human population explodes and we need more technology to sustain us. Thus we are enslaved by the machine and we have to work harder and harder to develop and build new technologies.

The development of immersive interactive environments is an effort to go beyond the screen-based paradigm of so much multimedia, which, in our opinion, alienates the audience from the content and the experience.

This exhibition will be at Linden Gallery, St Kilda from February 12 to March 9.

Garth Paine and Rebecca Young

## *L'image du feu dans l'eau* and the UPIC

Lawrence Harvey

UPIC - Unité Polyagogique Informatique de CEMAMu

The image of fire in water is the ultimate resolution of oppositions: held in suspended union, each retains its full power and nothing is lost in compromise, but there is complete balance.

A dictionary of Hinduism, discussion of the god Agni.

*L'image du feu dans l'eau* generated solely from material prepared on the UPIC system, was composed in Paris and Melbourne in 1996. The piece exists in two versions:

- version A: for tape only in a 2 or 4 channel mix, duration 11:30
- version B: for percussion quartet and 4 channel tape, duration 15:20

The examples later in the text refer to version A in a 2 channel mix. The four diagrams referred to in this article, appear at the end of this edition of *Chroma*.

### Introduction

From October 1995 to June 1996, I attended the 8 month course, Composition and Computer Music at Les Ateliers UPIC, Paris. Funds were provided by a Winston Churchill Memorial Fellowship and a Creative Development Grant from the Australia Council.

Les Ateliers UPIC was established in 1985 to provide composers with access and support to realise works on the UPIC system. The studio is funded by the French Ministry of Culture and is directed by the American born composer Gerard Pape. In 1996 Les Ateliers UPIC relocated from Massy, south of Paris to the inner suburb of Alfortville to begin a process of amalgamation and expansion with the studio La Muse en circuit.

In addition to the 8 month course, Les Ateliers UPIC hosts a summer course, a regular concert series and a residence scheme. It maintains close ties with Xenakis' Centre d'Etudes Mathématiques et Automatiques Musicales (CEMAMu). While Xenakis is not actively involved in the teaching programme, except as a guest lecturer in the course, his ideas and approaches have an influence on the direction and other activities at Les Ateliers UPIC. In its pedagogic activities, students are exposed to a range of ideas, composers and computer music programs, there being no strong party-line in one direction.

The difference between the two studios is primarily in their responses to the work of Xenakis. The CEMAMu is most concerned with implementing Xenakis' ideas in hardware and



software, while *Les Ateliers* responds more to the compositions and musical ideas.

### Background

During the composition of *Metastasis* and *Pithoprakta*, Xenakis made precise sketches on graph paper for the dense planes of string sounds. His training as an architect provided skills in design and the conception of three dimensional structures on a one dimensional plane. He continued this graphic method of pre-composition design through subsequent works. Similar designs and geometrical transformations, for example aborescences, can be found in these sketches to be realised in instrumental works, and also in his UPIC graphics.

The musical and philosophical concerns of Xenakis have often rested on the micro and macro structures of time, and also the inside, outside and temporal structure of time.

In composing electroacoustic works, consideration of all time strata – especially microstructure – is essential to avoid dull and stagnant sounds. Composing at this level can be a detailed and time-consuming task, akin to the years spent by an instrumentalist refining their sound. The microstructure of an instrumental composition may be articulated by choice of instruments, dynamics, vibrato/tremolo effects, modifications of bow or breath pressure or striking position. To achieve some complexity to the life of an acoustic sound requires combination of these effects.

The UPIC is characterised by a transparent relationship between micro and macro structuring elements. Its direct method of sound synthesis and composition occupies similar territory to another computer music system conceived and implemented in software by Xenakis. Dynamic stochastic synthesis, used to create the works *Gendy 3* and *S709*, implements ideas originally proposed in *Formalised Music* for using pseudo-random functions to compose microstructure. For an introduction to this technique, see *Computer Music Tutorial*, Curtis Roads.

The first version of the UPIC ran on a mini-computer and was not real-time. The composer could provide input via a graphics tablet, now a familiar feature in graphic design studios, but would have to wait for sound output to be calculated. In 1991 a 64 oscillator synthesis engine was coupled with the graphic system running on a PC under Windows. At present the hardware component is custom built, and makes the system an expensive one. Development is beginning towards a system utilising more readily available components.

Although sounds created on the UPIC first appeared in Xenakis' electroacoustic work *Legend d'Er*, the first pure UPIC piece was *Mycenae-Alpha* (1980). Since then over 100 pieces have been realised on the system in France and North America.

### General description of the UPIC

Sound generation methods available on the system include waveform playback - converted from sample input - additive synthesis, complex frequency and amplitude modulation.

Macro structures can be defined by the page. It is here that the UPIC is "played". A page contains arcs, which appear as lines on the screens, whose timbre, pitch, envelope and amplitude are defined by the four basic objects in the system. A page can have up to 4000 arcs, with 64 arcs appearing simultaneously. Its duration can be set to between 6ms and 2 hours - a useful feature for a particular type of time expansion/compression.

The playback cursor can be relocated on the page with the mouse while the system is playing. The feature transforms the UPIC into a tool for improvisation in the studio, the output being captured directly to DAT via digital connections. A variety of material can be collected using this method of improvising on pages combined with remapping of arc waveforms, altering envelope and frequency tables.

### The four basic objects

The relationship between the four basic objects is summarised in diagram 1. Note that the two arcs in the diagram are identical in their assignments of objects, but differ in duration. Further settings for these objects are available, but have been omitted in this description to achieve a concise overview.

#### 1. The envelope

Values on the X axis determine the envelope's position on the arc to which it is assigned ie 0 is the beginning, 4095 is the end. The values on the Y axis have no real meaning; they are index points into the X axis of an amplitude table.

#### 2. The amplitude table

This table determines the real world values in decibels of the envelope object by setting the dynamic range over which the envelope will pass. Note that the values of the envelope's Y axis map into the X values of the amplitude table to calculate a final value. The double lookup achieves a structural elasticity between elements.

#### 3. The waveform

The frequency of the waveform in cycles per second is determined by the Y coordinates on a page. The values of the Y coordinate are themselves determined by the frequency table.

#### 4. The frequency table

This table determines the frequency sweep of arcs. A pull down box is used to set the ambitus of the table and a discrete/non-discrete setting is possible so that arcs might glissando upwards and downwards or move by step with up to 99 equal tempered steps per octave.

The four basic objects may be hand drawn or modified, copied from a sample or another object. This can be done during sound playback. Complex amplitude modulation effects can be achieved by utilising sampled waveforms copied to envelope objects. Users can modify waveforms by drawing and the use of cut, copy and paste functions. This can be done while the system is playing the same waveform.

Transformations can be accomplished by changing some of the higher level structures, while leaving lower order objects invariant, for example, compressing the frequency table curve to a few cents and increasing the duration of a page, without changing waveforms.



All these parameters are brought together by assigning them to an arc. Adjacent arcs may be assigned to the same or different objects and tables. Diagram 2 shows a UPIC screen with sub-window for table arc assignments.

### Composition of the object set

A UPIC composition is characterised by its object set as the types of envelopes and waveforms will yield various hues to the final work. During the composition of *L'image . . .*, it became apparent that a great variety of sonic materials could be produced exhibiting an internal consistency. This was achieved by the predominate use of waveforms created from short percussion samples, sometimes further modified by hand. Diagram 3 shows the entire object set used in the piece.

### Modulation

Although using frequency modulation, more sophisticated sonic events are possible on the UPIC than with the more familiar FM synthesis available on the Yamaha synthesizers. This is due in part to: the possibility of complex waveforms at the modulator or carries position, the possibility of many carriers in a sonic event with or without common modulators, the use of feedback assignments, enhancement of phase information by assigning carries to different channels (see spatialisation), and most significantly, the possibility of working with 'real-world' values and hardware designed to produce frequencies across the audio bandwidth.

### Spatialisation

The output channel of an arc can be assigned to an individual output channel. Up to 16 channels of sound are possible, depending on the configuration of the individual UPIC and studio. All sonic objects in *L'image . . .* were created in a quadraphonic field. From the earliest composing sessions, the mixing desk was configured to explore spatial motions enhanced by phasing effects.

### Features used in *L'image du feu dans l'eau*, version A

The UPIC allows direct access to various levels of micro and macro structure elements in a simple way. By changing higher level values such as page duration, a sonic event might pass from sustained unfolding texture, to a dramatic gesture. The static wash after 1:26 and the explosive noise bursts of the opening are examples of this procedure.

The final section of *L'image . . .*, identified first by a cloud of castanets, was created from the final page shown in diagram 4. These arcs are designed to play on a page 4 minutes long. The duration of most of these arcs is such that the castanet waveform produces 1 recognisable attack at a frequency range of less than 10 Hz. The whole texture is gradually moved across arcs assigned to different channels which are panned around the quadraphonic field. The original stream also gradually changes timbre as it rises and changes spatial location. Additional background material in this section was created by re-recording the ascending stream with various timbre mappings.

While elegant UPIC pages have often appeared in computer music literature, it sometimes happens that the least interesting

visual objects, produce the most interesting sonic objects. Complex modulations combined with separate channel assignments proved useful. The fluid bell-like timbres appearing briefly at 3:00 were created by placing a sine wave carrier in the audio range, and a complex waveform as its modulator in the sub-audio range. The result is a liquid shadow of the sub-audio modulator, in this instance a bell waveform.

Other modulation settings include carrier/modulator combinations whose extreme settings produce noise and no effect. By drawing an arc that traverses these extremes, sonic transformations from noise to original waveform and back again can be achieved. An example is the high noise stream first perceivable around 7:37 and descending into a pool of noise, later to re-emerge after 8:12 and revealed as a castanet sound.

### Compilation and constraints

Although a version of the piece was presented at Les Ateliers UPIC at the end of the course, this final version was compiled in Melbourne after returning in June 1996. All sounds were brought from Paris on DAT tapes; 4 channels being stored contiguously as stereo files with a starting "beep" serving as an audio clapper to assist later synchronisation. Transfers at Les Ateliers UPIC and the University of Melbourne were via AES/EBU. Files were normalised, edited and mixed in Sound Designer II and ProTools. The UPIC offers an interesting environment for the creation and exploration of electroacoustic sounds, but its user friendliness for final compilation is surpassed by other platforms.

Two further constraints were set:

- a) during compilation, no additional processing would be used except for some reverberation, panning and EQ in the final mix;
- b) No editing of the waveforms was performed that could not have been achieved on the UPIC system.

### Conclusion

The real-time aspects of the system cannot be underestimated. Composing 'by ear' establishes a concise feedback system offered by few sophisticated studio environments and certainly not by traditional instrumental composition.

As the user is not required to learn a complicated set of instructions, work on the system can commence very quickly. This immediately brings the composer face to face with their composition language and procedures - a challenge not offered by systems that propose more technical demands of the composer. While accessibility is advantageous to children and others not widely experienced in electroacoustic composition, prior experience in a range of studio environments prepares the composer for a deeper exploration of the UPIC's potential.



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## References

- Matossian, N. 1991. *Iannis Xenakis*. New York: Pro/Am Music Resources.
- Roads, C. 1996. *Computer Music Tutorial*. Cambridge, Massachusetts: MIT Press.
- Interview with Gerard Pape, Friday 31 May 1996, Paris.
- Manuals for the UPIC system and the author's own tutorial and work notes.

Thanks to:

Gerard Pape  
Director, Les Ateliers UPIC

Brigitte Robindorè  
Musical Production, Les Ateliers UPIC

David Collins  
Technical Assistant, Faculty of Music, University of Melbourne

The piece has been presented at the ACMA concert on October 19, 1996 in Sydney, and the finalists' concert of the ABC Computer Composition Award in Melbourne and broadcast on *New Music Australia*, ABC Classic FM.

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## CD REVIEW . . . .

Warren Burt

### *Watt ever*

Double CD TP074 from Tall Poppies, PO Box 373, Glebe NSW 2037.

Watt is a collective of composers, performers, video artists, dancers, photographers, and film makers based in the Electronic Music Studio of the Sydney Conservatorium of Music and headed by Martin Wesley-Smith and Ian Fredericks. The group started in 1976, and since then, has presented at least one concert per year, as well as environmental events and other activities. Much of the material presented by watt is audio-visual in nature. They have been the most consistent presenters of audio-visual work in the country. And, in a Sydney scene dominated by establishment thinking and "straight" instrumental performance, they've been a powerful voice for alternative modes of music presentation.

Not before time, then, comes this double CD of music by composers and performers associated with watt over the years. It's not only an historically significant release, it's also fun to listen to. Packed with music – almost two and a half hours in eighteen compositions – it still barely scratches the surface of the more than 120 works presented by watt. There's something for almost everybody interested in electroacoustics. From the early tape splicing of Carl Vine's

3 BBC Exercises to the mathematically infused computer synthesis of Gordon Monro's Mandala 1086, just about every technique and electronic instrument used in the past 20 years is represented, although most of the works come from the mid-80s to the present, so digital instruments are more prevalent than classical or analogue techniques.

The cast list is impressive. The composers (all boys – why is this so?) include Martin Wesley-Smith (who also has his own new Tall Poppies CD of his electronic music from the 1980's (highly recommended!) TP072), Carl Vine, John Drummond, Jim Franklin, Adrian Luca, Anthony Hood, Julian Knowles, Ian Fredericks, Adrian Keenan, Anthony Jones, Rik Rue, Gordon Monro, Greg White, Robert Douglas, Greg Schiemer, Graeme Leak, and a collective work by watt (with some really amazing jaws-harp playing by Jonathan Mustard!) from 1979. With so many pieces, (all of them attractive in one way or another) it's impossible to cover them all in any depth, but my particular favourites would include Greg Schiemer and Graeme Leek's Polyphonic Variations, with its sudden shifts of tempi, polyrhythms, and very attractive percussion samples, Carl Vine's recent Array, which has some luscious timbral mixes, Ian Frederick's political radio work Viable Alternative, still as relevant and necessary now as when it was written in 1983, the gentle calm and beautiful timbres of Jim Franklin's Rolling and Gordon Monro's Mandala and sheer sonic intricacy of Rik Rue's A Longer View. Also good to have available and to hear again is Robert Douglas's Homage to Bessemer, previously released in 1986 on a 2 MBS LP, and those interested in interactive work with instruments will also be attracted to Greg White's Orchid. Also very attractive is Anthony Jones' Mandala, for violin and tape, and state of the art in computer sound modification is represented by John Drummond's Sea, Frogs and Magpies and Anthony Hood's Munyun.

As a slice of Sydney musical history, the album is invaluable. Educationally, it will provide many resources for teachers – and for just plain listening, it provides an embarrassment of riches. Congratulations to all involved. Here's to watt ever comes next!



## ACMA Contact List

To contact the committee, any of the persons mentioned in this issue or for any other information, electronic mail can be sent to:

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or write to:

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to:

listserv@latrobe.edu.au

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Anthony Hood  
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## Greetings from the Green Iguana

Andrew Martin

Late on a Saturday night in October, a buoyant group of composers and performers gathered at the Green Iguana cafe on the Sydney University/Newtown fringe of King Street for a post-bump-out meal. Organiser Gordon Monro described the evening's concert entitled pure sound and staged at the Old Darlington School, as the best programme of electroacoustic music he had ever attended in Sydney. The general consensus was that the whole day had been a great success.

The electroacoustic workshop is hosted jointly by the Contemporary Performers' and Composers' Fellowship and ACMA, and has become a major annual event for the Sydney electroacoustic community. This year the concert featured an abundance of new and exciting Australian works from Anthony Hood, Lawrence Harvey, Warren Burt, Andrew Martin, Nick Cross and Monro himself. Other works included a digital reworking of an older composition by Benjamin Thorne for bass recorder and delay, and the flute and tape piece *Sachamama* by the American composer Anne LeBaron, performed by Kathleen Gallagher. The programme was boosted by the inclusion of *Three Anna Studies* by Larry Polansky who, as luck would have it, was visiting Sydney at the time.

Those who were able to attend the afternoon workshop preceding the concert were richly rewarded. Most of the composers featured in the concert were able to speak at the workshop about their compositional processes, revealing insights and deliberations associated with each piece. Many different and contrasting compositional methods and outcomes were described: from the through-composed notation of extended technique by Ben Thorne to the computer-based strategies and systems for the pure improvisation of Nick Cross; and from the algebraic methodology of Gordon Monro's chaotic oscillators on the edge of instability, to Lawrence Harvey's exploration of ideas in sound using the graphic user interface of the UPIC (Unité Polyagorique Informatique de CEMAMu).

The evening concert began with the presentation of *Biriny: Ocean*, a major work composed at the University of York as part of Anthony Hood's recently completed Doctoral studies. The elaborate and expansive piece conjures a journey within Australian landscapes through well crafted spectral manipulations and granulation techniques. The piece served to focus and tune in the listening audience for the programme that was to follow. *L'image du feu dans l'eau* by Lawrence Harvey was composed in Melbourne and Paris. Using extended FM and additive techniques Harvey evokes an illusory fabric of rich and esoteric sound textures in a masterly demonstration of pure sound. *One Tone (Once)*, by Warren Burt is one of four movements of 4'33" duration of 'The 18'12" Suite. Typically witty and up front, the four pieces all investigate a technique of generating pseudo-FM through the "number controlled oscillator" subroutine of David Muller's US program.

Larry Polansky's *Three Anna Studies* used binaural recordings of his daughter Anna at ages 6 months, 3-4, and 4&1/2 as source material. All three incorporated pitch shifts and time stretches to illustrate respective moods at the time of recording. The second study, *Four Voice Canon #9(6:7:8:9)* ("Anna canon") is a set of mensuration canons in the manner of eight previous canons dating from 1975. Together *Three Anna Studies* are powerfully emotive and combine to form a sort of post partum comment with the third study documenting a certain awareness by Anna of another, her friend Eleanor Wilson also aged 4&1/2.

The second half of the concert began outside the old school house during the interval with Andrew Martin's *Cicada*, an algorithmically composed contemporary treatise on the imitation of nature. Performed through speakers positioned among the large gum trees, the piece competed with the loud chirping of crickets and other insects, and alarmed several birds nestling in the trees (all of which became impromptu performers). This experiment required an aural refocus of the audience, which had become accustomed to the enclosed sonic environment of the concert hall. The piece lost partial clarity and impact to the rustling wind and the mulling of the small crowd but gained an existentialism that enlivened and punctuated proceedings.

Back inside, the second half of the concert continued with Gallagher's performance of Anne LeBaron's *Sachamama*, for tape and flute. The tape was constructed by the composer from sounds produced by Harry Bertoia's sound sculptures and gongs, and complemented with traditional Peruvian and Mexican songs treated with digital processing techniques. In Nick Cross's *A Track Ted*, Henon and Lorenz chaotic attractors fuel a transient and emotive temperament for an improvisation on a Yamaha WX7.

Gordon Monro's *The Voice of the Phoenix* is a digital synthesis work using a chaotic process consisting of a system of differential equations used to model the magnetic field of the Sun (the sunspot cycle). The system drives the output of 13 chaotic oscillators on the edge of instability. Finally, Benjamin Thorne's *Pipistrelli gialli...* ("Yellow bats") explored the possibilities of combining a live instrument (bass recorder) with electronic effects. Each of its three movements deployed a different approach to the interaction of recorder and digital delay without lapsing into predictability.

Back at the Green Iguana, the convincingly androgynous waitperson is making signals that they might like to close, and the conversation has turned to promoting the event better next year. I was happy with the turnout (both people I invited showed up), but have a suspicion that there must be people that missed out on a great gig. So an open invitation: Electroacoustic Workshop 1997, keep an eye out for details.

email: andrewm@magna.com.au

## Opportunities . . .

Recently ACMA received two contacts from east Europeans. The following might be of interest to members.

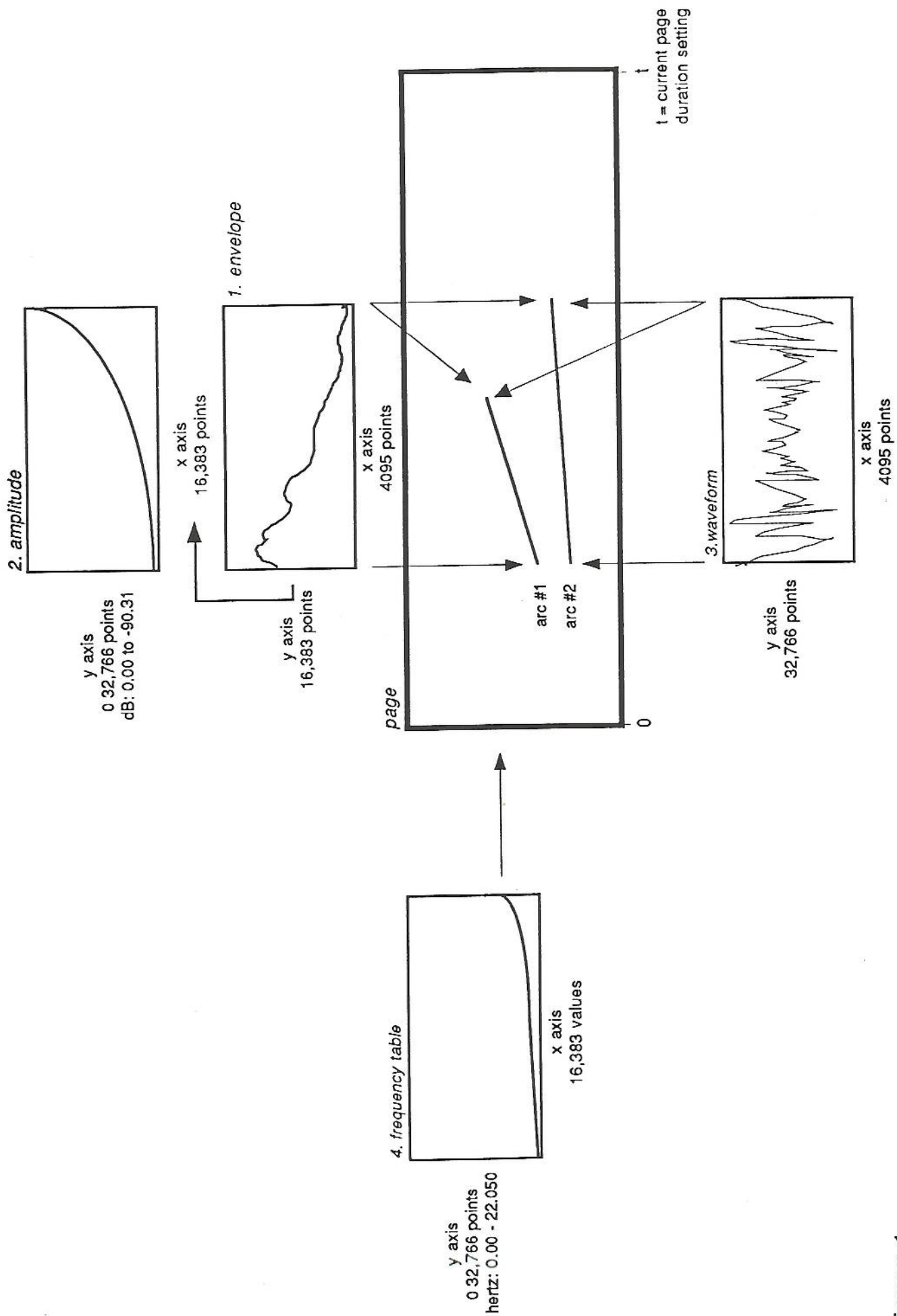
A new monthly 45 minute TV show has started on Russian TV. "Every month this particular show presents only one composer who works in the style of serious electronic, electroacoustic, experimental and avant-garde music. We show interviews, extracts from concerts, films, TV and theatre plays and use other audio and video materials connected with work and life of the composer. We broadcast extracts, interviews and other audio-video materials only with the permission of the author." For more information on the programme, called *Electroshock*, contact:

Artemiy Artemiev  
Composer, Producer  
Ul.Krilatskaya, 31-1-321,  
121614, Moscow, Russia  
Tel: (095) 415-3046  
Fax: (095) 415-6689

Anybody wanting to know more about computer music in Yugoslavia can contact:

Vedran Vucic  
vvucic@sfj.opennet.org





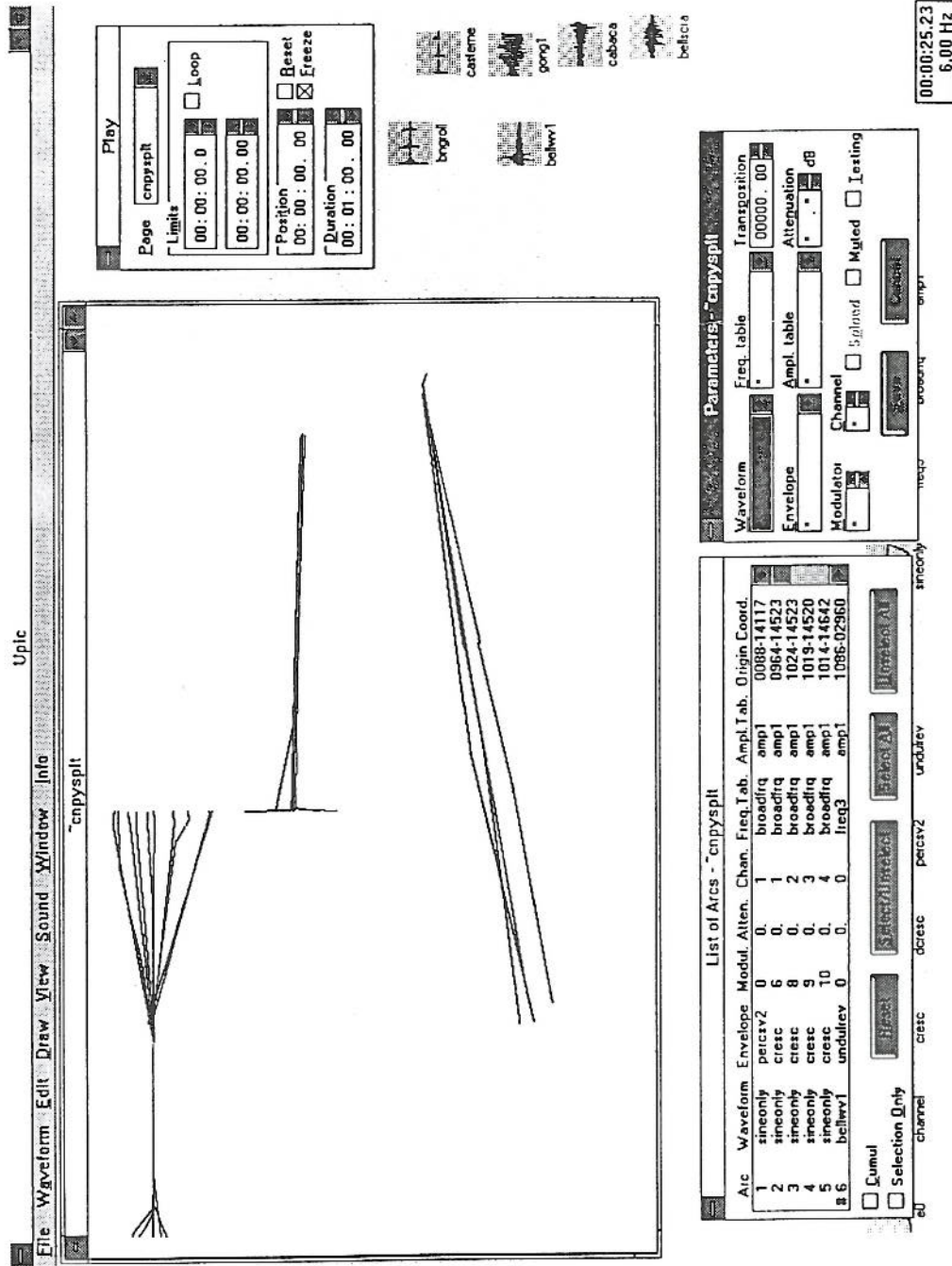
**Diagram 1**  
The basic relationship between objects. Some parameters that determine settings of the objects have been omitted.



## Diagram 2

A UPIC screen configured with a sub-window "List of Arcs - ~cnypspl". showing the arc assignments. This page called "cnypspl" or canopy split can be heard at 2:15 to 2:50. From left to right, the columns of "List of Arcs - ~cnypspl" indicate:

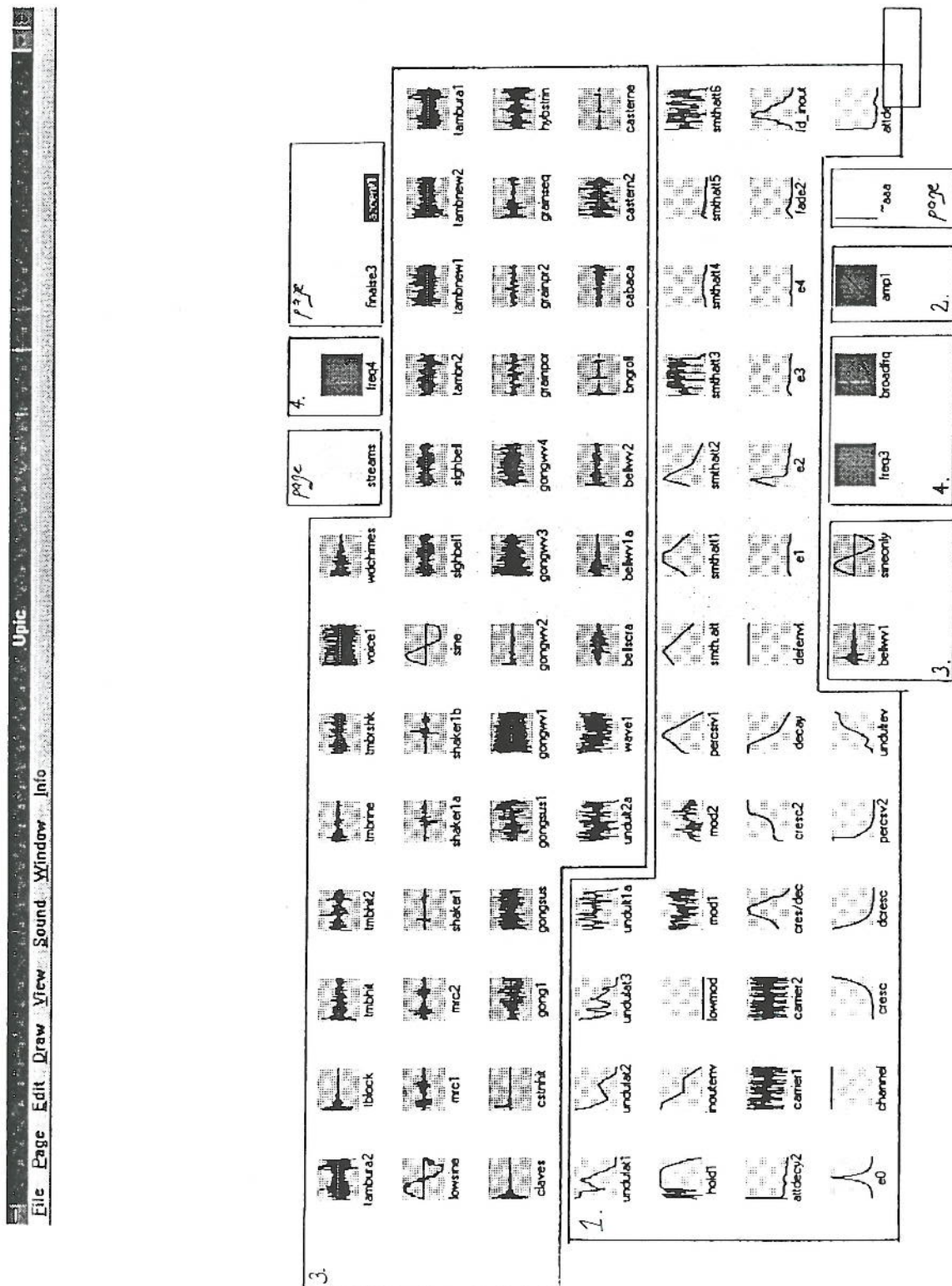
1. Arc number, a # indicates an arc selected for editing;
2. waveform of arc;
3. envelope of arc;
4. arc number acting as modulator of arc, 0 indicates no modulator;
5. individual attenuation of arc;
6. audio output channel of arc, 0 indicates no audio output;
7. amplitude table of arc;
8. coordinates of arc.



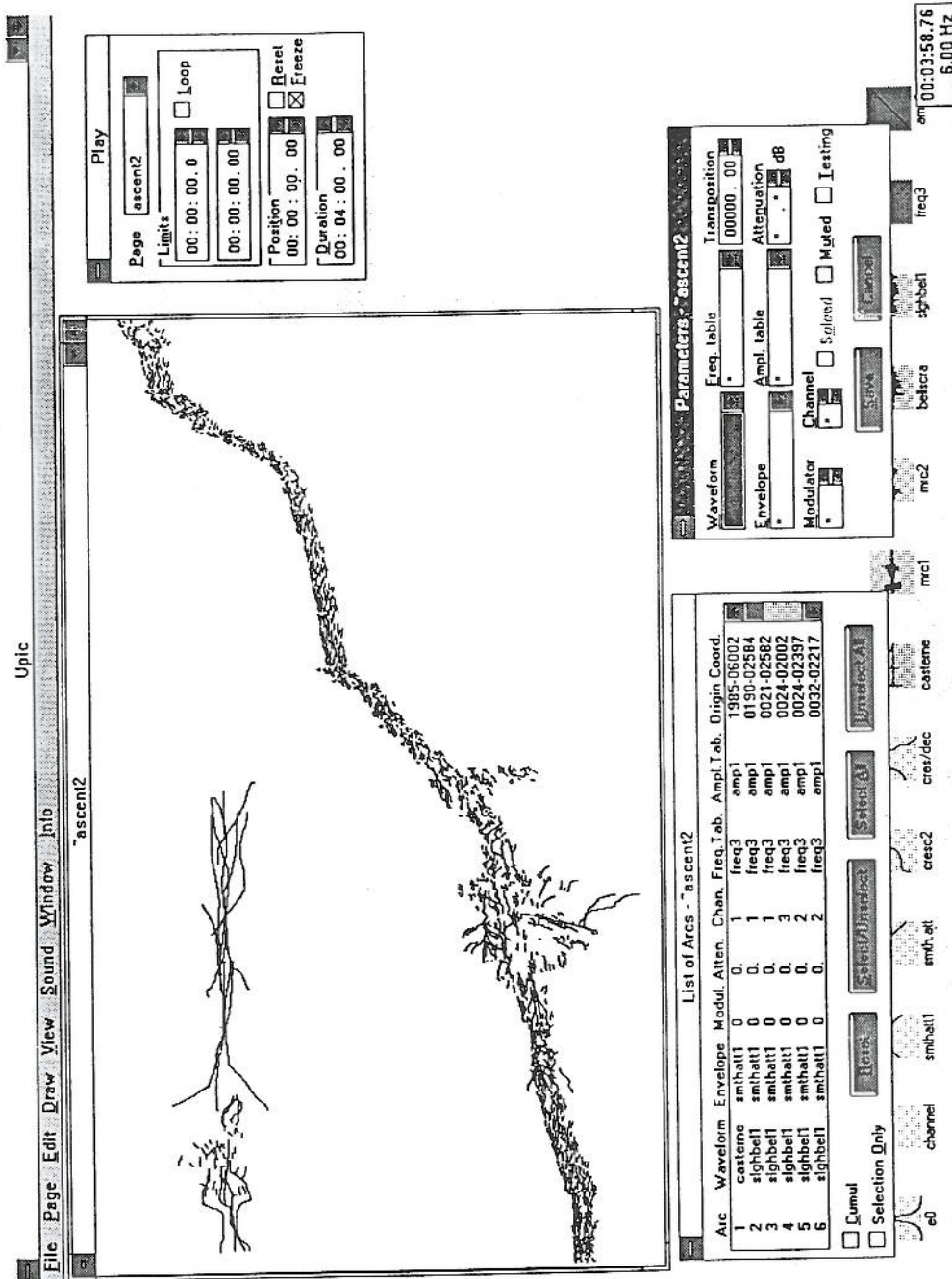


### Diagram 3

The object set used for this piece. The objects types are; 1. envelopes; 2. amplitude table; 3. waveforms; 4. frequency tables. Objects can be loaded and expunged from the work space on an individual or group basis. They are opened for editing by double clicking and appear as a typical window.







**Diagram 4**  
 The final section of this piece, identified first by a cloud of castanets, was created from the page displayed here. Other pages and sonic objects were mixed over this page during the ProTools sessions in Melbourne.