construct all four, it would be unfair to me, the artist, that I should be deprived of future commissions on these pieces because they already exist in a public collection. Therefore, for this and other reasons I will only allow two works of the four to be copies.

(2) Len Lye, the artist, would retain the authority to cancel and have destroyed either work in progress or work completed if he sees it becoming somebody else's thing. This means that he, or his assistant, would have to be kept in constant touch with stages of appreciable development of a piece and approve of them. If unable to visit the shop, he would want to see decipherable drawings.

(3) Whatever work chosen by the fabricator, and built, should not be exploited commercially (such as a roadsign type of role), nor subverted to a gimmick type attraction (such as being lit up in garish colors), but rather it should be set in surroundings which enhance it. To this end I would like some authoritative say in its exhibition. I would also, therefore, have approval of any ultimate disposition of the work, that is after it leaves the museum.

(4) When the exhibition is finished at the museum, my work is to be immediately crated and shipped to a given destination, possibly overseas.

(5) I retain full copyright of the start and end design and a blue print copy of all mechanisms and wiring schematics.

Lye had outlined several other definite requirements for the works: *Blade* and *Storm King* had to be fully programmed, and a type of steel must be used which was both resilient and would produce a proper tone when struck; *Gateway,* as an outdoor piece, had to be weatherized; *Storm King* and *Blade* would have to be placed in a soundproofed area in an installation; all three required secure bases to withstand constant vibrations.

The major drawback, as the Kaiser engineers pointed out, was that the company does not manufacture either spring steel or stainless steel, both of which are sufficiently ductile materials for kinetic sculptures. Kaiser produces structural steel which is strong, flexible and brittle, for architectural purposes and bridge building—I-beams, H-beams, piping, etc. The other difficulty was in programming the works; Kaiser has no electronic facilities to devise a control system.

Lye had also toured the Garrett Corporation and delivered the same proposals. Garrett had agreed to survey its various divisions to determine the capabilities for execution. Both Kaiser and Garrett eventually declined to take on the project.

Jackson MacLow's participation in A & T came about for several unusual reasons. His was from the beginning a special case, since he is not an artist but a poet, and could thus not be expected to have the same kind of relationship to a corporation as other artists contracted with us. Our rationale in approaching MacLow had in part to do with an intensely frustrating impasse reached with an important corporation: namely, there came a point in our dealings with IBM when it seemed we must either try a totally new approach or simply give it up. Since we had attempted unsuccessfully to obtain IBM's approval for interactions with several artists—Vasarely, Robert Irwin, Eduardo Paolozzi and Vjenceslav Richter—and since one reason for this failure appeared to be the difficulty for these artists of using computer technology in a way mutually satisfactory to them and IBM, we thought of bringing in a poet, who could use computers as a linguistic medium. The suggestion to include MacLow was David Antin's.

MacLow is associated with concrete poetry, an international, heterogeneous school of poetry, which came to prominence in the early fifties. However, unlike many of the younger exponents of this poetic movement who specifically seek a synthesis between traditional poetry and painting, MacLow has conformed to an older manifestation of this style. In his *Anthology of Concrete Poetry,* Emmett Williams discusses a kind of poetry which best describes MacLow's own work:

> The visual element in this poetry tended to be structural, a consequence of the poem, a 'picture' of the lines of force of the work itself, and not merely textural. It was a poetry far beyond paraphrase, a poetry that often asked to be completed or activated by the reader, a poetry of direct presentation—the *word,* not *words, words, words* or expressionistic squiggles—using the semantic, visual and phonetic elements of language as raw materials in a way seldom used by the poets of the past.

MacLow studied music from the age of four and began

composing music and poetry at fifteen. His educational background includes studies in philosophy, comparative literature, Greek language and music. In 1954 he published *Five Biblical Poems,* in which he invented a kind of verse using as the basic unit the "event" rather than the traditional foot, syllable, stress or cadence. The poems are based on actual Biblical happenings and the events are either single words or silences, each equal in duration to any word. Integers in the title indicate the verse structure which can be made verbal by musical or other non-verbal sounds produced at the ends of lines and stanzas. *Five Biblical Poems* is also the first work MacLow composed by chance operations, a method he has developed and extended in his later work. Since 1954, he has written several plays, as well as a book published in 1968 by the Black Sparrow Press, *Twenty-two Light Poems.* Besides writing poetry and plays, he has done a number of paintings, collages and constructions.

Besides admiring MacLow's work in general, Antin knew of several performance pieces he had composed involving simultaneous readings of randomly ordered fragments of poetry by several people in concert, following a rhythmic "score," and accompanied by musical sounds. The principle behind this technique, it seemed, could be applied to computer input and output, similar perhaps to methods used by John Cage.

In April, 1969, Jane Livingston met with MacLow in New York, where he lives and teaches at NYU. Jackson was immediately enthusiastic about coming to California to work with IBM: in fact he had even then a definite idea for a project. He talked in terms which seemed impressively knowledgeable: the areas he indicated were of interest had to do with artificial grammars and word-string processing, computer-generated sounds, modification of speech by computer or related methods, and the use of APL consoles and various educational machines. The theme he wished to pursue was "The Conservation of the Earth": he would draw on regional ecological information for the words and images. He wanted, he said, to combine words projected as pictures, with sound-recorded words or abstract sounds.

We contacted IBM to describe MacLow's general intention for collaboration. It was agreed that MacLow would come to Los Angeles to meet with personnel at IBM's Scientific Research Center in Century City, rather than touring the enormous San Jose facility which had until then been intended as the base for an artist's residence with the corporation. In June, 1969, MacLow arrived with his wife and young children—they came by train, as he avoids flying—and a meeting was held the day of his arrival at Century City with the poet, JL and a number of IBM physicists and mathematicians. It was a two hour session, and a memorably uncomfortable occasion, at

least for Jane Livingston. MacLow had formulated an immensely ambitious proposal, involving an egg-shaped, environmental housing for the work—he had a rough sketch for this structure, which stood on legs and was conceived to be large enough in its interior to accommodate several people—and an elaborate computer system for accepting and feeding out massive amounts of information based on the ecology of the Los Angeles metropolis. It was to be a participatory experience. The viewer should, according to his scheme, be able to request information at will and receive it in one of several forms—flashed onto a screen, orally recorded and emitted through a speaker, etc. As Jackson presented his idea (which was obviously more complex and technical than outlined here), the seven IBM computer scientists attending the meeting listened politely, but with palpable skepticism and even amusement. The contrast between MacLow's demeanor—he looked, on one hand, like a mad professor, and on the other like a gypsy itinerant—and the cool, groomed appearance of the gentlemen whom he addressed, was extraordinary. After the poet's initial description, the conference developed into a series of patient explanations as to why Jackson's ideas were totally beyond the realm of practicability, both from a financial standpoint and in view of the limitations of computer technology. Gradually, MacLow altered his requirements to conform to the realities of the situation, and by the end of the meeting it was plain that he would be willing to compromise significantly enough to work within whatever parameters IBM might set for his project. However, it became evident to us later that IBM was not interested in working with MacLow no matter what his project involved. IBM did, as a sort of consolation gesture, arrange for MacLow to attend a week-long course in computer programming at IBM's downtown Los Angeles headquarters.

Fortunately another, much smaller, computer company—Information International—had joined A & T as a Sponsor Corporation in December, 1968. We had visited the company with Eduardo Paolozzi and Vjenceslav Richter, and had discussed with them the possibility of working with Ron Davis, but no match had been effected. The computer system that I.I. wished to make available to an artist, and demonstrated for each visitor, was a graphic display console manufactured by them. It is described in a letter from their Public Relations consultant, Dawn Walker:

> A system made by this firm seems exceptionally suited to your purpose. It is a computer optical system which can be used as an artist's tool to produce graphics. It is capable of generating computer-animated film and other graphics. The machine, valued at half a million dollars, is used for a number of scientific and industrial purposes. However, it becomes a tool for the artist because of its high capability to react to what is desired of it graphically.

Because it has the capability to record directly on 35-mm or 70-mm film, it can be used to produce computer-animated movies from digital information. The creation of these movies is controlled by the operator through a number of means, including monitoring of the process via a television-like screen. In essence, film is created via a number of controls, and emerges ready for the camera from the machine.

(A widely-shown animated film made with Information International's system was created by John Whitney and his son, Michael, we had seen this, and the Whitneys were eager to participate in A & T, but we were not especially interested to have another such film done through the program, although such an undertaking by an artist would have exploited the unique capabilities of the machine in a way more advantageous to the corporation for commercial exposure than what was finally done with it by MacLow.)

On June 19, MacLow visited Information International, met with Charles Ray, Manager of Applications Development, who demonstrated the graphic display console. (Both Ray and the company's president, Alfred L. Fenaughty, were to be extremely helpful to MacLow and enduringly cooperative with us in the course of the project.) One of the programs used abstract, linear geometric configurations which appeared on the screen and moved rhythmically through a randomly ordered sequence of alterations, accompanied by music—a Bach fugue in this case. A program accompanied by abstract sounds—bips and bleeps—synchronized to image fluctuations was also shown. Programs could be called up or altered with the use of a light pen held to certain points on the screen; MacLow sat at the typewriter console for fifteen or twenty minutes experimenting with this device, which fascinated him.

It was agreed on this day by the company, the poet and us that MacLow would enter into collaboration with Information International. The poet began work immediately, commuting each day for ten weeks from his rented apartment in Hollywood to the company's facility in Santa Monica. He was at first assisted principally by the Corporation's Director of Programming, John Hanson. The use MacLow made of the company's PDP-9 Computer (manufactured by D.E.C.) was actually not technically difficult or sophisticated in terms of the programs themselves; according to Charles Ray, the basic programming for MacLow's poems was accomplished in an eight hour period early in the collaboration, and was later refined. This was done by Hanson. In later stages of the project, Senior Programmer Dean Anschultz was heavily involved in working with MacLow, refining and extending the program to enable greater sophistication in his word groupings than was initially possible. MacLow didn't learn to actually program himself (this would have been virtually impossible in the time he had)—in other words, he couldn't *instruct* the machine— but he did learn to *operate* the equipment, by manipulating the typewriter-console. He was given access to the computer system for four hours a day, from six to ten A.M., five days a week, and working on this basis he composed a significant body of poetry.

Although MacLow's demands on Information International's programming expertise were relatively modest, he did provide a novel experience for Information International's personnel in that the PFR-3 system (this is the designation for the entire graphic display unit, including the programmable film reader, magnetic tape units, etc.) had not previously been used by them to produce *word* images, but was employed chiefly for graphic patterns. By relying on the computer's ability to propagate words directly onto the screen (as a series of dots, rather than by scanning lines, as in a television screen), MacLow bypassed the PFR-3's film reading capacity, which involves photographing images.

MacLow finally composed nineteen poems. Each one was built differently, and they became progressively more complex as he, John Hanson and particularly Dean Anschultz elaborated the program. Only one program was made. It initially consisted of forty-eight characters, including spaces, which could be generated by pressing the typewriter keys on the display unit. During the first phase, individual two- or three-letter words could be permuted in various ways. They then devised a linker mechanism, enabling series of words to be always linked together in the same way; thus larger blocks of words could be permuted in various configurations. Finally a carriage return device was added to the program, so that a number of lines of poetry could be made to appear simultaneously on the screen. In the last poem, *THE*, each message was composed of a number of complete

sentences, rather than just linked words or phrases. Most of the poems were based on a family of words with related imagery. *SOUTH,* for example, uses words all referring to plants and animals in Latin America and Africa.

MacLow submitted several of the poems made with Information International to *Stony Brook,* for its no. ¾, 1969 issue. He included a letter to the Editor, George Quasha, explaining the way in which the poems were composed:

> The . . . poems enclosed are xeroxes of print out realizations of poems I composed last summer (1969) on a PFR-3 programmable film reader at Information International, Inc., in West Los Angeles, for the Art & Technology exhibition of the Los Angeles County Museum of Art, organized by Maurice Tuchman. A PFR-3 programmable film reader is a device, or rather a linked group of devices including a DEC PDP/9 computer, which 'reads' film in the sense that it turns the image on the film into digital form and thence projects this image via a computer onto a special type of cathode-ray tube (CRT) in a monitor console. It can modify the image when it is in digital form or analyze it in myriad ways (e.g., it can project the x-ray image of an organ of the body, increase the contrast of its features, trace the contours and give notice of anomalies, etc.). Its applications range from medical diagnosis to oil prospecting.

> In composing nineteen poems this summer (see below for what I mean in this case by 'poem') on the PFR-3, I didn't make much use of the film-reading potentiality of the device (I did wish to work with photos of handwriting, but my programmers, John Hanson and Dean Anschultz, were too deluged with other work to be able to get to that program before I had to leave L.A.). The program made for me by Hanson and Anschultz began as a simple permutation program: It allowed me to type in (on a teletype) up to one hundred forty eight-character, single-line 'messages' as one group or poem. When one was not typing messages in, the computer would pseudo-randomly range over the entire group of messages, settle on one, select one or more or all of the units in the message, and select one permutation of that group of units. This group of units would appear at a pseudo-random position (I say 'pseudo-random' because the means used were pseudo-random numbers) on the monitor CRT.

> Two special features of the CRT must be noticed: the fact that it propagates its image by a series of dots rather than by line-scanning as in video., and the fact that images fade gradually rather than abruptly from the face of the two due to the use of long-persistence phosphors. As against the bluish-white first appear-

ances of images, the after-images are chartreuse and black. In addition, the particular PFR-3 monitor console I worked on was wired to an audio amplifier in such a way that every time an image (e.g., a series of words) appeared on the CRT, the same series of impulses from the computer which fired the electron gun to produce the image also went through the audio system to produce a sound. In the case of my word groups, the longer the series of characters was, the deeper in pitch the tone (a sound in the oboe-bassoon family, more or less) and the longer its duration. Thus single words would produce high pitches; several-line groups (which the later forms of the program made possible) had the sound of deep organ pipes.

In addition, if one desired printout, one could push down one of the 'program-sense' levers on the console, whereupon the teletype would type out every tenth word group that appeared on the screen. This feature of the program is the source of the present examples. Moreover, in the later forms of the program, I was able to vary the speed of propagation of the word groups by depressing various combinations of the AC levers on the computer itself. A regular feature of the console itself is a group of knobs that enables one to shift the image horizontally or vertically or change its horizontal or vertical size (or any combination of any number these four possibilities); when one shifts the setting of one or more of these knobs while an image is being propagated, one produces chartreuse tracks!

In the earlier forms of the program, the permutable units were single words and I had no period as a printable character. The program would pull out any of the permutations of any of the combinations of the words of any of the up-to-one hundred messages which constituted a single 'poem' in this sense. The two-page run beginning 'ALWAYS ARE TRANS-FORMING ENERGIES ALL PARAMETERS' is the earliest example of this stage. It is printoff from the poem 'TRAN,', which consists of the single message 'ENERGIES ARE TRANSFORMING ALL PARAM-ETERS ALWAYS' and which I improvised on the PFR-3 teletype the first day I worked on it in the middle of June, 1969. From the same stage is the poem 'DANISH' (or 'DANSK') which was the first one completed with one hundred full-line messages. (Of this I enclose the first realization drawing on all one hundred messages—the actual printoff beginning with 'GRANDFATHERS BENIGNANT' .... I also enclose three xeroxed runs of printoff of 'DANISH': the single-page beginning 'CRUNCHING ARE'; the three-page run beginning 'PAVEMENTS CARPET-ING ARE JACARANDA VIOLET FLOWERS'; and the single-page beginning 'TROMBONES LOUD

TONES ARE RESONANT SOUNDING LONG'.)
SENTENC)ES'

'DANISH' consists of one hundred complete sentences, some composed by means of systematic chance, some just dreamed up, each of which has its verb in either the present progressive (e.g., 'is/are going') or past progressive (e.g., 'was/were going') tense and each of which consists of a maximum of forty-eight characters, including spaces. It was composed during most of the last week of June, 1969. The use of the '-ing' form of verbs as present participles, gerunds (nouns), adjectivals allows for a maximum of at least fragmentary grammaticalness when these words appear in random groups as in these examples: it is easy for the *-ing* form to shift from one grammatical role to another according to the permutational context. Elements of some of the sentences were drawn by chance from a dictionary and from *Black Elk Speaks* (Neihardt).

In later stages of the program, I had a 'linker' by which I could link up any number of words—even whole sentences—and use them as units rather than merely single words. 'SOUTH,' of which I send you a complete sixteen-page run, is one using this linkage feature. It began as a series of sentences improvised the first time I worked with the PFR-3. Somehow the lack of grammaticalness in the resultant printout of pseudo-random permutations of combinations of the words of the sentences I typed in didn't 'make it' for me, but by scanning through it for actual and suggested sentences, I produced the one hundred messages of the final version of 'SOUTH'—each of which consists of one or two whole sentences which are the actual units of the messages since their words always appear in the same succession because of the linkage. The imagery of 'SOUTH' is an indiscriminate mixture of flora and fauna from both Central and South America and Africa (possibly also southern Asia) . . . .

A very late feature of the program was a workable 'carriage return'—i.e., the possibility of messages having more than one line of forty-eight characters, of propagating on the CRT face multiline groups of units or whole messages, and of printing out such multiline messages and unit groups. This was a terribly complex programming problem (or rather, making these *three* types of carriage return possible and compatible and also making it possible to *edit* such messages—which is another long story)—finally solved by Dean Anschultz, the red-bearded Demon Programmer of Venice on the Pacific.

In the poem 'DAVID' (the name refers to Dave Antin, I guess, whom I saw several times in both Los Angeles and in Solana Beach, and who saw and heard the PFR-3 in action—both 'playing' some of my

poems and having new ones typed into it), all of the one hundred messages are questions or statements about questions involving 'DAVID' asking questions, etc. All of the words of each question or statement are permanently linked, and they run from two words in length to three lines. See the page beginning 'DAVID ASKED.' (By the way, I also got an operational period about the time that I did the final [sentence] version of 'SOUTH.') This page is from the middle of a long run of printout-realization of 'DAVID.'

The last poem I worked on (for two or more weeks, I believe) in August, 1969, was 'THE'—of which I enclose three short runs of printout. In 'THE,' each message consists of four to six short sentences, each typed originally on a separate line. These short sentences are the units of the messages of the poem, and their words are permanently linked within each sentence. Thus each word group propagated on the CRT face and/or printed out is a sort of strophe of one to six lines, each line of which is a complete sentence. As is obvious from the printout-realization examples enclosed, each sentence mentions a more or less 'universal' phenomenon; each strophe consists of a closely related group of such phenomena. Ex. 1 ('THE SUN SHINES.') is from an early stage of this poem, in which I had not yet accreted many messages. One may print out at any stage of the game, so that earlier printout draws from small numbers of messages; later printout is drawn from larger numbers of messages—up to one hundred, except for 'THE'— which has such long messages that it overran the memory core of the PDP/9 at about the 43rd message: it's the Saint-Saens' 4th—organ pipes and all—of my PFR-3 poems. It reached the limits of the computer's capacity and had to be trimmed back before the computer stopped, just giving up altogether (as it did every time I passed a certain limit in adding messages to the poem). There were a lot of *human* phenomena that I never got to put into the poem because I put them off to the end of the list of messages, thinking I'd be able to accrete up to one hundred of them despite the extreme lengths of the individual messages. The organ pipes came from the fact that there were so many characters and lines in most of the word groups propagated on the CRT that most of the corresponding audible tones were similar to those of very deep organ pipes—still vaguely 'double-beating-read' in timbre, some being chords or tone clusters. (This isn't the Saint-Saens' 4th but the Mahler 9th of the PFR-3 poems.)

Ex. 1 is early since it draws from only a few messages and still has the word 'animals' rather than 'mammals'—the word used in the later stages of 'THE' 's composition. Ex. 2 ('THE WIND BLOWS.') and Ex. 3

('THE PEOPLE BUILD METROPOLISES.') are from late stages of 'THE'; they are, respectively, complete two and four-page runs of printout.

We seriously considered displaying MacLow's computer-generated poetry in the New Arts Exhibition at Expo 70, and even went so far as to have some test film footage made of the PFR-3 screen with the poetry appearing on it. (It was plain that the equipment itself, in operation, could not be seen long enough or closely enough to be understood by crowds of people passing through the exhibition area.) The film as we saw it was not entirely successful, and it would have required an expenditure beyond our means, or the company's, to produce it in acceptable form.

The following are excerpts from six poems made by MacLow at Information International: *The, Danish, Diane, David, South* and *Trans.* They are reproduced from Xeroxes of direct printout. *Diane* is given in two forms: the first is a series of "messages," which are then randomly arranged to form the poem.

Jane Livingston