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Electronic Abstracts - Art for the Space Age

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Electronic Abstracts—Art for the Space Age

By Ben F. Laposky

New forms and techniques of art for the space age may involve physical forces and ideas, as well as materials and procedures from technology. Such a new approach to abstract design is that shown here in the *electronic abstractions* or *oscillons.*

Moholy-Nagy, one of the leaders of the Bauhaus movement in Germany, has stated in *Vision in Motion* that "most of the visual work of the future lies with the 'light-painter'." Moholy-Nagy continues: "He will have the scientific knowledge of the physicist and the technological skill of the engineer, coupled with his own imagination, creative intuition and emotional intensity." Electronic abstractions are a form of painting in light, traced on the fluorescent face of the cathode-ray tube of an oscilloscope by the moving electron beam.

These designs, patterns or abstract art compositions are created by means of electrical waveforms, generated by various electronic circuits borrowed from radio, television, radar, or by some especially designed for this work. The waveforms are modified and controlled by these circuits, as manipulated by the artist or composer for the best design values or the greatest aesthetic appeal. (Figures 1-4).

Experiments in other forms of the art of mobile light have been carried on since about 1890 by several people using various optical and electrical lighting or projection systems. The best known in this field is the "Lumia" work of Thomas Wilfred. In this, abstract forms in colored light in motion are displayed by a projection apparatus, the Clavilux, played by an operator as a kind of light organ. However, neither the Clavilux nor the other earlier experiments involved the use of the oscilloscope.

The possibilities of using the oscilloscope in the design field had been noted occasionally by engineers and artists. In 1937 C. E. Burnett first suggested the idea in *Electronics* magazine. However, it seems that little was done with it except for a couple of experimental abstract movies made by Norman McLaren and by Mary Ellen Bute in which some electronic oscillograms in motion were featured; these moved in time to music accompanying the films.

About 1950 this writer began experimentation with the oscilloscope and various electronic circuits with the objective of creating

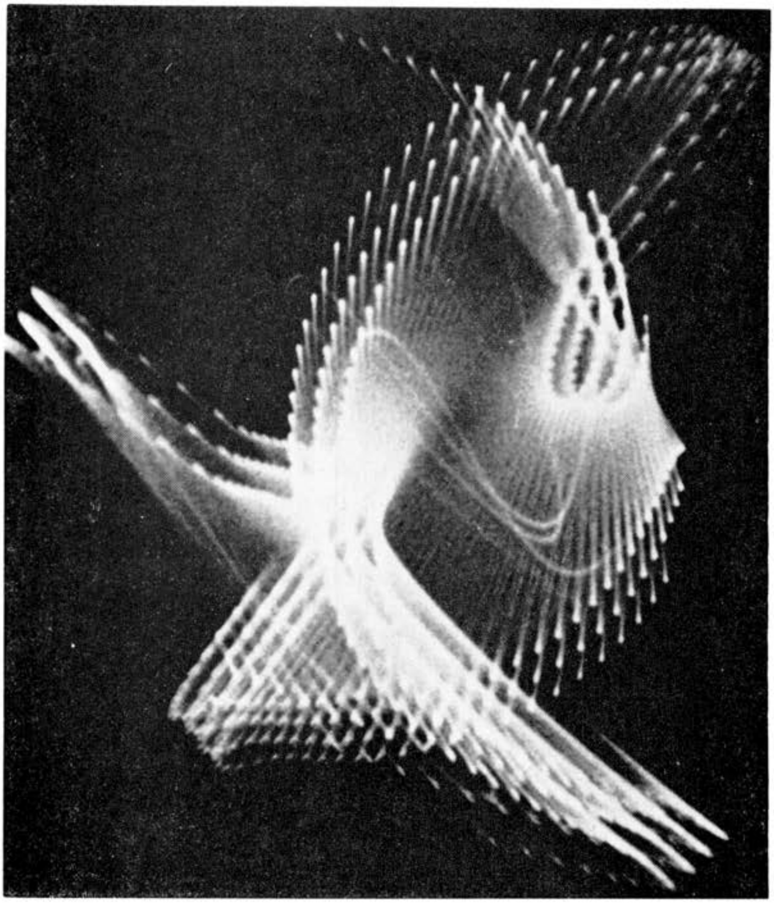

Figure 1. Electronic Abstraction Number 4.

new abstract art or design forms with a mathematical character to a more advanced or complex degree than those already shown. The results of this project were called *electronic abstractions* or *oscillons* (the latter being derived from oscillogram, electronic, as a coined word). These designs were recorded by means of special films, such as the Linagraph films used for oscillographic recording in laboratory work, as well as some high contrast aerial color films. High speed lenses were used on three different 35mm cameras, and on a 4x5 inch press type camera for the photography.

The electronic abstractions are related to other mathematical and physical patterns traced by pendulums and harmonograph machines in which various rectilinear, circular or curvilinear motions are combined to produce a visual effect. However, with the electronic technique it is possible to obtain a much greater range of designs, and to control them more effectively from the creative standpoint.

To compose the variety and complexity of patterns as shown by the electronic abstractions requires a large amount of electronic equipment, such as amplifiers, modulating circuits, various control and connecting circuits and especially waveform generators. As space will not allow a more complete description of all this circuitry, only a brief description of some of the basic waveforms produced by it will be given.

The most fundamental waveform used is the sine wave. This is the circular waveform, the projection of the circle in time, and the waveform generated by the alternating current generator. It is a pure wave, and as such is not so interesting by itself as a design element, just as the pure sine wave as a tone in music is not so interesting to the ear. This wave, like the others used, may vary in its amplitude and frequency—for the oscillon work from about 30 cycles through 100 kilocycles.

Another basic waveform is the square wave, which may be obtained directly from the sine wave by clipping circuits or by overdriven amplifiers. It is not as simple as it looks, actually being the resultant of all the odd harmonics of the sine wave composing it, as shown by Fourier analysis.

The next type of waveform is the triangular. The sawtooth is representative of this type, being used in most oscilloscope sweeps. The symmetrical triangular wave can be derived directly from the square wave by means of an integrating circuit, consisting of resistance in series and capacitance in parallel with the output of the square wave generator. This, like the sawtooth, is not a simple wave—being the resultant of all the even harmonics of the sine wave (the sawtooth is the resultant of all the harmonics of the sine wave).

There are, of course, other basic waveforms which may be used in this electronic design technique, such as the parabolic, exponential, pulsed waves, and so on.

By combining the basic waves in different ways, new figures of interest are obtained. For instance, putting two sine waves into the horizontal and vertical sections of the oscilloscope will produce the Lissajous figures. If the input waves are integral multiples, the resulting figures are symmetrical and have some appeal as simple designs. Lissajous figures can also be traced by pendulums. They are useful in electronics for frequency determinations.

The waveforms may be combined in other ways—by putting two sine waves in parallel into the vertical section of the oscilloscope,

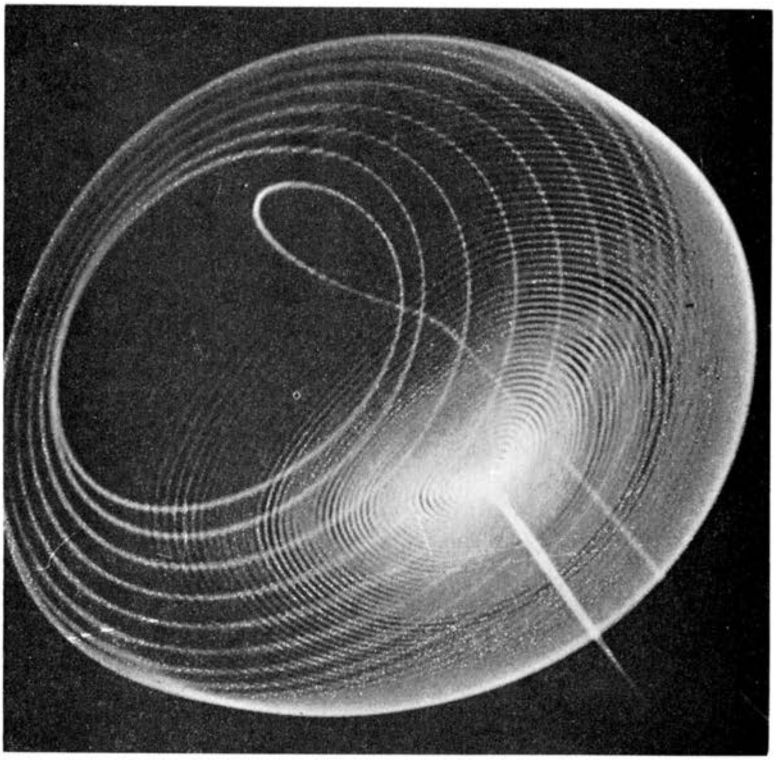

Figure 2. Electronic Abstraction Number 27.

modulation patterns result. Varying the frequencies of these waves produces interesting forms which have more aesthetic appeal than the simple sine waves alone.

Further, by using a phase-splitting network, which consists of a resistance and capacitance across the output of the sine wave generator, connected to the horizontal, vertical and ground connections of the oscilloscope, circles and ellipses are obtained. These may vary according to the frequency of the sine wave and the values of the capacity and resistance of the network.

Again, these figures may be modulated by adding a sine wave in parallel to the input of the phasing net, getting various cycloidal, spiral or roulette figures.

These are just some of the simpler ways of creating patterns of design value on the oscilloscope, with basic electronic circuits. By using amplifier distortion, special sweep or modulation combinations, special deflection circuits, electronic switching, and so on, a great variety of forms may be produced. However, only a fraction of this array will be worthwhile from the standpoint of design or abstract

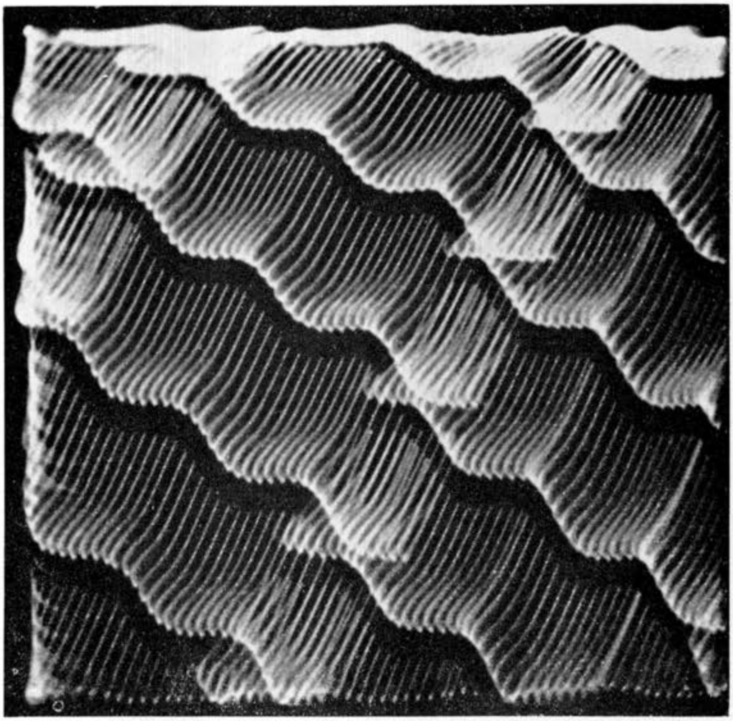

Figure 3. Electronic Abstraction Number 29.

art. The designs must be composed by the combination of selected basic circuits, and the intelligent control of them. They are not normally mere accidental traces nor naturally occurring electrical phenomena.

The photographs shown here were created by different controlled circuit combinations. They were taken from a green trace or a blue trace cathode-ray tube (P1 or P11 phosphor) for the black and white photography. By using a white trace (P4 phosphor), as in the television picture tubes, it is possible to create vari-colored forms. This can be done also by using a tricolor television picture tube, or by using three single color tubes, as red, blue, green, and combining or registering the images by means of prisms or dichroic mirrors. However, employing a moving filter ahead of the single white tube is the least costly and the simplest to control.

This filter, which is made up of similar segments of red, blue and green—the light primaries—is rotated by a motor which has a variable speed control, or in which the speed is synchronized with sweep circuits in the oscilloscope. This rotating filter system is similar to that used in the first type of commercial color television, but later dropped because of the large filter wheels required. (For a 27 inch set, for example, it would require about a 5 to 6 foot rotating filter wheel.)

The color in the various parts of the designs as they appear to the eye, or to the camera, depends on which filters are in front of the face of the cathode-ray tube at the same time that a certain part of a waveform is there. The texture of the designs depends, of course, on the frequencies of the waveforms, the high frequencies giving the more solid appearing sheets and forms. Or, it may depend on varying voltages if intensity modulation is used on the z-axis. The three-dimensional quality sometimes seen in these compositions is generally due to various phase relations of the waveforms.

A large number of color compositions (besides several thousand black and white figures) have been photographed by this writer, using various types of filter wheels as well as the same complex circuits also employed for the monochrome or black and white patterns.

These designs have appeared in a number of magazines and some books in the scientific, mathematical, art, business and other fields, both in America and abroad. *Fortune* magazine displayed a group in a six-page feature in color in 1956. Because of their mathematical interest and possible value in the teaching of mathematics, *Scripta Mathematica* published several. Relating more directly to physics, an electronic abstraction was used as a decorative piece on the jacket of a new book on the great physicists, published in France last year. Also, one appeared on the cover of *Argonne News*, a publication of the Argonne National Laboratories, of the Atomic Energy Commission.

An exhibit of the black and white photographs of the designs has been circulated by Sanford Museum of Cherokee—it has been shown at the Cranbrook Institute of Science, Bloomfield Hills, Michigan, at the Vassar College mathematics department, and at a science seminar at Colorado College, Colorado Springs. In addition, a number of university and college art departments have displayed it, as well as many art museums.

The electronic abstractions have been applied in advertising art in some national advertising and other ways to call attention to electronics. They may be used in other graphic arts as well as for textile and ceramic decoration, and so on.

As art forms, the designs are called abstractions as they do not, of course, illustrate any real objects in nature. They are more non-objective, actually, as they are not abstracted from anything, either. The viewer of the designs may use his own imagination to see natural forms or objects in them, which may account for part of

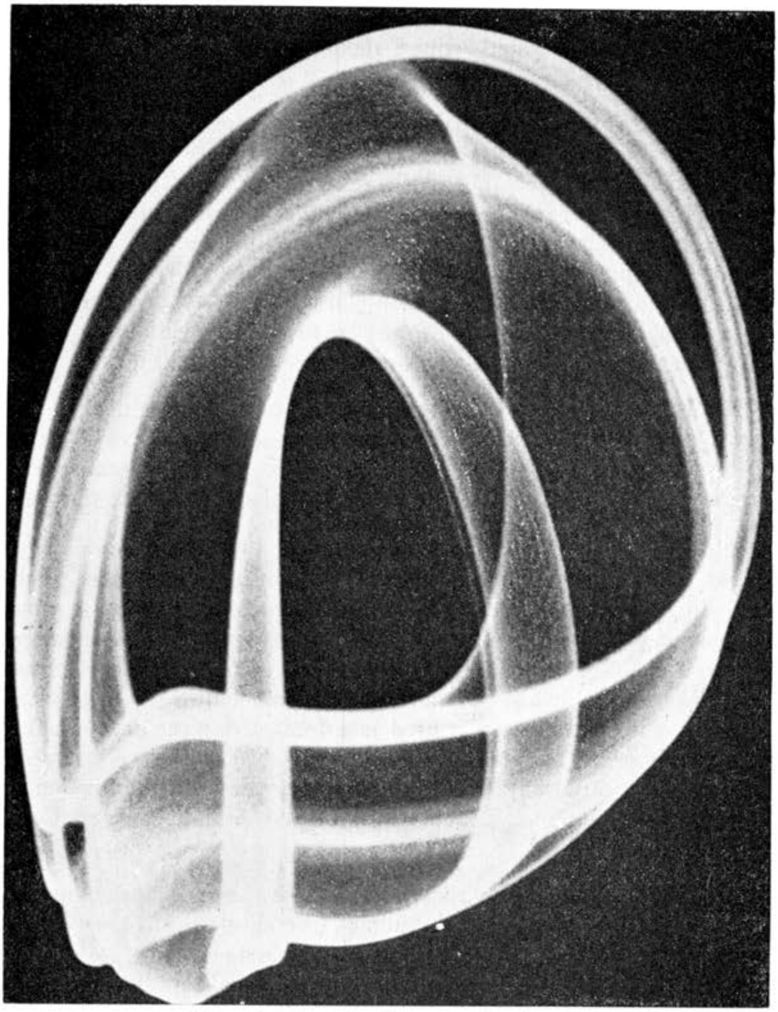

Figure 4. Electronic Abstraction Number 34.

their appeal. But, part of it is also due to the rhythmic nature of the patterns and their mathematical precision. It is in this symmetry, balance and rhythmic sequence that art and science meet on a common ground, as Gyorgy Kepes points out in his book, *The New Landscape in Art and Science*.

There is also an interesting parallel between these designs and music, as can be shown in several ways. The abstractions, as has been demonstrated, are created by electrical waveforms, as music is made up of sound waveforms. The designs are abstract and mathematical, just as music is, for the most part, abstract and mathematical. Then there is another association through electronics in that music may be played on electronic organs or the theremin, and may even be synthesized by electronic computers.

In relation to physics, electronic abstractions or oscillons are created by the use of the forces of electricity and magnetism, and of atomic vibrations and the movements of electrons. They are formed according to the laws of electron optics and of magnetic fields. Their appearance on the cathode-ray screen is due to the action of the electron beam on the fluorescent phosphor, converting electrical energy to light energy. They are recorded photographically by means of light optics, on films utilizing photoelectric and color filtering effects. Many of these physical forces and phenomena may be used, of course, in the development of the space age.

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