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UNVEILING THE MYSTERIES OF KIRLIAN PHOTOGRAPHY

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Introduction

In recent years, considerable interest has developed in a type of high-voltage photography called Kirlian photography after its chief developer, the Soviet scientist, Semyon Kirlian, who investigated many aspects of the technique over a 30-year period.[1-3] Current interest in this subject is very high on the part of psychologists, psychiatrists, biologists and physicists who look upon the technique as a unique way of observing energy states associated with all living things. In fact, some investigators in the United States are already trying to use it as a diagnostic tool to monitor the psychological and physiological conditions of their patients.

Extravagant claims are being made about the process based upon very little first-hand information. Of course, the fascinating color photographs of plant leaves and human fingertips[3] would make anyone wax poetic. (See Figure 1) Early statements suggested that the aura, as seen by clairvoyants, was being photographed.[1] From the Soviets, we heard of evidence of cut leaves with significant portions removed that still exhibited the radiation pattern of the entire intact leaf[1,2] suggesting evidence for the "lost limb" effect. Remarkable color effects have been reported in the United States and related to various physiological and psychic events. Indeed, an abundance of extremely interesting and potentially exciting observations has been made that demands our attention.

On the other hand, the intensity and character of the energy emissions seem to depend strongly on the mental, emotional and physical health condition of the subject being photographed, and this has prompted some people to postulate new types of energy emission from the body (called bioplasmic energy by some of the Soviets). On the other hand, the process itself is clearly associated with an electrical discharge and looks, on the surface, like a corona discharge effect which has prompted other people to relegate the entire phenomenon to a category of fairly familiar and thus uninteresting electrical discharge effects. We are on the horns of a dilemma! Being subject to the "human condition", we strongly desire evidence for these newly suggested dimensions of the universe and for the non-physical aspects of our nature. This new topic has allowed us to exercise our imaginations and to recognize great inherent potential in this new tool. However, we can build only on a firm foundation which is the tried and tested and that strongly constrains the imagination and tends to make us miss the potential inherent in new things.

Thus, it seems to be time to take stock and assess where we stand in this new field; i.e., what we know, what we may reasonably expect to find, and what we must do to maximize the yield of our studies. After two years of experience with high-voltage photography (kirlian) in the United States, it is now time we asked ourselves some serious questions concerning the process:

(a) Does the evidence show that we are dealing here with physical or what we might call non-physical effects?

(b) Can we realistically account for the observations made to date with a specific model?

(c) In what way might the changes of energy states in the living system be made manifest on the photograph?

(d) Can we presently specify the weaknesses of the technique and thus delineate which observations reveal new information and which are merely artifact associated with poor technique?

(e) Is this a potentially useful technique, and where do we go from here?

We shall see that there is a specific physical explanation, called the "streamer" phenomenon of corona discharge, that can account for all the observations made to date.[4,5] We shall also see that identification of a specific physical mechanism does not mean that energy interactions with non-physical levels of the universe are not untimately involved.

Rational Experimental Expectations Re Non-Physical

By non-physical energies, the authors mean

(1) energies of a non-electromagnetic, non-sonic, and non-gravitational variety as we know them,

(2) energies that do not directly stimulate our five physical senses as we know them, and

(3) energies that do not propagate in the four-dimensional space-time continuum as we know it.

The present models of the non-physical aspects of the universe, of one of us, is presented elsewhere[6,7] and will not be dealt with here.

For most of us, using only our five physical senses and an army of instruments based upon similar reference frame experience, we discriminate information patterns radiated to us by the universe; i.e., by the reality of the universe which we then interpret according to whatever "picture book" of reality we have in our consciousness. Because of the way we are constructed, we cannot expect to "know" reality but can only ask for consistency relationships amongst the many information patterns we perceive concerning reality.[6] Following this line, suppose we seek to discriminate information patterns radiated to us by nature on a non-physical energy band rather than on a physical energy band. We will find that the phenomenon, which we think of as distinctly non-physical, will influence our physical observations in some way, and we will eventually come upon a description of these consistent physical influences which serves as a physical explanation. This should not be too surprising to us because all we can presently perceive, with any reliability, are physical manifestations of energy; thus, there must be a perfectly logical mechanism and physical explanation for the process of its appearance and its registration on our senses.

Thus, for the eventual understanding of such phenomena as Kirlian photography, it is necessary to understand the physical process to such an extent that one can track its roots to some causal or non-random event that strongly suggests non-physical connections. We can expect that an information pattern at a non-physical level will act as a force field with coupling elements to the physical dimensions so that a corresponding (but not necessarily the same shape or intensity) force field pattern will be mapped (or transduced) into the physical level which, in turn, sets a physical process in motion that we then observe with our physical instruments.

Mechanism of Light Generation

A schematic representation of a simple Soviet device and power source characteristic is given in Figure 2. The object to be photographed is placed between the parallel metal plates of a capacitor-like electrode arrangement and separated by a small distance from a piece of photographic film (emulsion side towards the object). The Soviets have indicated that, for a good picture, a certain critical spacing, d, should be maintained between the object and the film. Since no light is applied during the exposure of the film to the electric field, how is the picture of the object recorded on film?

We conducted a number of experiments using a similar electrode configuration to Figure 2 and a special power supply operating at 1 MHz (megahertz) that has been described elsewhere.[5] Single pulse discharges from both biological and metallic electrodes were found to occur from a network of points on the electrode surface. Multiple pulses were found to produce a superposition effect such that a uniform "aura" exposure appeared on the film. Figure 3 illustrates the effect of single and multiple pulses for both a coin and a fingertip. During the fingertip studies, it was found that the photograph depended significantly on the electrode-film combination. Considerable variability occurred in these results as a consequence of the inability to repeatedly establish a well-defined and controlled discharge spacing, the orientation and tilt of the finger plus other unknown factors. This was especially true with the multiple pulse technique. Thus, we decided to restrict our initial studies to those wherein reliable information could be gained and started by studying discharges between flat, polished metal electrodes (brass, stainless steel, silicon). In this initial study, the film was contained in the inter-electrode space; later studies, using a transparent electrode, allowed the film to be placed outside of the electrode system. Figure 4 is a representative photograph of the initial results with brass.

All the photographs were found to reveal the same characteristic dot discharge pattern with relatively uniform dot spacing. The general trends noted in the study were the following:

(1) For a given electrode material, increased pulse width increased the dot intensity.

(2) For a given pulse width and electrode material, multiple pulses resulted in a decrease in the average inter-dot spacing.

(3) For a given pulse width and approximately constant electrode spacing, the inter-dot spacing, λ varied only slightly from material to material even though their electron work functions differed by as much as two volts.

(4) For a given material, increasing electrode spacing results in fewer discrete dots but produced dot clustering and an increase in the amount of diffuse exposure around each dot.

(5) For laterally displaced electrodes (relative to each other) giving only a fractional matching area of electrode, the shape of the discharge not only conforms to the shape of the overlap area, but one sees an additional edge discharge from the upper edge that overlies the metal on the lower electrode.

(6) In a number of photographs, large clear patches containing no dots were found. This effect disappeared when glass photographic plates instead of film were used.

One has only to casually read the work of Loeb[4] to realize that we are dealing here with the corona discharge phenomena called "streamers." In this process, a few electrons are first produced in the interelectrode space either by cosmic ray events, U.V. radiation, of field emission from the cathode. These electrons are accelerated by the field and ionize the air molecules yielding an exponential growth in the number of electrons and positive ions; i.e., an avalanche. The electrons sweep quickly toward the anode (positive side) and the cluster of positive ions moves somewhat more slowly toward the cathode (negative side). When the positive ion cluster in the air-gap reaches a critical density, it strongly attracts the electrons so that a large number of recombination events occur and photons of light are generated to such a degree that the cluster of positive ions is brightly luminous and travels at speeds about 1% the speed of light ($\sim 10^7$ to 10^8 cm/sec). Both positive and negative streamers move between the electrodes so that, if visually observed, one could see a group of discrete balls of light, "light globules" or "light pulses," moving in various directions.

In air at high field strengths, the normal color of the streamers is a bright blue since the most frequently excited radiation is from highly excited nitrogen (N_2) molecules. One finds ultraviolet (U.V.) radiation produced in abundance also. The intensity of U.V. greatly exceeds that of blue in most cases. In air at low electric fields, the ionization and excitation favor the arc spectrum of N_2 (nitrogen) and nitric oxide yielding a reddish purple glow. Yellow flashes have sometimes been observed in the streamer corona, and this is thought to be due to the presence of sodium from sodium chloride (salt) on the electrode surface. In addition, it is thought that if minute carbon flakes are ejected from the electrodes and rendered incandescent in the corona bursts, these could give rise to red or yellow streaks of light. However, a bluish-white color is the overwhelmingly dominant feature of the discharge.

Using the transparent electrode,[8] the discharge pattern from both polished metal electrodes and fingers was observed to be the same as in the initial studies, and the color was found to be completely in the blue and U.V. range of the electromagnetic spectrum, as expected from our theoretical understanding of the mechanism. With this new electrode, the authors[8] have studied the effect of electrode spacing, pulse length, electrode tilt and several other factors. In Figure 5, we see color photographs of three quite different discharge patterns depending upon the interelectrode spacing and the pulse length. Note the striking changes as these device parameters are varied. Such patterns, for electrode voltage, spacing and pulse length constant, are found to be fairly reproducible. Thus, in any reliable diagnostic device, we must design into the system the ability to control these device parameters. Only then can we be assured that pattern configuration, color and intensity changes are due to energy state changes in the living system under study. In these studies, some non-blue and white color was observed with lengthy discharges when deposits of organic matter and water vapor were allowed to build up on the transparent electrode. Cleaning of the electrode produced immediate change back to solely blue and white light generation.

Early Streamer Studies

In the 1930's through the 1960's, American electrical engineers were studying and photographing streamers developed between a point electrode and a plane electrode as illustrated in Figure 6. They used constant direct current (D.C.) fields initially and pulsed D.C. fields later and found that a distinctly different morphology of discharge picture appeared on the film depending upon whether the point had a positive or a negative voltage relative to the plane electrode. This is illustrated in Figure 7; the dendritic or Lichtenberg figure observed with the positive point occurs because the electrons accelerate towards the positive point joining into trickles and then streams and then rivers of electrons becoming more concentrated and clustered at each step; the diffuse soft figure observed with the negative electrode occurs because the electrons decelerate in moving away from the negative electrode and become more diffuse rather than more concentrated with increasing distance. Thus, we see that an electrode polarity effect is important to the morphology of the photograph and must be influential in the Kirlian photographs which use pulse alternating current (A.C.)

A second important contribution of these early studies was to illustrate the effect that electronegative gases had on the discharge. (These are molecules that become ionized by trapping electrons.) In Figure 8, the influence of carbon tetrachloride and Freon on both positive and negative point discharges is readily noted. In this case, the electron impact splits the molecules into two highly electronegative components which trap slow electrons, thus hindering both the initiation and growth of electron avalanches. The action of suppressor gases (organic vapors are found to be extremely effective) is not constant so that both marked spatial and temporal changes may appear in the discharge patterns under such conditions (discharge instability). It should be noted that the presence of water vapor also tends to mask the discreteness and clarity of the discharge pattern. The important point to be noted here is that the surface chemistry of the living electrode under study may strongly influence the pattern observed in the discharge and awareness of this factor is necessary for proper interpretation.

It was also shown that the length of streamer generating light is linearly proportional to the applied voltage (for fixed interelectrode spacing).

Different Colors in Contact Photography

In our earlier work,[5] we suggested that the lack of dot exposure over the entire electrode area might arise as a result of buckling of the film surface resulting in a negligible discharge space over a specific patch of the electrode. Subsequent tests showed that, when rigid glass photographic plates were used in place of the film, the patch effect disappeared. In addition, the work of Loeb[4] mentions experiments wherein sheets of color film were exposed to streamers both via the emulsion side and via the non-emulsion side. When exposed via the emusion side, the discharge patterns were blue; when exposed via the reverse side, the discharge patterns were red. It seemed to us[5] that perhaps we had here the clue to the many observations of non-blue or non-white color in contact photography experiments;[3,9,10] i.e., many cases of red, orange, yellow and even green splotches had appeared on photographs amongst the blue and white color, especially after what had been reported to be emotional or psychic experiences.

An explanation is easily arrived at by considering the structure of color form. Basically, it is composed of three pigment layers, blue, green, and red, in that order, separated by a filter layer and with the blue placed first on the emulsion side and with red placed last adjacent to the film support side. We felt that if film buckling or film vibration occurred during device operation, streamers would develop between the electrode and the back of the film as well as at the front. Because of this, blue and U.V. light would enter the back side of the film as well as from the front. That which enters the back side will expose the red and green layers to some degree providing color production in the orange range with variations to the red and yellow side depending upon the preponderance of U.V. or blue light generated by the streamer. For the exact details, see the earlier publication.[5]

The fact that people using Polaroid film with a staff opaque backing never see anything except a blue and white exposure is consistent with the film-buckling postulate. In addition, our experiments with the transparent electrode also reveal only blue and white patterns.[8] Finally, a direct series of experiments using filters and with light entering the back versus the front side of the film, completely confirm the color predictions of our model. (See Table I) For these cases of film exposed on both sides via streamers, one expects to find a magenta color (blue + orange) as a result. (See Table I)

Living Organism Effect on the Streamer Process

To move forward and reliably identify psychoenergetic effects via high-voltage photography, we must monitor those parameters of the system that can directly influence the "streamer" process. These appear to be at least five-fold:

(1) A change in the electrostatic potential, ϕ, of the skin leads to a change in the half-cycle voltage difference between the skin and the driving electrode. Such a change in voltage affects the maximum possible light-emitting streamer length[4] which determines the width of the corona around a fingertip, for example. Since we know that emotional changes in the human organism can increase the skin potential by up to 500%, this effect should be noticed in the corona width and corona brightness if the skin potential change is large enough. We also know that electrostatic potentials of about 5,000 to 10,000 volts may be discharged on metallic objects, like doorknobs, after one has walked on certain carpets when certain atmospheric conditions prevail.

Table I

Results for Light Entering Emulsion vs. Support Side of Color Film

Light	Entering Emulsion Side (Front) Predicted (Model)	Entering Emulsion Side (Front) Observed (Experiment)	Entering Support Side (Back) Predicted (Model)	Entering Support Side (Back) Observed (Experiment)
Ultraviolet	Blue	Blue	Red + Green	Orange*
Blue	Blue	Blue	Red + Green	Yellow†
Green	Green	Green	Green	Green
Red	Red	Red	Red	Red

*Orange is a additive mixture of red and green with a greater proportion of red.

†Yellow is an additive mixture of red and green with equal proportions of red and green.

(2) As a result of mental or emotional state changes in the organism, one may expect to find a change in the surface chemistry of the skin. This effect should give rise to electronegative ion type effects which would alter the morphological character of the discharge. In addition, weak color radiations may come from the excitation of these molecules. It should be noted that small electrical arcs can create hot spots on an electrode as much as 2000°C higher than the ambient temperature; thus, we should not be too surprised if the corona discharge produces a sufficient hot spot to evaporate and ionize organic molecules from biological specimens. However, these colors are unlikely to be seen distinct from the background of intense streamer colors.

(3) There will be a geometrical induced-field effect due both to shape and polarization of the skin surface which will lead to certain types of diffraction effects resulting from the spatial and time variation of the dielectric properties of the skin.[7] In order to reproduce and control the "cut-leaf effect" reported by the Soviets,[1] this type of wave interference effect would need to be studied very carefully.

(4) As a result of the driving field on the electrode, we should anticipate some type of energy coupling with the cells of the object. This, in turn, may lead to energy emissions from the cells which could influence the ionization properties of the gas and thus alter the quantitative details of the electron avalanche process. Since skin is strongly piezoelectric, an electrical stimulus will generate a mechanical resonance and vice versa. We do hear mechanical noise in the high audio range during the discharge. Conventional secondary emission events due to impacting photons, ions and electrons will lead to photoelectron and secondary electron emission. Changes in mental or emotional states should change the electron state population in the finger and thus reveal itself via altered emission processes.

(5) A change in the electrical impedance of the skin or the surface membrane of a plant will serve to alter the "external circuit" impedance of the electrode system. Since it is the external circuit impedance that largely controls the amount of current flow during the corona discharge, both the light intensity and the film-buckling or film vibration effect (for contact photography) will be strongly influenced by the electrical impedance of the biological subject. It is well known that this varies quite strongly with change of emotional and mental states.

(6) As a final word of caution, we should recognize the fact that such an electrical discharge is a severe perturbation to the energy states of the biological specimen so that one should not pulse the system too severely and should let it relax and recuperate before repeated stimulation.

What's in a Name?

A minor semantic problem that we face at the moment is the plethora of names applied to this photographic process: i.e., Kirlian photography, corona discharge photography, high-voltage photography, radiation field photography, and photopsychography, to name a few. The most popular modern name is Kirlian photography, defined as: photography which uses a pulsed, high-voltage and high-frequency electric field and two electrodes between which the object to be photographed and an unexposed film plate are placed. No optics or external light source are involved. In practice, such photographs can be taken using D.C. pulses and low-frequency pulses as well as high-frequency pulses. The single factor that is necessary for the streamer mechanism of light generation to work is the requirement of a large applied electric field (∿ 1 million volts/ centimeter). In principle, one might imagine this to be achievable at extremely small electrode spacings and thus small applied voltages. In practice, however, it is not feasible to deal with electrode spacings smaller than about 0.001 centimeters and, more generally, about 0.01 centimeters or larger spacings are used. Thus, in all practical cases, one deals with large applied voltages (greater than 1000 volts). We suggest that "high-voltage photography" be used as the generic name for the entire family of such photographic processes with the name, Kirlian photography, recognized as the prime initial motivational force in the field.

Can We Separate Fact from Artifact?

The Soviets found that it was possible to detect the electrically generated light via microscopes and cathode ray tubes and to monitor flares or bursts of light emitted from points on the living system or object.[2] From the color and the intensity of the flares, they stated that it was possible to deduce relevant facts concerning the physical, emotional and mental condition of a human subject. They report that the technique has found meaningful use in agriculture, biology, medicine, psychology and engineering.

Although the Soviet work observes the images in the visible portion of the electromagnetic (E.M.) spectrum, some English work[2] found images only in the short wavelength U.V. portion of the E.M. spectrum. Using short single pulses of D.C. energy, they found that the energy shapes appearing in their pictures depended markedly on the electrical polarity of the electrode against which they placed their photographic plate.[2]

American work by Thelma Moss at UCLA[3,9] has utilized the simple technique of

(1) placing a sheet of film face up on a single large electrode,

(2) placing the finger pad (or leaf) directly in contact with the film,

(3) making contact to the body with the second electrode, and

(4) applying a controlled duration pulse to the electrodes (all in a darkened room).

Her basic pulse generator is a low-frequency device yielding multiple frequencies in the one to ten kHz range. She has studied the effects of drugs and alcohol on the energy emission from finger pads and has shown some remarkable color effects (white, blue, red, orange, yellow-green) and energy intensity effects.[11] She has also studied effects associated with damaging leaves of plants and the changes associated with their treatment by a healer (laying on of hands). In addition, she has investigated changes in human energy conditions associated with specific acupuncture treatments. In these experiments, no precautions were taken to clean the patient's fingers in a standard cleaning solution nor was there any attempt made to control the pressure applied by the subject's finger pad to the film.

Several other American groups are doing very useful work in this area, but we wish to comment on only one other.[11] These investigators have been using a technique similar to that of Moss and have been studying the manifested energy changes on Kirlian photographs both before and after treatment of a group of schizophrenics and a group of alcoholics. They have observed that, before treatment, both of these groups show a marked spatial fragmentation or annihilation of large portions of the normal emission from the finger pad as illustrated in Figure 9. In addition, the pattern of emission from the contact portion of the finger pad appears quite chaotic. As a result of successful treatment, as indicated by conventional psychiatric criteria, one observes

(a) the filling in of the emission pattern around the finger pad,

(b) an enhancement of manifested energy intensity, and

(c) a more orderly and coherent fingerprint pattern on the contact portion of the photographs.

They have also noted marked pattern changes associated with respiratory infections. Once again, no finger pad cleaning or pressure control procedures were instituted. In addition, the pulse length used in this study was four to eight seconds.

From the Soviet work with transparent electrodes and microscopes,[2] we must deduce that the light generation mechanism we have discussed is operative. However, from their description of visual observations of the finger pad and from the color observations found with different parts of the body, it seems reasonable to deduce that varying skin surface chemistry is in large part responsible. Of course, information patterns would also be present in the electron stream and could be made manifest directly by the use of phosphor screens. The Soviets use this method of display as well.

The color observations of the English work[2] may be explained since they used only a single short D.C. pulse. In this case, the light intensity would be low and would be largely ultraviolet in content--so that no imprint would appear on a normal visible light film. The electrode polarity effect illustrated in Figure 7 accounts for the differences observed with the photographic plates adjacent to a particular electrode. The actual shapes observed cannot be accounted for at this time except to say that statistical time lag effects[4] and other transient phenomena would influence these short-pulse studies.

In the American work just discussed, the skin pressure and skin chemistry variables may be clues to a portion of the explanation of these results.

If one does not control the finger pressure, then we have streamer discharge between finger pad and film from several possible contours of finger pad leading to the type of results illustrated in Figure 10 just from geometry changes. In addition, the altered pressure will lead to altered blood flow rate through the capillaries of that portion of the finger which changes the local dielectric constant. This should also influence the results. The lack of control of skin chemistry is perhaps an even more severe handicap. Long discharge exposures would tend to produce results very dependent on this chemistry. Anyone attempting to take movies of the discharge from living systems using a transparent electrode will find that the chemical deposits of the electrode, as perturbed by the wandering streamer spots, will dominate the generated light pattern.

In spite of the inadequate experimental techniques, there appears to be some meaningful information contained in these photographs. Although we have been able to explain all the colors observed, we have not yet been able to devise an experiment that unambiguously relates the film buckling or film flutter to physiological changes in the subject. It is too easy to put it all down to poor experimental techniques, and it is extremely difficult to prove the opposite. In one recent experiment, we studied a subject's finger pad while he changed his mental state. He changed state every two minutes, and we took a high-voltage picture with him consciously trying to maintain constant finger pressure on a transparent electrode. The sequence was

(a) normal,

(b) State 1,

(c) State 2

(d) State 3,

(e) rest, and repeat sequence again and again.

The results from our control subject are illustrated in Figure 11 which indicates that, indeed, the change in mental state manifests as a change in emission pattern. Since the rest state result corresponds more closely to the normal state result than that of either States 1, 2, or 3, and since two minutes does not seem like a long enough time for skin surface chemical changes to have occurred, we can deduce that other physiological effects are important here and that we are monitoring a real internal state change. In general, we might expect a reaction process of the following sort to be operative.

mind state = energy state = chemical state

and that, although one may be able to quickly alter one's mind state, the energy state population cannot be changed so quickly and the chemical state population has an even longer relaxation time. Thus, because of the short time between repeat sequences of the mental state change experiment, one might expect to find delayed effects and hysteresis effects in the results. Such effects were indeed noted, and the experiment is being redesigned. We have mentioned it here only to give some credence to the proposition that once the poor experimental techniques have been cleaned up, we will indeed still have something interesting to work with.

Where Do We Go from Here?

The high-voltage photography technique utilizes a very complex process which will require very sophisticated instrumentation for its control and for its effective utilization as a life-energy monitoring system. Once sufficient work has been done with the system, it should be possible to

(a) develop an early warning system of growing pathology in living systems,

(b) develop a reliable monitoring system for detecting the physical, emotional and mental conditions of human beings,

(c) develop systems for determining the peak condition of participants in a critical team activity,

(d) develop a fatigue level device useful for industrial operations,

(e) develop what could be called a "thermometer" for psychiatrists who are sorely in need of an objective standard, and

(f) develop monitoring devices that reliably register cause-effect relationships associated with non-physical energies, etc.

We must develop high-voltage photography devices that control and vary applied voltage, pulse duration, pulse repetition rate, radio frequency under the pulse, electrode spacing, and gas chemistry. In addition, one will need to independently monitor the discharge current, skin chemistry, capillary blood flow, etc. In this way, we will have developed a reliable and useful life-energy monitoring device that should be extremely useful to both medicine and parapsychology.

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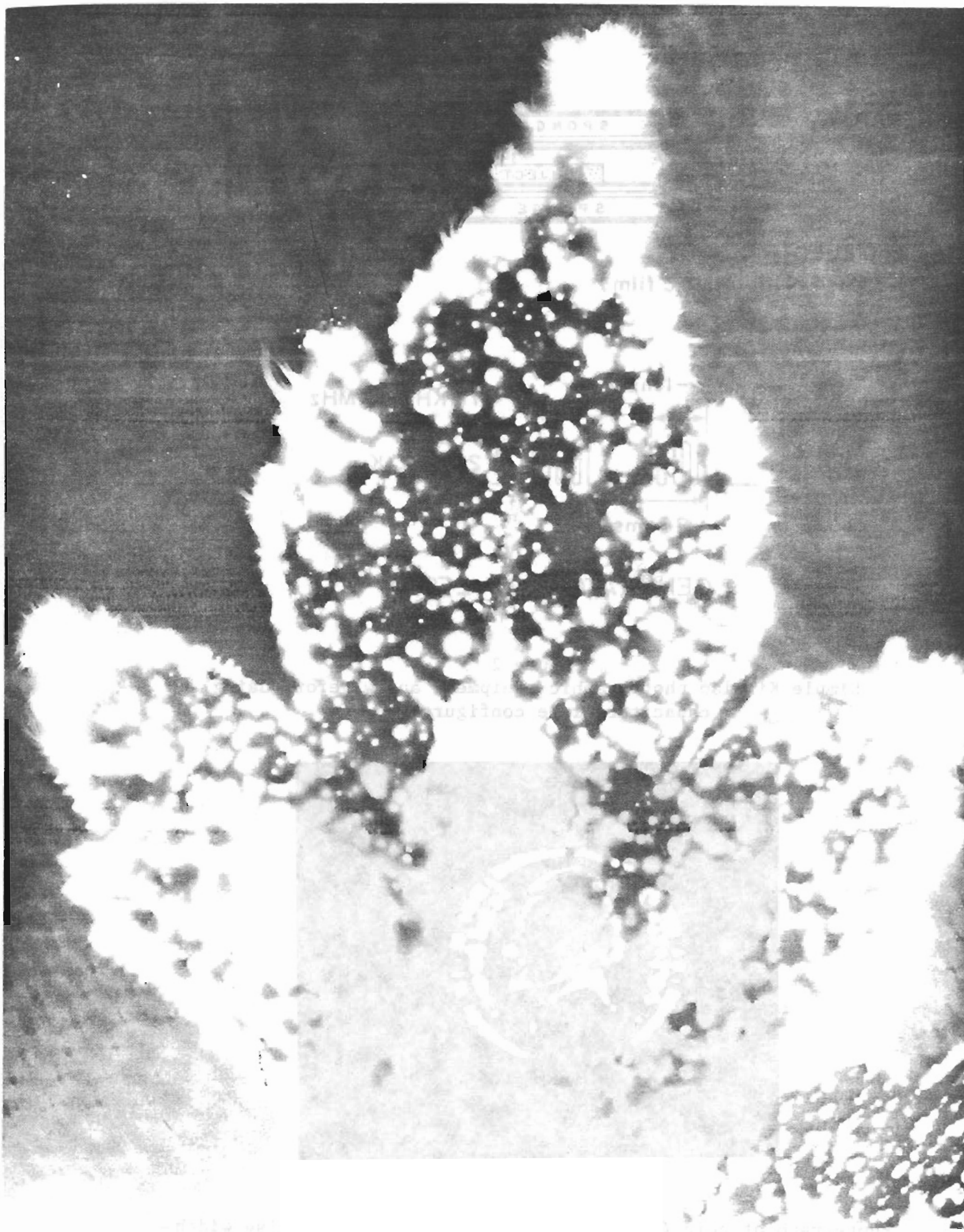


Figure 1

Kirlian photograph of leaf (Courtesy of Thelma Moss)

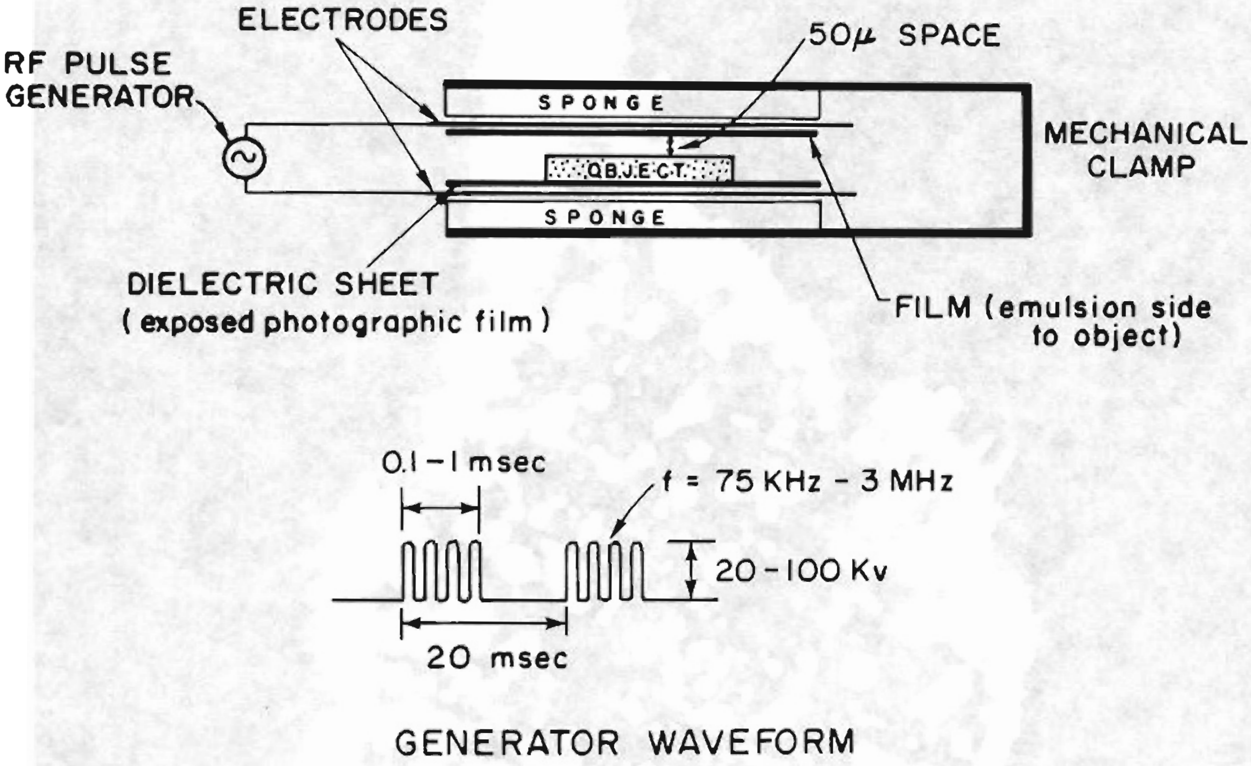


Figure 2
Simple Kirlian photographic equipment and waveform using capacitor plate configuration.

Figure 3 (a)
Photograph of coin (U.S. nickel); multiple pulses, pulse width–100μ sec, rep. rate = 20HZ, duration ∿ 2 sec. (2X)

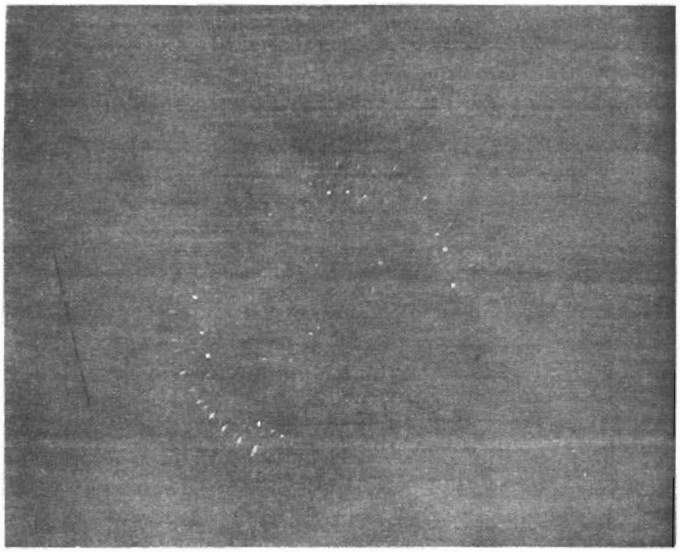


Figure 3 (b)
Photograph of coin (U.S. nickel); single pulse, pulse width +
100μ sec, rep. rate = 1HZ (2X)

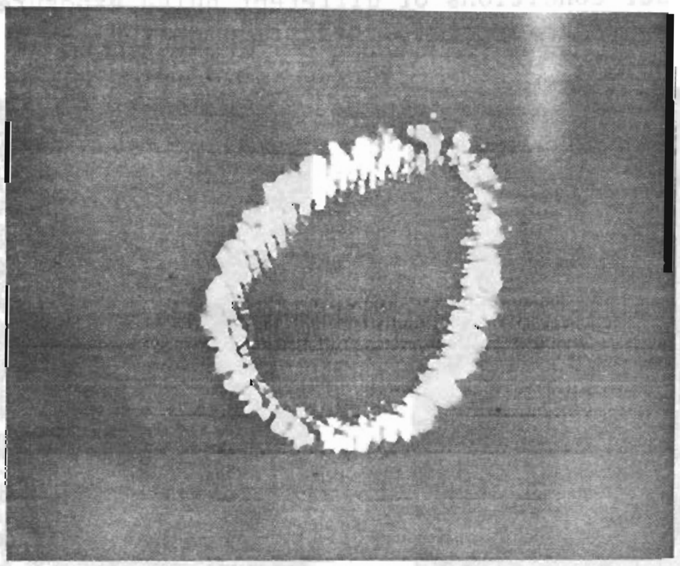


Figure 3 (c)
Photograph of fingertip; multiple pulses, pulse width = 100μ sec
rep. rate = 20HZ, duration ∿ 2 sec. (4X)

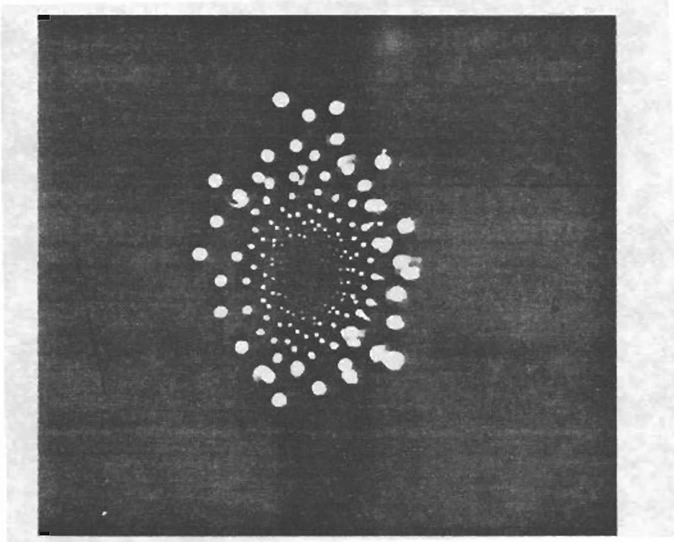
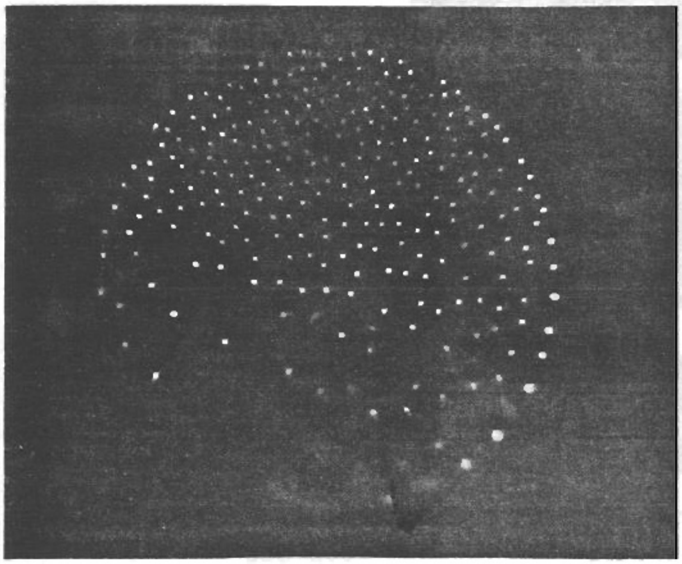
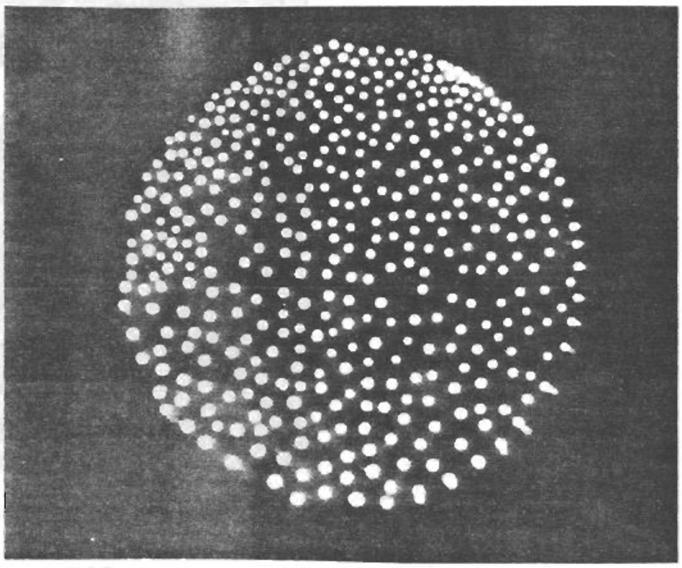


Figure 3 (d)
Photograph of fingertip; single pulse,
pulse width = 100μ sec, rep. rate = 1HZ. (3X)

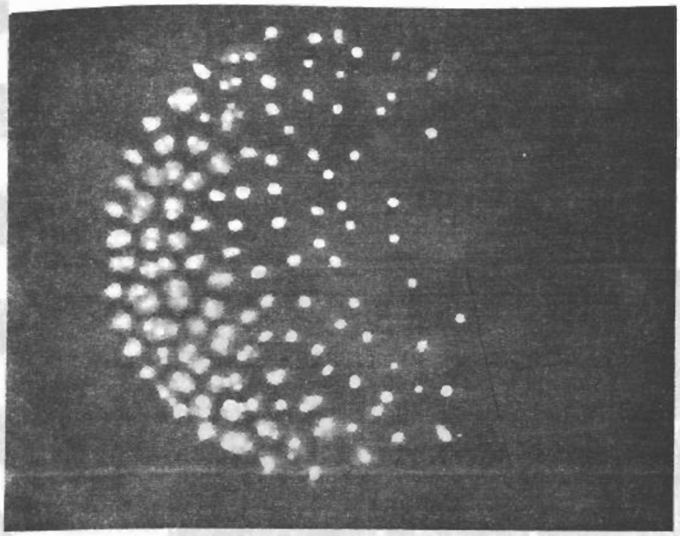
Figured 4 (a) - (f)
Photographs of single pulse discharge between flat, polished brass electrodes under conditions of different pulse exposure, electrode spacing, and orientation. (4X)



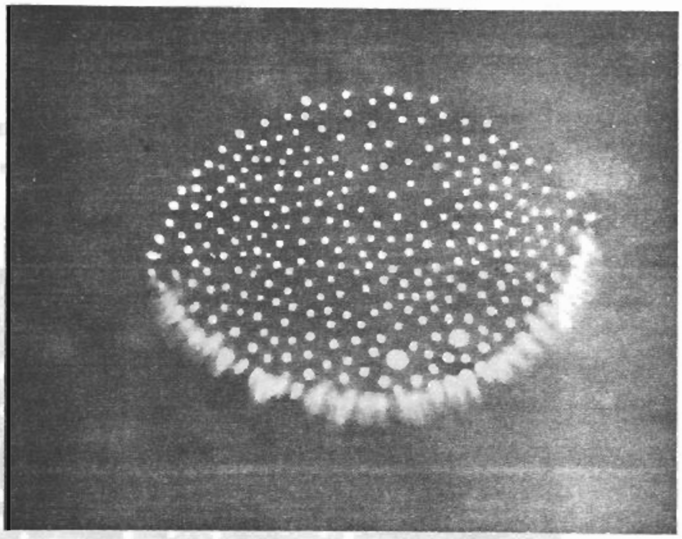
(a) Pulse width - 100μ sec.



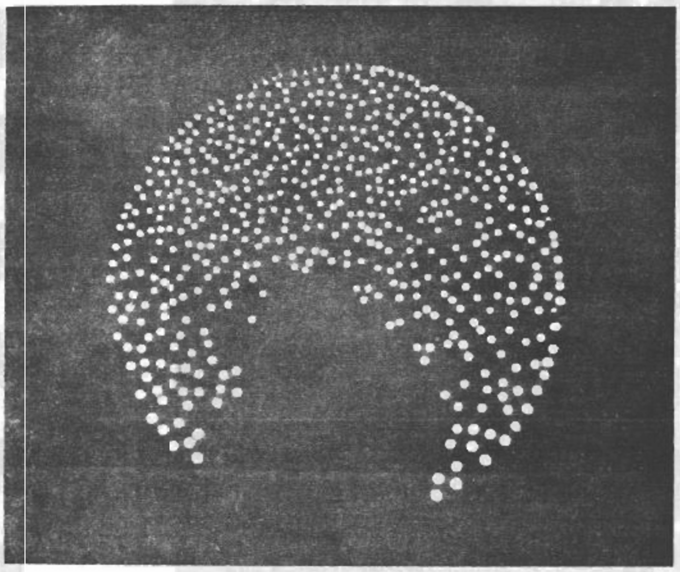
(b) Pulse width - 500μ sec.



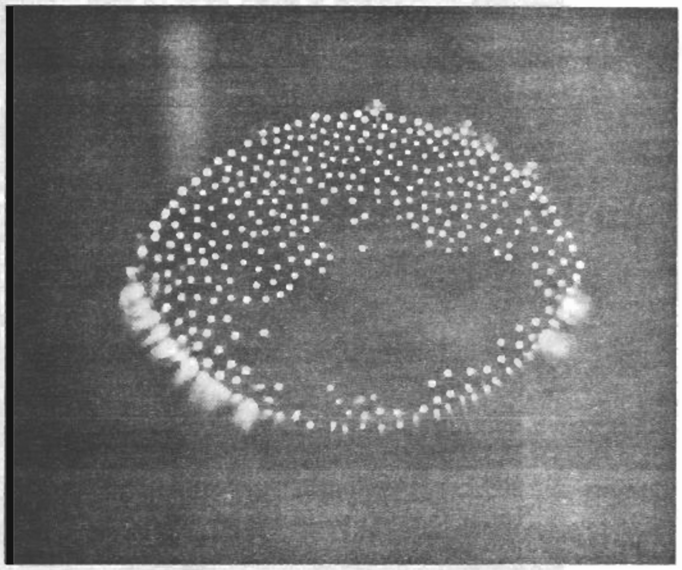
(c) Pulse width = 500μ sec; non-parallel d, slight increase in discharge spacing d.



(d) Pulse width = 500μ sec; electrode areas non-concentric.



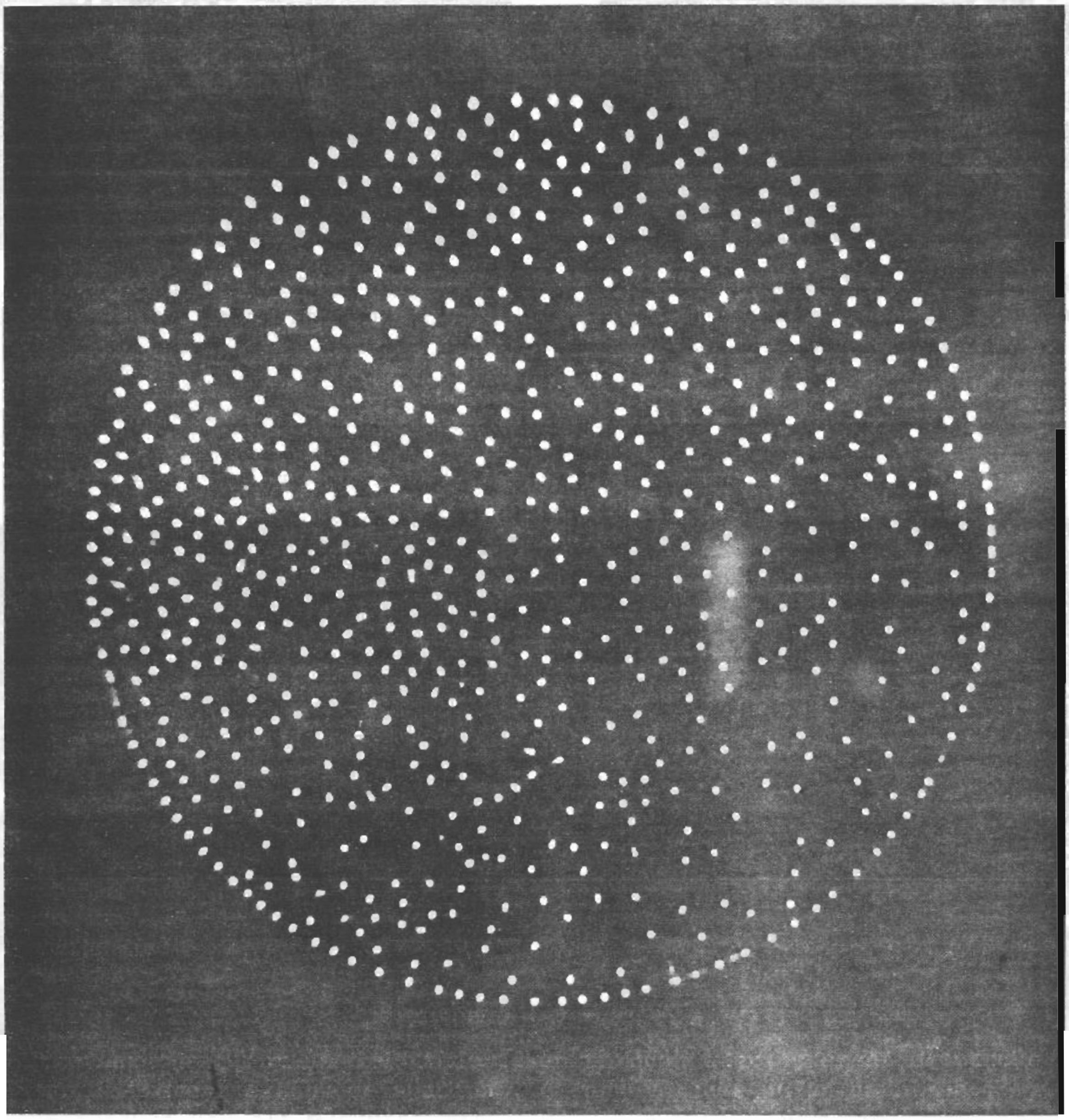
(e) Pulse width = 500μ sec; local film buckling.



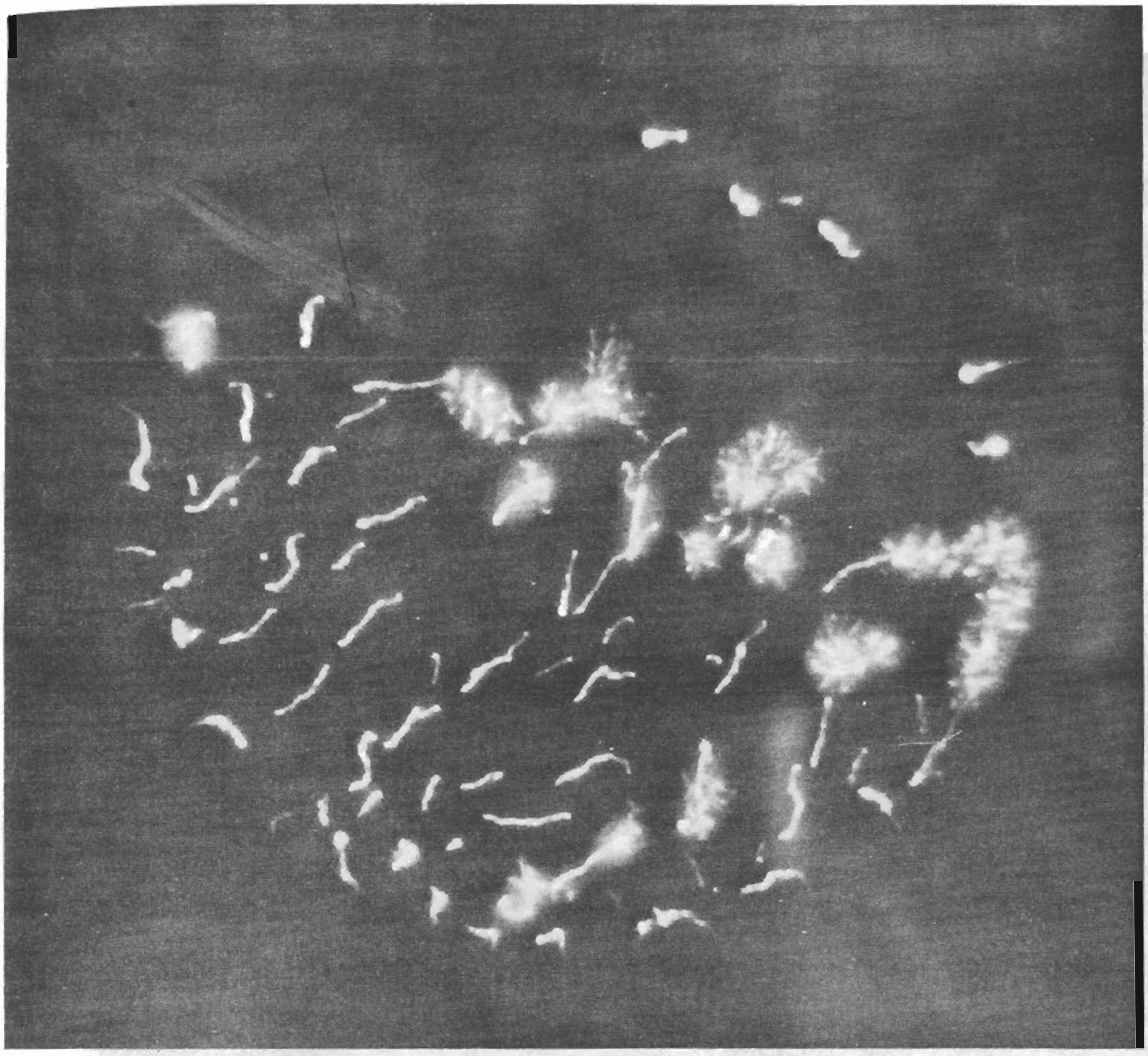
(f) Pulse width = 500μ sec; local film buckling for non-concentric areas.

Figures 5 (a) - (c)

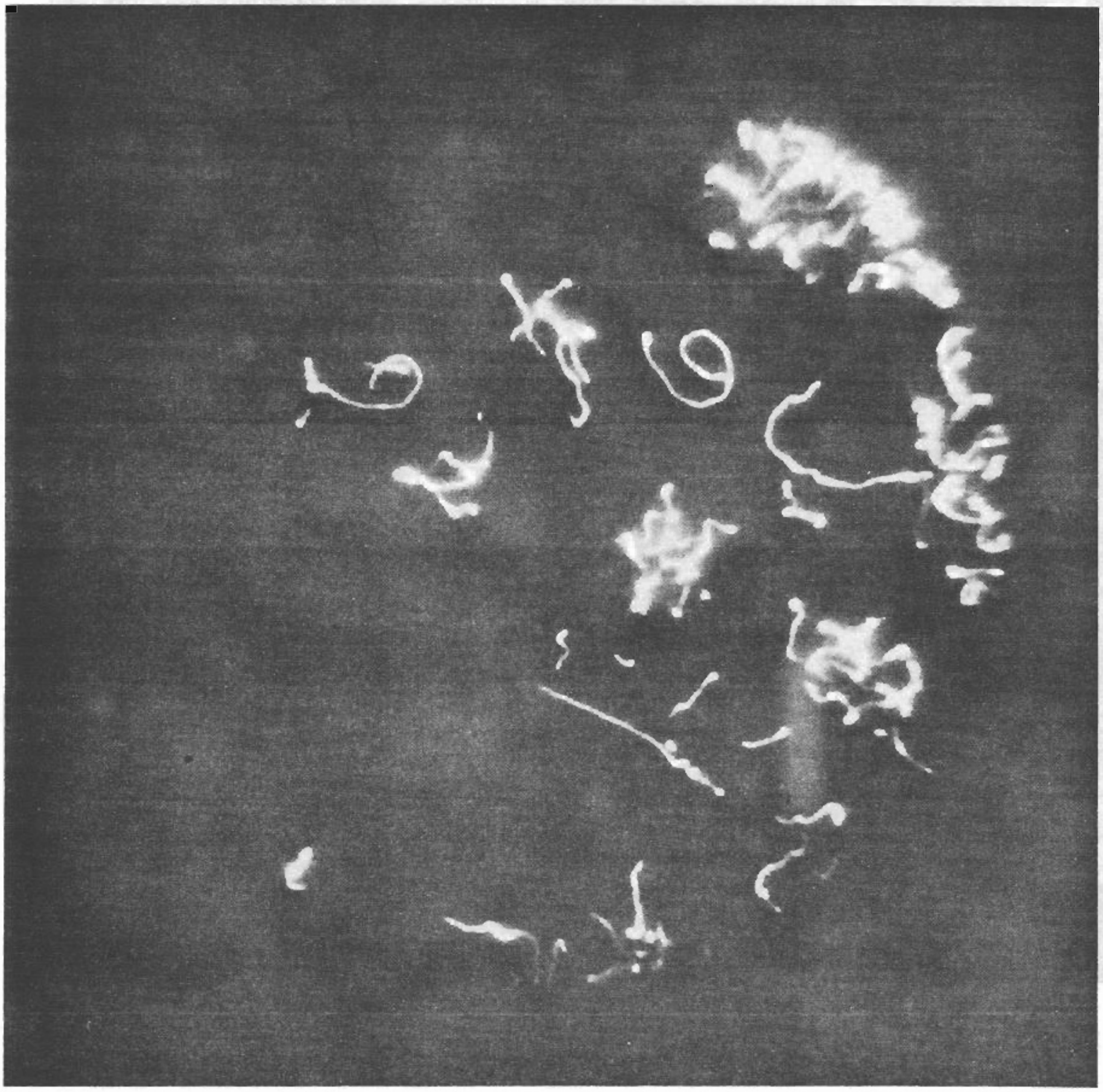
Photographs of brass electrode taken through a transparent electrode for different electrode spacings, d, and voltage pulse duration. τ.



(a) d = 0.2 mm, τ = 8 millisecs



(b) d = 0.6 mm, τ = 4 millisecs



(c) d = 1.0 mm, τ = 4 millisecs.

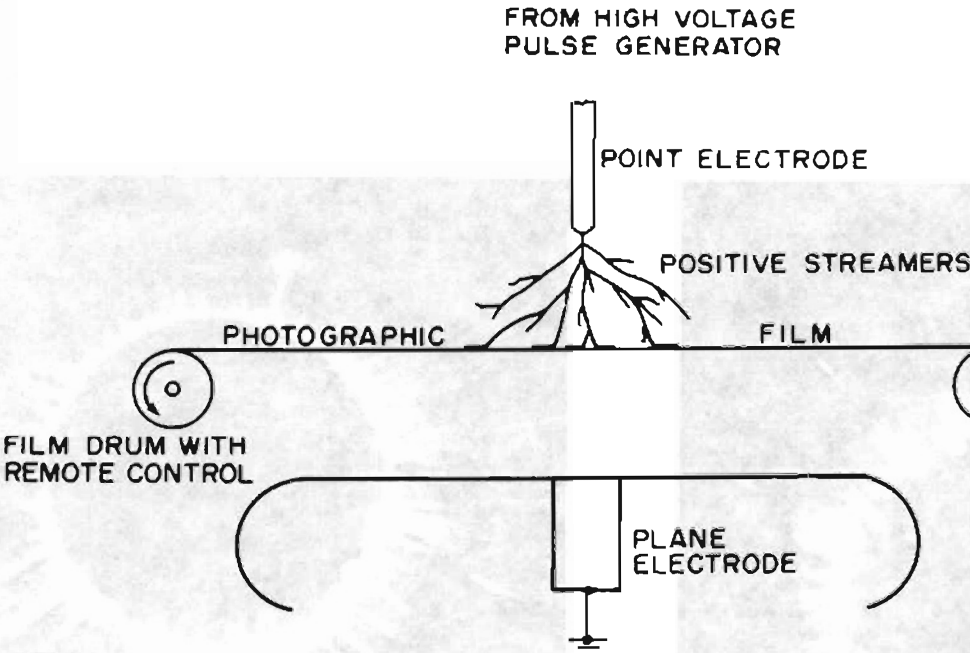


Figure 6
Experimental arrangement for studying streamer development photographically.

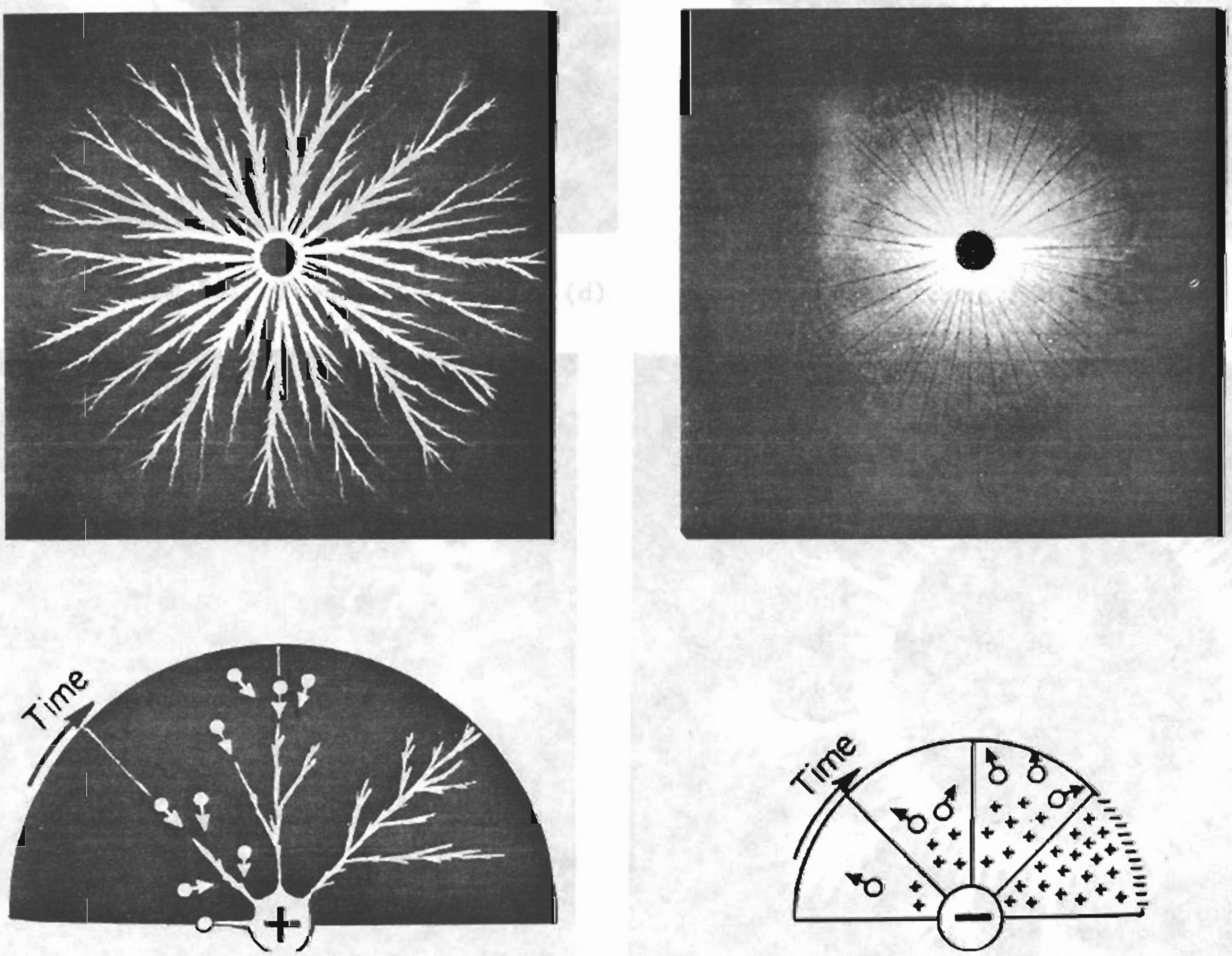
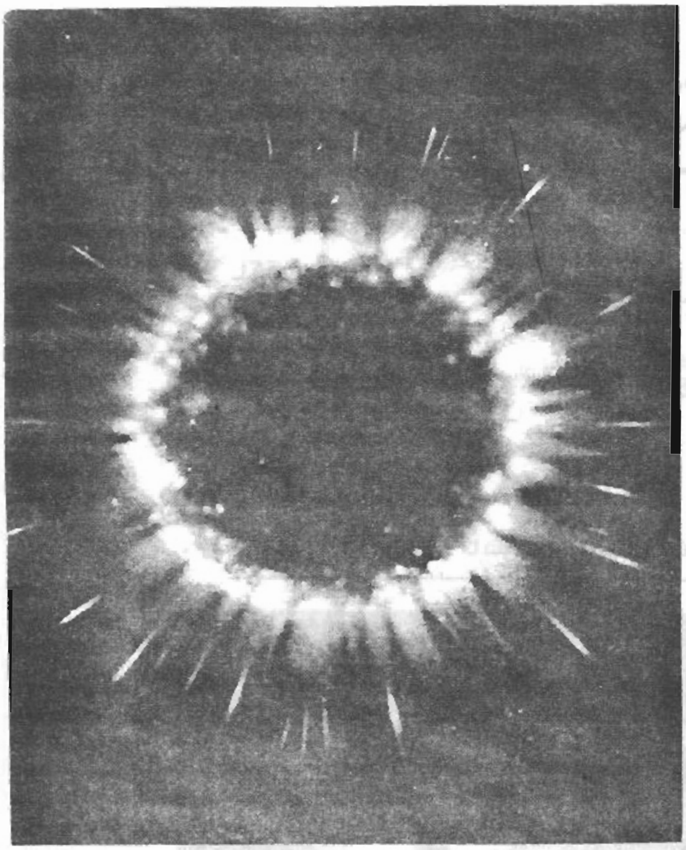
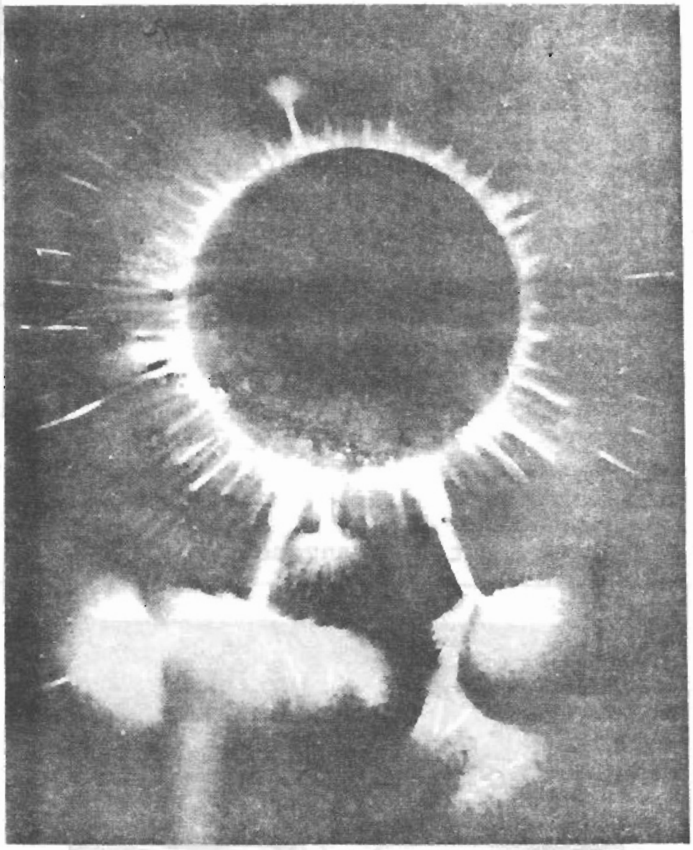


Figure 7
Positive and negative Lichtenberg figures (positive: 1 atm, 10 kV, point-ring electrode arrangement; negative: 200 mm, 3 kV, point-plate electrode arrangement).
(Courtesy of A. von Hippel)

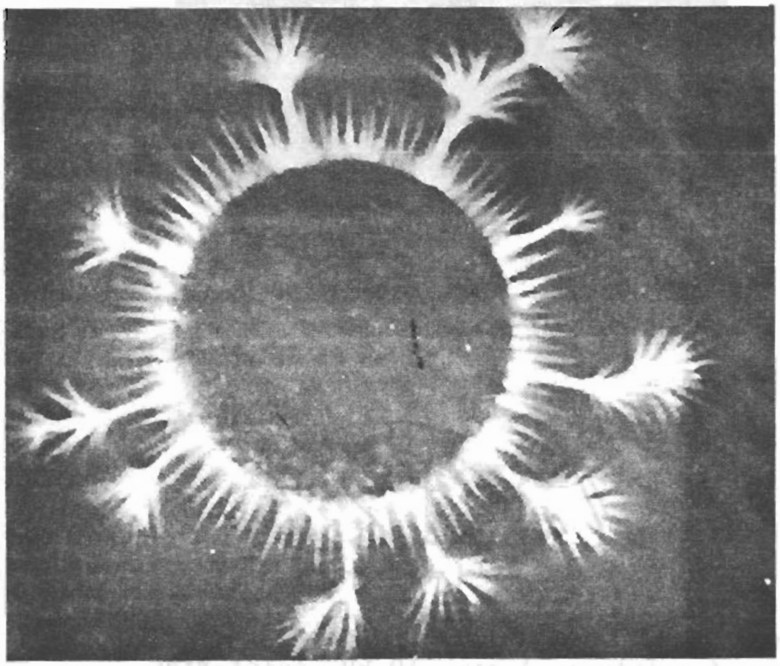
Figure 8
The Influence of CCl_4 vapor on size and structure of the primary figures.
(Courtesy of A. von Hippel)



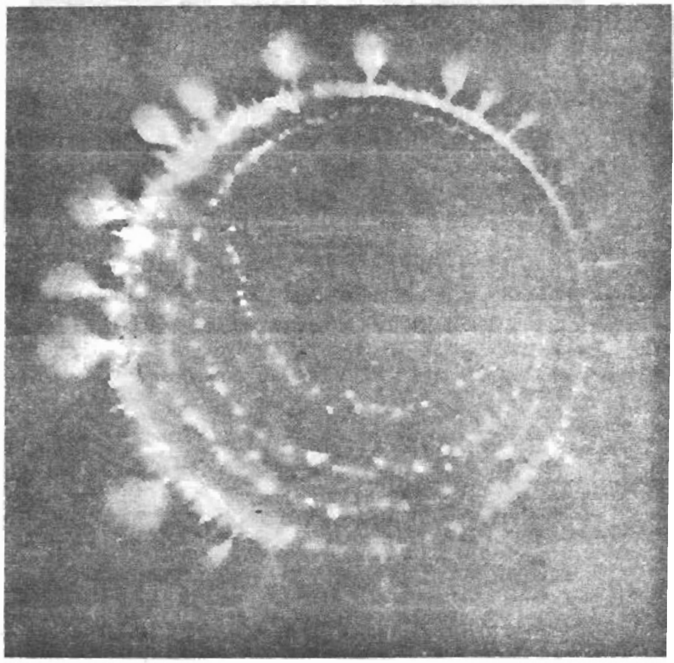
(a) Positive figure in 1 atm. N_2 + sat pressure CCl_4, 30 kV.



(b) Negative figure in 227 mm N_2 + sat pressure CCl_4, 3 kV



(c) Positive primary figure and sparks in Freon (410 mm CCl_2F_2, 3 kV).



(d) Electronic eruptions (7 atm. air + saturation pressure CCl_4, 20 kV).

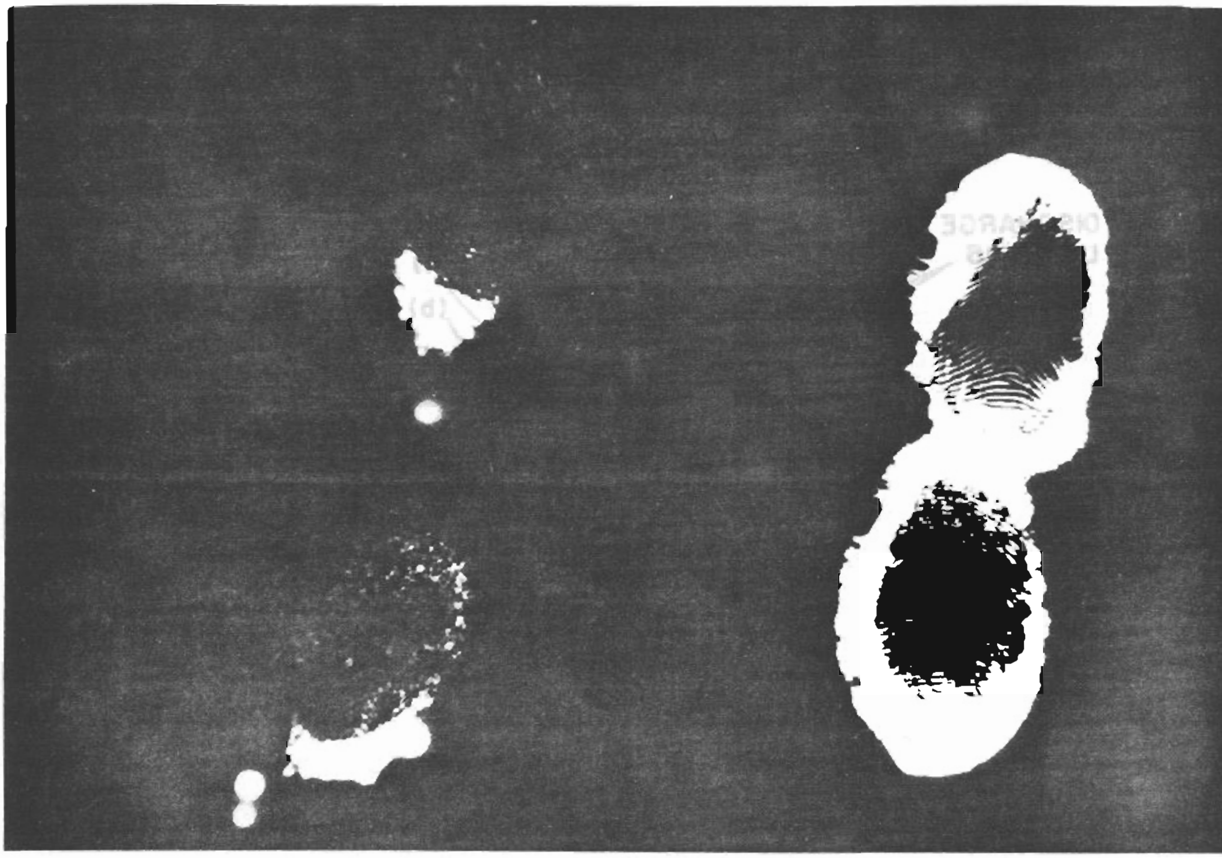


Figure 9

(left)

Discharge from finger pad of schizophrenic patient during a psychotic episode.

(right)

Discharge from same patient six days later after phenothiazine therapy.

(Courtesy of Dr. David Sheinkin and Dr. Michael Schachter)

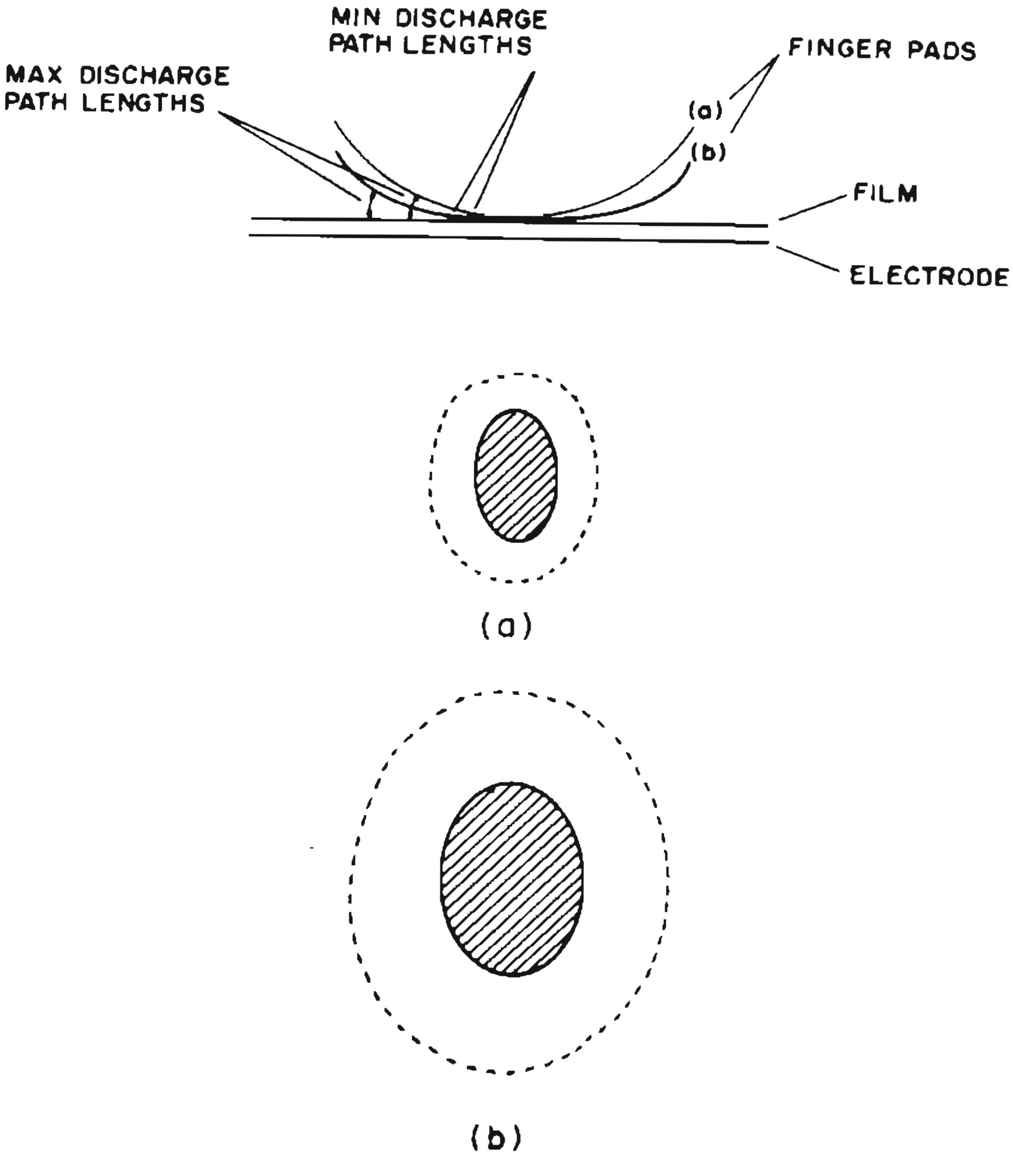
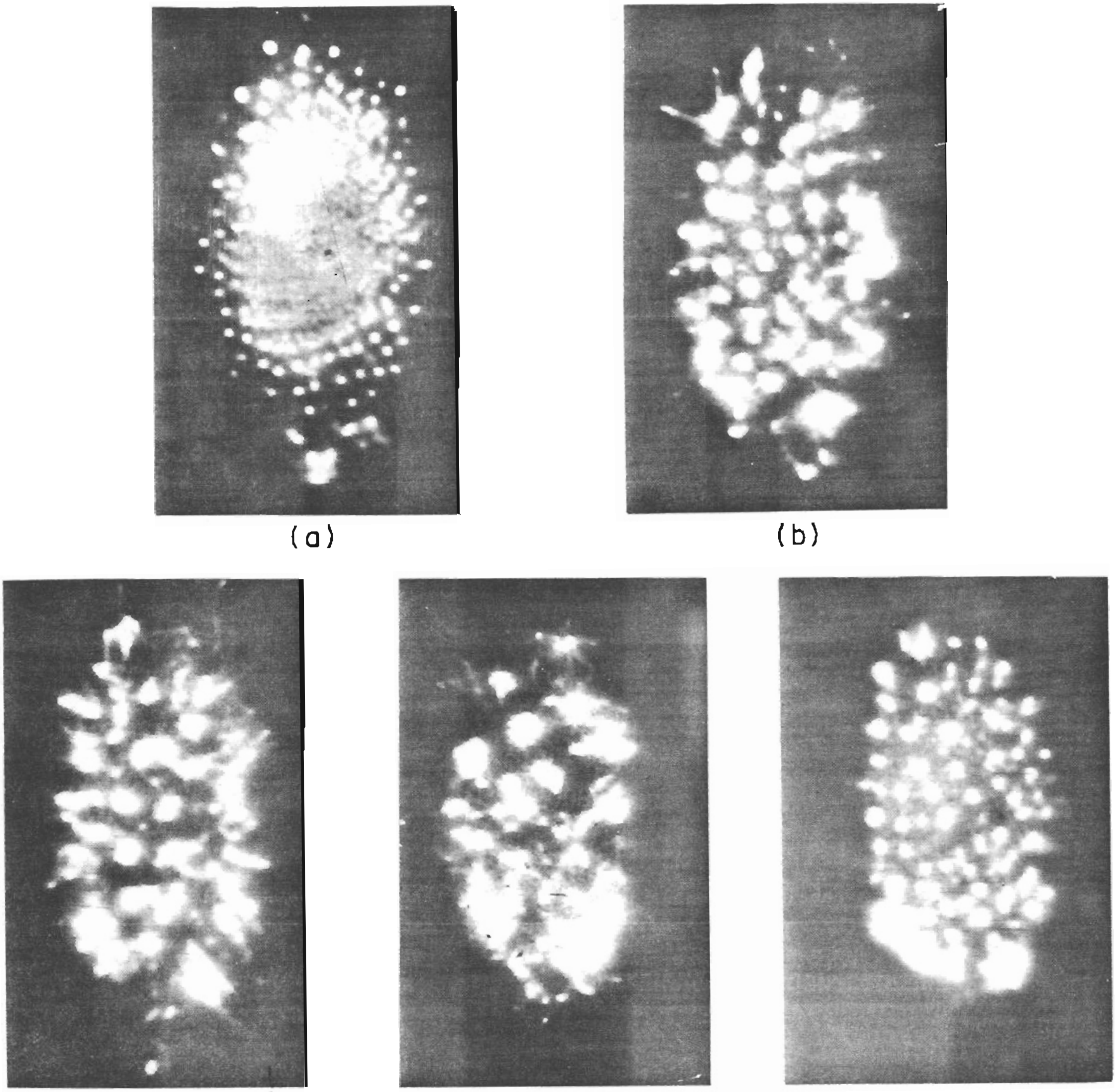


Figure 10

Schematic illustration of finger pad distortion (b) due to pressing on film compared to undistorted finger pad (a). This leads to change in discharge zone size.

NORMAL STATE

(IN LIVER)
INTERNALIZED CONSCIOUSNESS



(a)

(b)

(c)

EXTERNALIZED
CONSCIOUSNESS
(IN ANOTHER CITY)

(d)

EXTERNALIZED
CONSCIOUSNESS
(ON MOON)

(e)

REST STATE

Figure 11

Finger pad photographs (superposition of 5 to 100 microsec pulses) associated with changes in the mental state of the subject. (Mag. = 3X)