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# Kirlian Photography: Potential for use in diagnosis

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Plant leaves and salamanders were photographed employing light from high voltage discharges. The photographs were influenced by the moisture and geometry of the object, but not by its cellular activity. Possible diagnostic use appears limited to cases where the presence of moisture is of interest.

Kirlian and Kirlian (1963) have described a form of photography involving the application of a high voltage across an air gap capacitor whose plates are covered with dielectrics. Such an arrangement produces a volume luminous phenomenon (VLP) in the gap, which is capable of exposing a photographic emulsion placed therein. Objects placed on the emulsion may be imaged by virtue of the VLP. The Kirlians found different classes of images, depending on the object being photographed. Metallic objects gave structureless images, as did homogeneous dielectric objects. Inhomogeneous dielectric objects however, such as living objects, gave more complex images composed of variations of color and intensity. They found that changes in plant leaves such as disease, aging, and dehydration, could be visualized by means of the high voltage photography, presumably because of changes in the electrical properties of the object which accompany the biological change.

The Kirlians originated the technique of grounding the object being photographed, thereby creating an asymetric electrode configuration, and constructed devices which permitted various parts of the human body to be photographed. They reported variations in the shape, size, and color distribution of the image, depending on the biological state of the subject (e.g., fear or illness). They concluded that high voltage (Kirlian) photography merited serious study for its possible value in the early detection of disease.

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The possibility that Kirlian photography has diagnostic or prognostic value has caused considerable interest, and has resulted in photographs of leaves and fingertips, showing varied color and shape, and showing the characteristic flairing in the images, known as the aura (Tiller, 1974; Anon. 1973). The aura has been described as either a corona effect, or the result of emanations of particles from the object (Boyers and Tiller, 1973; Aaronson, 1974). Reports have described the effect of drugs, alcohol, and mental illness on the human aura (Tiller, 1974; Anon. 1973; Aaronson, 1974; Moss and Johnson. 1974), however no acceptably controlled studies have been reported, and the biological significance of Kirlian photography, if any, remains in considerable doubt.

We report here the results of a study of Kirlian photography employing plant leaves, and salamanders. Our object was to determine whether any evidence could he found to support the idea that the technique has diagnostic value.

## METHODS

The Kirlian photographic apparatus is shown in Figure 1. The object and the photographic paper were placed on the bottom dielectric of a capacitor whose air gap was preset by means of removable spacers. The magnitude of the applied voltage (which roughly corresponds to shutter opening in ordinary

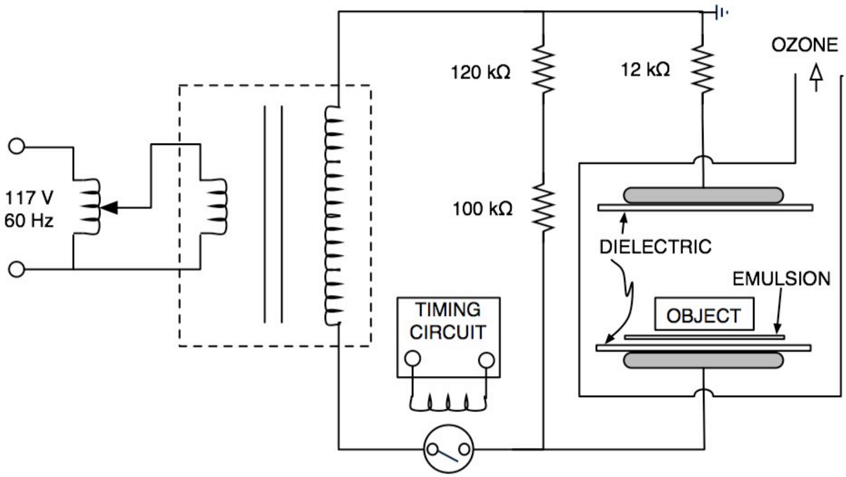
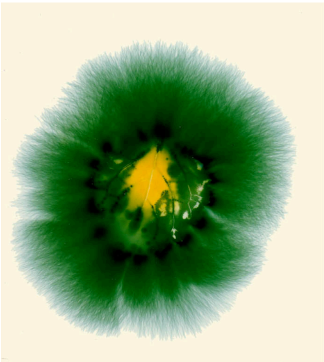
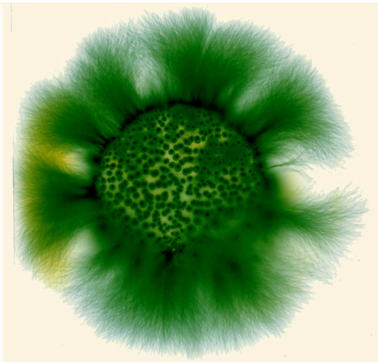



FIGURE 1 KIRLIAN PHOTOGRAPHY APPARATUS. Maximum output of iron-core transformer, 21 kV. Timing circuit range 0.1-99.9 seconds. Capacitor plates, 10.1 X 12.7 cm. Dielectric thickness, 1.5 mm. Total plate current at 0.64 mm gap, and 7.5 kV, 1.7 ma with gap empty, 0.8 ma with photographic paper and leaf in place. Plate assembly shown in exploded view for purposes of clarity.

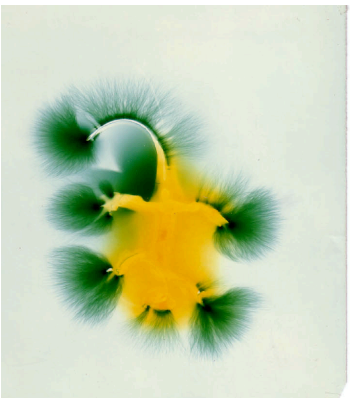
photography) was controlled by means of an adjustable autotransformer, and the duration of the applied voltage (exposure time) was controlled by means of a timing circuit which activated a vacuum relay.

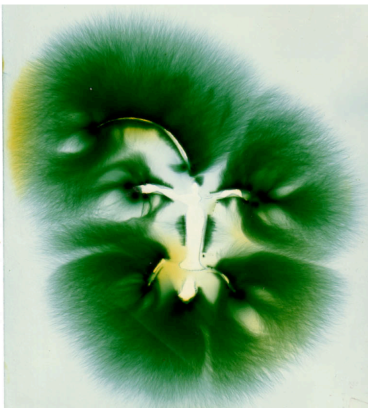
Leaves of Swedish ivy, Begonia and Episcia were studied. To produce intimate contact between the leaves and the photographic paper, the thickness of the leaf plus that of the paper was 0.05-0.10 mm greater than the spacer height, which was 0.64 mm unless noted otherwise. In some cases the top metal plate (but not the top dielectric) was replaced with a wire (ground wire) connected between the object and the current measuring resistor.

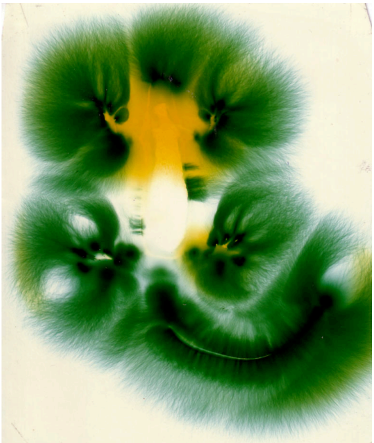




Salamanders (Triturus viridescens) were photographed under anesthesia (Tricaine Methanesulphonate), and were rephotographed after sacrifice by pithing. Other salamanders were photographed following transection of the spinal cord, and were rephotographed after sacrifice. A third group was photographed under anesthesia following foreleg amputation, and was rephotographed daily for three days thereafter (under anesthesia). In all cases, a gap of 8 mm was employed.







Photographic paper (Kodak Ektacolor 37 RC) was used throughout the study. The paper was exposed in the air gap of the capacitor, and then processed in the standard manner, resulting in a color negative of the original object. No further photographic steps were performed.

## RESULTS AND DISCUSSION

The application of voltage to the plate assembly shown in Figure 1 yielded a multitude of individual discharge channels across the air gap, giving rise to a VLP. At an air gap of 0.64 mm, the threshold of the VLP was about 375() volts. We calculated that the electric field in the air gap at threshold was about 2.5 x lO volts/m, which is sufficient to cause dielectric breakdown of air. The presence of objects in the air gap did not materially alter the electrical characteristics of the plate assembly.

Typical photographs of intact leaves are shown in Figure 2a and h. Surrounding the image of the leaf is a region of apparent activity referred to as the aura. Within the image can he seen structure corresponding to the topological features of the leaf. Visually, the air gap discharge was blue-white, and resulted primarily in shades of green on the photographic paper, with some yellow and orange. The aura surrounding the intact leaf did not change in size when the leaf was pierced with a needle or cut with a scalpel, if the damaged areas did not include the leaf perimeter. The auras of freshly cut edges however, were larger than those of uncut edges (Figure 2c). This effect was examined in detail in Swedish ivy, and was observed in every one of more than 100 cases. When cut Swedish ivy leaves were photographed in 1.9 mm air gaps, no auras were seen up to 21 kV.

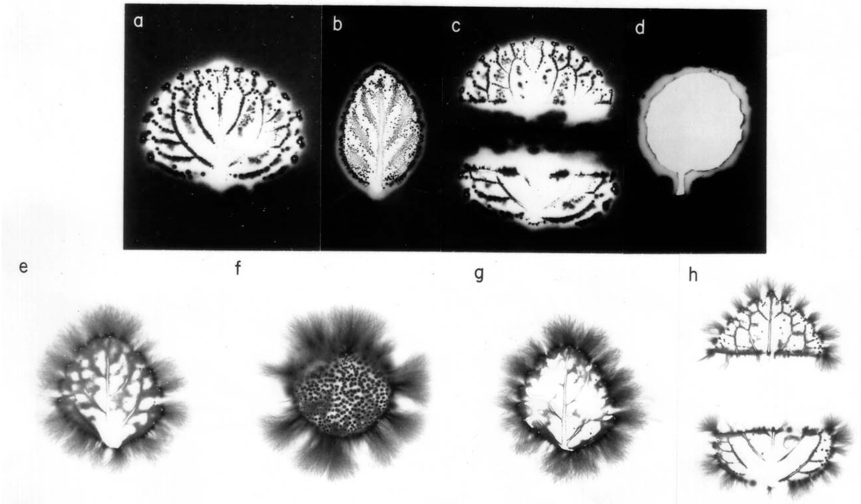



FIGURE 2 (a) Fresh intact Swedish ivy (SI). 7.5-1 (applied kilovolts-exposure time in seconds). (h) fresh intact Episcia, 7.5-I. (c) fresh cut SI, 7.5-1 (d) cardboard immersed in water. 7.5-1 (e) fresh intact SI, 7.5-1 (f) fresh intact Begonia, 11.6-I, (g) fixed intact SI. 7.5-1, (h) fresh cut SI, 4.2-I.

Auras were generally not reproducible in shape, even upon immediately successive photographs of the same leaf section. On the other hand, the structure within the image was routinely reproducible. The size of the auras decreased with time. In Swedish ivy, the aura at a cut edge began to decrease after about 30 minutes, and disappeared about seven hours after sectioning the leaf. Throughout the range of exposure times employed (1-300 seconds), the photographic emulsion was not exposed in the absence of the VLP.

A central question in the evaluation of Kirlian photography is whether the aura contains diagnostic information. In the case of the leaf between parallel plates, the question is tantamount to whether the increase in the aura at the cut edge is due to some kind of biological activity at the cut edge occasioned by the trauma. To examine this claim, leaves of each species were fixed in formalin for 1 8 hours to stop cell activity. After removal from the fixative, they were air-dried for 30 minutes, sectioned, and photographed. We found increased auras at the cut edges, and the photographs were indistinguishable from those of fresh leaves.

At the cut edge of a leaf, fluid appears from the severed veins, ruptured cells, and from the interstitial spaces. The formalin treated leaves might also be expected to exhibit a higher rate of water loss at the cut edge. The results therefore suggested that the aura was correlated with the presence of moisture.

This was verified by photographing cardboard before and after immersion in water. An aura was seen only in the latter instance (Figure 2d). Thus, the Kirlian aura is present at an edge when moisture is present, irrespective of the presence of cells or cellular activity.

Bearing in mind that the image produced and analyzed throughout this study are photographic negatives, it can be seen that the aura is the absence of light, or more generally the reduction of light intensity in the vicinity of the object. We found that the photographic emulsion remained unexposed in the absence of the VLP, and that the latter occurred only when the dielectric breakdown of the gap was achieved. It appears therefore that the aura (absence of light) at an edge indicates that the electric field in that region is below the value for dielectric breakdown of air, the reduction being brought about by the present of moisture.

The second Kirlian photographic technique involves the removal of the top metal plate shown in Figure 1, and the substitution of a ground wire. Typical photographs of leaves produced in this manner are shown in Figure 2e and f. Surrounding the image of the leaf, and emanating from its edge, can be seen bursts of light (dark area) composed of numerous filamentous lines. The leaf exhibited a blue-white luminous phenomenon along its edge (ELP) during exposure. Green was again the dominant color registered on the photographic paper, with small amounts of yellow and blue also present. The photographic emulsion was not exposed in the absence of the ELP.

The size of the ELP decreased slowly with time. For Swedish Ivy, the ELP after 24 hours was essentially identical to that which appeared immediately after picking. The ELP at cut edges was generally smaller than that at natural edges (Figure 2h). No characteristic changes in the ELF were observed when the surface of a leaf was pierced with a needle or cut with a scapel.

Photographs of leaves fixed in formalin for 18 hours were essentially identical to those of the same leaves taken immediately after removal from the plant (Figures 2e and g). After examining about a hundred such paired photographs, it was not possible to correlate the characteristic of cellular activity (i.e. the freshly picked leaf) with the size or shape of the ELP, or with its spectral distribution.

In the parallel plate air gap, the relatively uniform electric field produced a discharge throughout the gap except around the edge of the leaf where the electric field was lower. When the leaf was grounded however, an asymetric electrode arrangement was produced, with the highest electric field occurring principally at points along the edge of the leaf (smaller electrode). The class of luminous phenomena which are thus associable with one electrode is termed corona (Loeb, 1965).

The ELP or leaf corona was independent of cellular activity, but correlated with moisture content and leaf geometry. In the former instance, leaves fixed in formalin were photographically identical to fresh leaves. In the later instance, dryer (less conductive) leaves exhibited smaller coronas, and cut edges, which do not possess the complicated geometry and hair-like projections of natural edges, exhibited smaller coronas.

It seemed worthwhile to make some observations on more complex organisms, to determine whether their Kirlian photographs exhibited characteristics different from those of leaves. Salamanders were photographed employing both methods described above. Photographs of live (anesthetized), transected (unanesthesized) and dead salamanders were essentially identical. Also foreleg amputation resulted in no characteristic luminous effect.

In summary, we found that Kirlian photographs mirror the moisture content and geometry of the object. We could find no evidence that the Kirlian aura, corona, or spectral distribution was related to the activity of either plant or animal cells. Our observations indicate that the potential of Kirlian photography as a diagnostic tool is limited to its possible development as an indicator of moisture content, or moisture distribution. The parallel plate method seems less likely to find application. With the exception of thin objects, very high voltages are required, and the resulting photographs are relatively structureless. The ground wire or corona method however, requires lower voltages, is adaptable to any organism or part thereof, and results in highly complex photographs. The precision of the method is limited by one's ability to reproducibly establish the relationship between the object and the plane of the photographic emulsion, since for a given object this relationship determines the electric field distribution and hence the resulting image.

**Acknowledgements**

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## COMMENTS ON BECKER/MARINO/HURD PAPER

### Referee's comment

V. A. Tiller does not think that 60 Hz is the appropriate frequency to be used.

### Editorial comment

The Editors feel that, although these results might be applicable to leaves and salamanders, it is not clear that they can he extrapolated to such a complex organism as man. Although the authors claim that Kirlian photographs indicate the moisture content of the organism, in agreement with Pehek et al, there is no proper justification of this given. Finally, there has been no indication of pressure control during these experiments. This should have been done.

### RESPONSE

We know of no reason why 60 Hertz would not be an appropriate frequency to use for this study. There are no reports indicating a frequency dependency for the phenomenon. The anatomical complexity of the salamander is quite equivalent to that of man. Differences between the two organisms are related more to specific tissues and functions: none of which appear to have any particular bearing upon the phenomenon in question. The pressure exerted during each experiment was that of the object under study therefore, control and experiment are identical. No external pressure was applied in any instance.

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