PARTS TO BE CONTROLLED AND MEASURED

We have ten buttons for the choice of the different parts and one button for the zero position on the main switch board of the Van de Graaff generator. When the zero button is pressed, no other one is on. The pushing of any one of the ten buttons will automatically replace the one already pressed back to its original position. The whole control system on the main switchboard consists only of 2 buttons (i.e., a control button z and a "synchronizing" button) and one ammeter—as the measurement of all the quantities is done with the same ammeter. This latter has to be calibrated for all these quantities.

Just at present, the following parts are controlled and measured as shown in Table I. All the parts of this control and measuring system in the h.v. electrode are very small and fit in very well. So far the system has given satisfactory results.

This system was designed and built under the guidance of Professor Dr. Ir. F. A. Heyn in the Electrotechnical High Voltage Laboratory. The authors wish to thank Mr. J. Bezemer for his help and useful suggestions.

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Light Shifter for Čerenkov Radiation*

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Measurements are reported of the use of luminescent materials as a light shifter for Čerenkov radiation, with the object of increasing the pulse height from Čerenkov light observed by a photomultiplier tube. By this process the directional properties of the Čerenkov light are essentially lost.

IN this investigation, we have found that some chemical compounds can act as light shifters for Čerenkov radiation; i.e., by luminescence convert some of the ultraviolet radiation into a region of wavelengths for which a photomultiplier is sensitive. With some milligrams of 2-amino-6,8-naphthalene-disulfonic acid, disodium salt dissolved per liter of distilled water as a radiator, we were able to increase the pulse height caused by Čerenkov radiation from cosmic rays (muons) by about 30% compared to that in water. It was checked that this was not due to a scintillation effect.

The apparatus we used is described essentially in Fig. 1. A Lucite tube, 5 in. i.d. and 15 in. long, was sealed off with $\frac{1}{4}$-in. thick Lucite plates cemented to both ends. The container was placed in optical contact

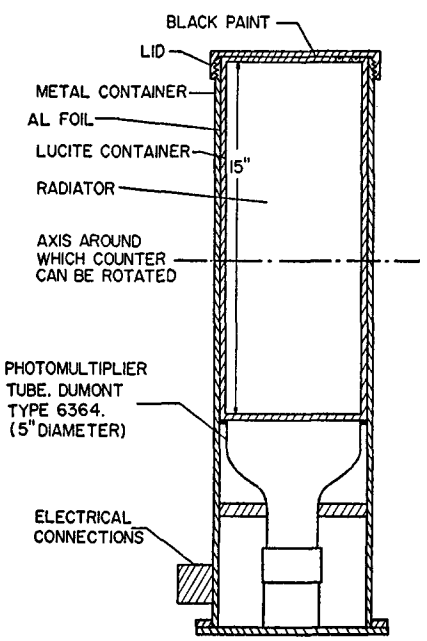

FIG. 1. View of Čerenkov counter. Counter in "normal" position.

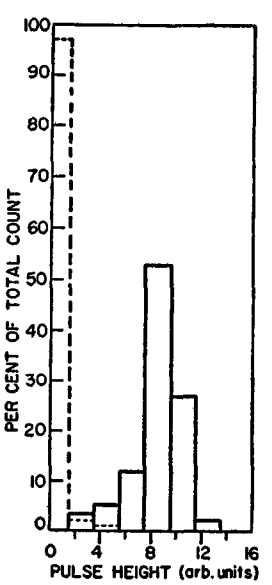

FIG. 2. Histograms of the pulse-height distribution with distilled water as radiator. Drawn histogram represents effects based on 355 pulses. Counter in "normal" position. Dotted histogram represents background effects based on 190 pulses. Counter in "down" position.

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TABLE I. Increase of pulse height in Čerenkov radiation for various compounds.

Agent (Du Pont classification)	Concentration mg/l	Increase of pulse height rel. to H_2O	Coloration of H_2O
MDD-3161	1	1.0	Milky
Representing a fluorescent whitening agent marketed by Du Pont.	10	1.0	
MDD-3162 (U.S.P. 2,700,053)	1	0.9	Yellow
N,N'-bis (2,4-dimethoxybenzoyl)-4,4'-diaminostilbene-2,2'-disulfonic acid, disodium salt	10	0.8	
MDD-3167	1	1.0	White
4,5-Diphenylimidazolone	10	1.0	
MDD-3168	1	1.0	Brown
R Salt, technical (65.6% purity) (2-Naphthol-3,6-disulfonic acid, disodium salt)	10	1.2	
MDD-3169	1	1.2	Blue
Amino G Salt, technical (94% pure) (2-Amino-6,8-naphthalenedisulfonic acid, disodium salt)	10	1.3	
Mixed Solutions			
MDD-3168+MDD-3169	0.5+0.5	1.1	
MDD-3168+MDD-3169	5.0+5.0	1.2	

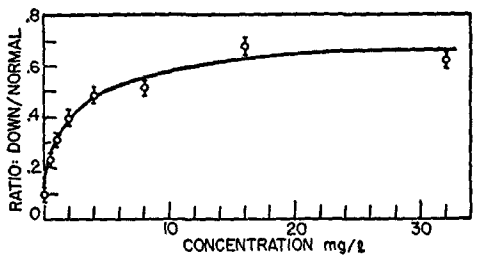

FIG. 3. Effect of luminescent material (2-amino-6,8-naphthalene-disulfonic acid, disodium salt) in radiator.

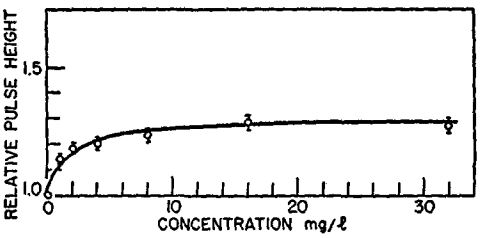

FIG. 4. Increase of pulse height with luminescent material in radiator relative to distilled water. Counter in "normal" position.

with a 5-in. diameter Du Mont photomultiplier tube (type 6364). To avoid reflection, the top lid was painted black on the outside surface. To obtain optimum reflection on the side walls, the container was wrapped with aluminum foil. It was then placed in a metal tube to provide light tightness.

Coincidence arrangements were made with scintillation counters, such that only pulses caused by single particles traveling through the scintillation counters and the entire length of the Čerenkov counter were registered. The pulses were photographed on an oscilloscope. The measurements were taken with the counter in two different positions; one with the radiator assembly above the photomultiplier, which we define as the "normal" position, and the other in the opposite direction defined as "down."

Figure 2 shows a histogram of the pulse-height distribution with the radiator filled with water. The maximum pulse height obtained with the radiator in the "down" position is less than 10% of that in the "normal" direction, which is indicated by the histogram of the background. The background pulses are probably caused by cosmic-ray particles knocking electrons out of the cathode of the photomultiplier tube.

An idea of the loss of the directional property of Čerenkov radiation by putting a luminescent material in the radiator is given in Fig. 3. It shows that the optimum ratio of the pulse height in "down" to "normal" position is about 65%. Painting the top lid with white reflective paint, instead of black, increased this ratio to 85%. As some absorption must exist with the present geometry, it is obvious that most of the directional property is lost in this system.

Figure 4 gives an indication of how the pulse is increased due to the luminescence effect. A couple of the compounds investigated gave an increase in pulse height. However, as previously mentioned, the optimum was achieved with 2-amino-6,8-naphthalene-disulfonic acid, disodium salt, and the increase in pulse height was approximately 30%.

Table I gives a summary of the results achieved with the five compounds investigated. It is observed that the only other chemical which gave an effect was 2-naphthol-3,6-disulfonic acid, disodium salt, and in this case, the optimum increase in pulse height was about 20%.

It was thought that the two successful compounds might convert light of different wavelengths, so by mixing them together, an added effect would eventually be obtained. The results in Table I indicate that this was not the case.

The directional properties of the Čerenkov light is, as previously mentioned, lost by putting a luminescent compound in the radiator. However, for pulse height analysis work with Čerenkov counters, the described effect may have some importance.

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