The Lumistat, an Aid in the Study of Chemiluminescence

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In any photographic or photometric work pertaining to chemiluminescence, it is necessary to have some means of maintaining the luminescence over a period of time. Also it is desirable to keep the intensity of the luminescence as nearly constant as possible while it is being studied.

In a recent article[1], the writer described a device which was used in maintaining luminescence for photographic purposes. The apparatus to be described in the present article is similar in principle to the one just mentioned, but carries a number of improvements which make it much more convenient and efficient. By means of this apparatus, the light may be maintained automatically and may be controlled. The name,

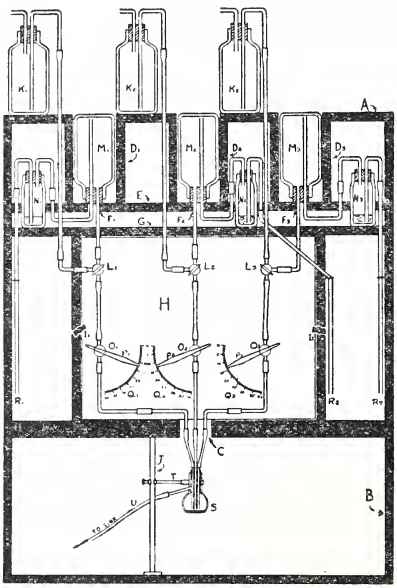

Fig. 1. Diagrammatic drawing of the Lumistat.

"Lumistat", is suggested as an appropriate one, since its purpose is "automatically to control luminescence". It is inexpensive to construct, and is so made that it can be taken apart for transportation purposes.

[1] J. Chem. Ed., 1939 **16**:292-4.

[2] Cottman, (1937), J. Chem. Ed., **14**:236-7.
Cottman, (1939), J. Chem. Ed., **16**:292-4.
Cottman, (1939), Sci. American, **160**:364-6.
Cottman, Moffett and Moffett, (1938), Proc. Indiana Acad. Sci., **47**:124-9.
Cottman, Moffett and Moffett, (1939), Proc. Indiana Acad. Sci., **48**:77-8.

The writer has found it very satisfactory in maintaining an almost constant chemiluminescence over long periods of time, using the solutions described in various preceding articles[2]. A diagramatic drawing is presented in Figure 1, for which the following explanation is given:

The framework, which is of wood, consists of an upper chamber, **A**, which is set directly above a lower chamber, **B**. **A** is 40″ x 40″ x 12″. **B** is 40″ x 24″ x 12″. A hole, **C**, in the bottom of **A**, coincides with a hole in the top of **B**. Three pockets, D_1, D_2, and D_3 are built of such a size that each will hold a five pint bottle. A shelf, **E**, 4″ wide, is built as a support for the bottles M_1, M_2, M_3. Three notches, F_1, F_2, F_3, each ½″ in width, are cut back into **E** as shown, so as to allow the tubes from the bottles to extend downward through **E**. Another shelf, **G**, 6″ wide, extends across the apparatus to support the bottles N_1, N_2, N_3. **H** is the control panel. It is a board, 24″ x 24″, which can be removed from the rest of the framework. When mounted in the apparatus, it is held in place by the turn-buttons, I_1, I_2. **B** is fitted with an iron ringstand rod, **J**.

The solutions used in the chemiluminescence reactions are made up in the large supply bottles, K_1, K_2, K_3. These are connected to the three-way stopcocks, L_1, L_2, L_3, which are mounted on the panel board, **H**. M_1, M_2, M_3 are the reservoirs which are filled by siphoning from K_1, K_2, K_3 through the three-way stopcocks, as shown. Connected to the long air tubes of M_1, M_2, M_3, are the "bubble bottles", N_1, N_2, N_3, which are partially filled with water, so as to cover the lower end of the long tube in each. O_1, O_2, O_3 are two-way stopcocks which are mounted on the control panel, **H**. Attached to the tops of these stopcocks are the wooden levers, P_1, P_2, P_3, each 6″ in length. To fit these to the stopcocks, a depression should be carved into the under side of the lever, into which depression the upper convex surface of the stopcock handle will fit. The wood and glass may then be cemented together with Apiezon wax. Extending down from the ends of the levers are steel pointers of moderate flexibility. Q_1, Q_2, Q_3 are the scales for marking the positions of the pointers. To prepare these scales, the arcs described by the pointers should be marked in pencil, then brass brads with rounded heads should be driven in along this arc very close to each other. This will make an arc having a "stop" between each two brad heads. The flexible steel pointers should be of such a length as to slide over this arc. The "stops" should be numbered as shown. These numbers are arbitrary, but will serve as a means of marking the positions of the pointers and will indicate the rate of flow of the liquids. If P_1, P_2, P_3 are each marked with a streak of phosphorescent paint, this will aid in finding them in the dark.

The "bubble bottles" N_1, N_2, N_3, are equipped with long rubber "listening tubes", R_1, R_2, R_3, which are held in place as shown, with screw-eye guides. As the solutions flow down from the reservoirs M_1, M_2, M_3, bubbles of air will be drawn through the water traps of N_1, N_2, N_3. The operator can then, in complete darkness, know with certainty whether each solution is feeding properly and how rapidly it is flowing, by simply placing the ends of the tubes R_1, R_2 and R_3 to his ears and listening to the bubbles.

The tubes from the three reservoirs all lead into the reaction chamber, S, which is a small distilling flask supported by a clamp, T. Here the liquids mix, producing chemiluminescence, which may then be photographed or otherwise studied. The used liquids escape through the overflow tube, U.

To operate the lumistat requires the following procedures:

1. K_1, K_2, K_3 are filled with the required solutions.
2. Stopcocks L_1, L_2, L_3 are turned so as to connect K_1, K_2, K_3 to M_1, M_2, M_3.
3. The rubber stoppers of N_1, N_2, N_3 are loosened so that air will be admitted at the mouths of these bottles.
4. Air is blown into K_1, K_2, K_3, which will cause the solutions to siphon into M_1, M_2, M_3. A source of compressed air will, of course, speed up this siphoning.
5. When M_1, M_2, M_3 are nearly filled, L_1, L_2, L_3 are turned so as to connect M_1, M_2, M_3 with the control stopcocks O_1, O_2, O_3. The stoppers are then replaced tightly in N_1, N_2, N_3.
6. The room is darkened and the pointers P_1, P_2, P_3 are carefully adjusted until the maximum luminescence is obtained. This adjustment is sometimes critical, but once obtained, can be immediately duplicated at a later time for any given set of solutions.
7. If anything should go wrong so that the luminescence is extinguished or reduced, the source of trouble may usually be located by listening through R_1, R_2, and R_3.
8. When M_1, M_2, M_3 are filled, there will be sufficient solution to keep the lumistat operating continuously for about an hour. During this time, K_1, K_2, K_3 may be removed and refilled if necessary.
9. If desired, L_1, L_2, L_3 may be so turned as to connect the supply bottles K_1, K_2, K_3 directly with the control levers. This, however, will cut out the bubble bottles.
10. Care should be taken that no liquid should collect in the long air tubes leading into M_1, M_2, M_3. If this occurs, the flow of liquid from the reservoirs will be uneven.