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APPARATUS FOR EXHIBITING THE FLUORESCENCE OF FLUORESCENT SUBSTANCES.

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Fig. 1,

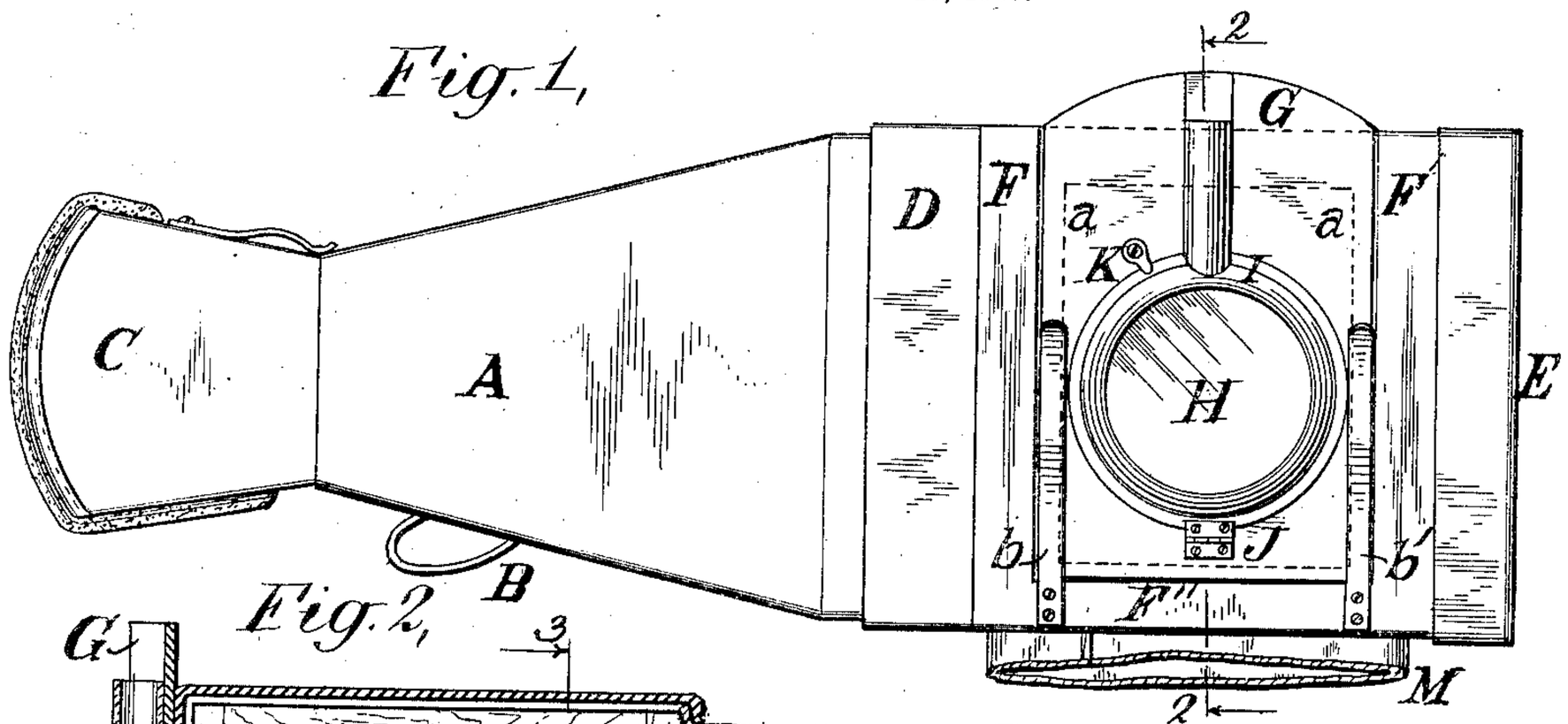


Fig. 2,

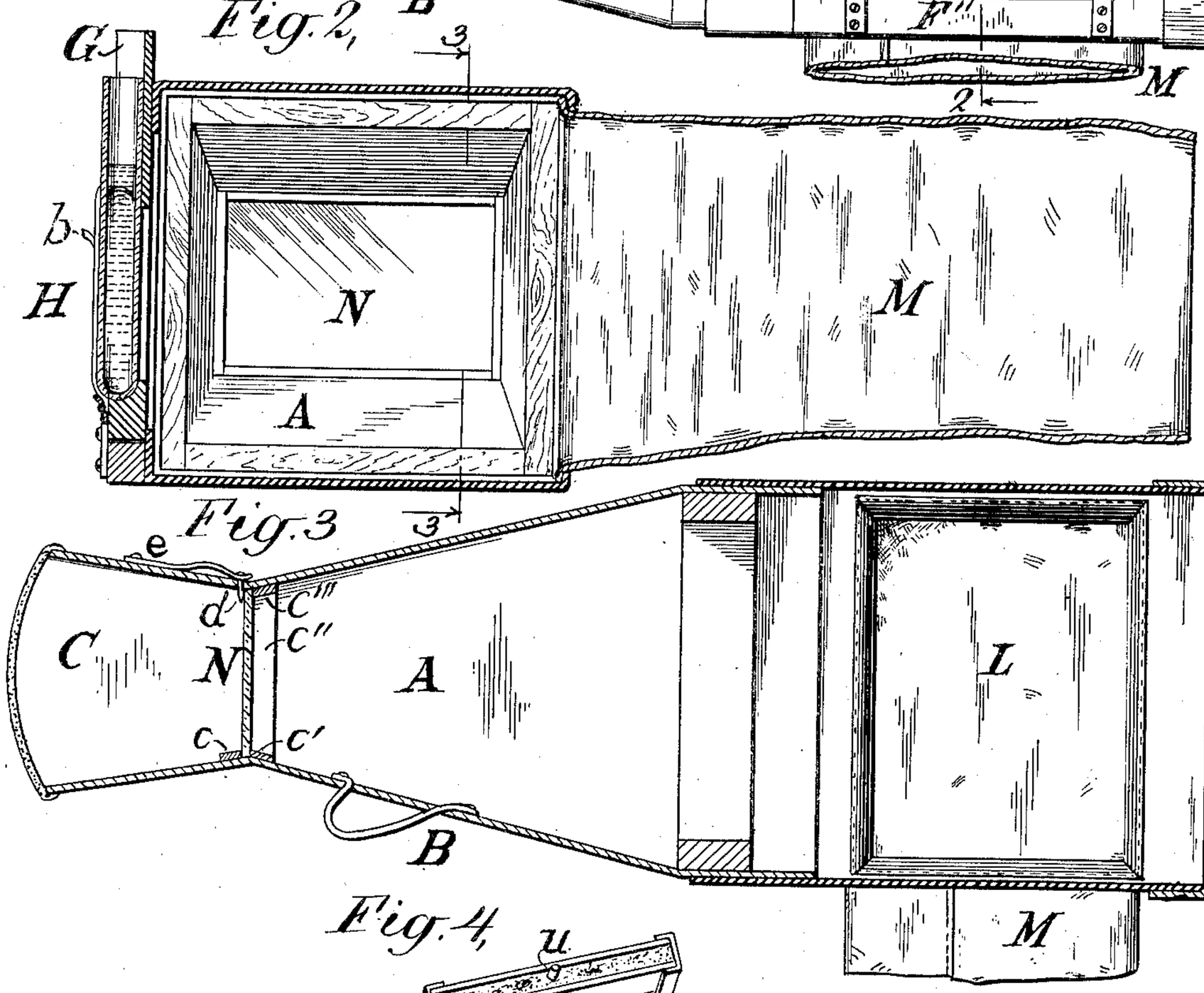
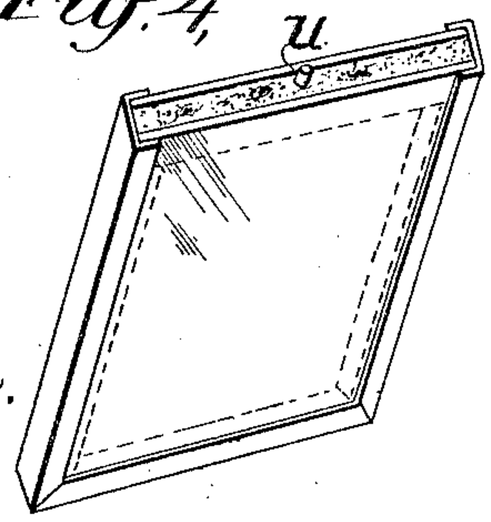


Fig. 3

Fig. 4,



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APPARATUS FOR EXHIBITING THE FLUORESCENCE OF FLUORESCENT SUBSTANCES.

No. 883,653. Specification of Letters Patent. Patented March 31, 1908.

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To all whom it may concern:

Be it known that I, WALLACE GOOLD LEVISON, a citizen of the borough of Brooklyn, county of Kings, and city and State of New York, have invented a new and useful Apparatus for Exhibiting the Fluorescence of Fluorescent Substances Applicable to Various Practical Purposes; and the following is a description of my invention, such as will enable any one skilled in the art to which it belongs to make and use it, reference being made to the annexed half-size drawing of a fluoroscope, of which the following is a description.

Figure 1, is a side view of the right hand side. Fig. 2, is a cross section on the line 2, in Fig. 1. Fig. 3, is a longitudinal section on the line 3, Fig. 2. Fig. 4, is a perspective view of a cell to hold colored liquids in which india rubber is insoluble. It contsists of two panes or plates of transparent material, (quartz, glass or other material as may be preferred, usually $3\frac{1}{4}$ x $4\frac{1}{4}$ photographic glass plates), separated by a frame cut from packing rubber and cemented with plaster of paris, in a sheet brass frame. An opening *u* (Fig. 4), which may be closed with a cork permits the introduction of the colored liquid employed.

In all the figures, like letters, indicate the same parts.

Figs. 1, 2 and 3 represent a light pasteboard box. A is the body of an ordinary X-ray fluoroscope which is provided with the usual handle B and chenille edged shield for the eyes at C. The X-ray screen is removed however, only the case being used. D is an additional section which slips tightly over the box A and is provided with a tight fitting cover E. This section is provided with opposite openings in its two sides. The one on the right hand is indicated by the dotted line *a a* Fig. 1, is surrounded by strips of half inch wood F, F^1, F^{11}, forming a rabbeted recess to permit the insertion of the block of wood G which is held in place by the springs *b* b^1. This block of wood is perforated with a circular opening rabbeted to hold the flat bottle H. This bottle, polished on both sides, is kept in its recess by the aluminium ring I hinged to the block at J and secured by a turn button K. The block of wood G together with the bottle H may be removed by simply drawing it from under the springs *b* b^1 and the cell Fig. 4, sheets of blue glass, or other colored screens as may be desired, inserted in its place, being retained by the springs *b* b^1. Thus bottles or cells filled with any colored liquid desired or other colored screens may be employed at pleasure to cover the opening *a a*. The opposite opening, on the left hand side of the case L shown in the section Figs. 2 and 3, must be large enough to easily admit the hand. To this opening a sleeve M made of flexible material, as suède kid, is attached by means of glue. Through the sleeve M, shown full length, in the section Fig. 2, and also in part hanging below the case in Figs. 1 and 3, the hand and wrist may be inserted. Thus a mineral specimen, a gem, or any other object, may be held in the hand within the box and turned about at pleasure for examination on all sides in the colored light admitted by the window and its screen H, Fig. 1.

N Figs. 2 and 3 is a window or pane of yellow glass or yellow stained gelatin coated glass which is held in place by a groove formed of strips of wood *c* c^1 at the bottom, a rabbet formed of strips of wood c^{11} c^{111} at the sides and top and a pin *d* attached to a spring *e* Fig. 3, which when lifted allows of the removal of the window when desired.

Fluorescent substances in common light usually present an insignificant aspect, but in a light capable of exciting their fluorescence, which is not accompanied by other light acting to mask its effect they are caused to appear in vivid and beautiful colors of great beauty. Unfortunately no way is known of subjecting such substances to a strictly monochromatic light of the particular wave-frequency desired wholly unmixed with other light waves, except by placing them in a spectrum, and the illumination in any ordinary spectrum is so feeble that it excites only a few of the more sensitive fluorescent substances at all strongly. But this method has served to determine that it is certain of the more refrangible waves from light sources (differing somewhat with different substances), but especially including certain groups of waves in the blue, violet and ultra-violet which are best adapted to excite this fluorescence. These constitute the larger proportion of waves in certain kinds of light artificially produced. Thus, the light from a high potential electrical discharge in air or other gases across a spark gap between various terminals forming part of a circuit con-

nected with a Leyden jar or other condenser to form a sort of oscillator is particularly applicable for this purpose. The mercury vapor lamp is also highly efficient in a few cases. Next most convenient is the light from a quartz Geissler tube containing a suitable residual gas, such as nitrogen. Next most convenient and efficient is the light from a glass Geissler tube, otherwise similar. In light from all these sources suitable rays to excite fluorescence predominate. There are other sources which afford light equally rich or even richer in rays capable of exciting fluorescence but in which there are also rays of lower refrangibility in such quantity as to predominate and thus more considerably or even wholly mask the effects produced. Sources of such light are the arc electric light especially between electrodes of iron, the magnesium light, condensed sunlight and finally the acetylene gas light, each being less efficient, perhaps, in the order named. All the above lights are more efficient when condensed by suitable lenses and when the undesirable components of lower refrangibility are more or less removed by ray filters, transmitting chiefly or only the desirable rays. Whether the masking effect of the associated rays of low refrangibility is purely subjective or whether they reverse and so frustrate the activity of the rays of high refrangibility, their presence is equally undesirable. To condense the desirable rays, quartz lenses should preferably be used and to filter them from the undesirable rays they should be transmitted through suitable ray filters, such as colored materials, either in the form of solution in cells, preferably of quartz, or spread in suitable vehicles as gelatin collodion or varnishes over the surface of plates or lenses, preferably of quartz or transmitted through lenses of colored vitrified quartz, which it seems probable will be eventually produced in available quantities for the purpose. For all these appliances glass may be used instead of quartz but to less advantage as it more largely arrests the desirable rays. Even with glass appliances, however, brilliant effects may be produced. The ammonium sulfate of copper, which forms a blue solution, is about the most effective ray filter for the purpose, although other colored solutions, the colored solid materials above mentioned, and ordinary cobalt-blue and violet glass may be used in certain cases, with proper precaution to avoid misleading effects. When the undesirable rays from the four latter sources of light are thus removed by color screens the residual transmitted light compares favorably with that from either of the sources previously mentioned and is efficient in even a greater number of cases. But in all cases the incident light being itself partly reflected masks more or less the fluorescent color developed and so affects or wholly conceals the intensity and beauty of the effect produced. As the incident light thus reflected consists only of rays of higher refrangibility, while the fluorescent light produced consists usually of rays of lower refrangibility, to obviate the masking effect of the reflected incident light it is only necessary to examine the excited objects through a second ray filter which will not transmit the former but will transmit the latter rays. Such a ray filter must have a so-called yellow color and may be a solution of bichromate or picrate of potash or other substance or canary yellow glass, or gelatin collodion or varnishes colored of a suitable yellow color and spread over or between surfaces of glass. In the latter case the cover glass may be cemented to the colored glass with balsam and benzol and the whole edged with binding strips for protection in the usual manner.

The color best adapted for the eye screen is not a simple monochromatic yellow but a color which seems yellow to the eye but which in point of fact transmits red, orange-yellow, yellow-green and green. It is the tint usually employed for photographic color screens, especially in the three color process, and the color screens supplied for photographic purposes are well adapted for the eye-screens herein described. By means of the combination of these two screens, as described, with light from any of the sources mentioned, or of the yellow eye screen alone, with some of them (such as the light of the spark gap, the Geissler tube or the electric arc with iron terminals) fluorescence of all colors below the blue may be equally well detected and exhibited in objects of any size. Fluorescence of a blue color may be detected by using a violet colored solution or violet glass for the light ray filter, without the eye screen but much of the color produced may be due to residual incident blue, becoming evident through the removal of the violet by absorption. Thus examined, the following series of minerals, either in specimens or pulverized and spread out as a coating to form fluorescent screens may be mentioned as examples illustrating fluorescence of various colors below the blue.

Red.—Ruby and ruby corundum. Fluorescent sphalerite (*e. g.* from Cerro de Pasco, Peru.) Calcite, especially associated with Willemite phosphorescent sphalerite and some other minerals.

Orange.—Arragonite, especially associated with sulfur from Sicily and sulfids of metals in general. Calcite, especially associated with Willemite from Franklin, N. J., phosphorescent sphalerite and some other minerals. Tribophosphorescent limestone (*e. g.* from Wahsatch Mts. Utah.) Wollastonite of some varieties.

Pink.—Hexagonite (*e. g.* from Edwards, N. Y., especially the white variety.) Calcite

from Cerro de Pasco, Peru. Sombrerite from the Sombrero Islands. Apatite, some varieties (*e. g.* from Haddam Neck, Conn.)

Yellow.—Pectolite and a large number of other minerals.

Green.—Autunite. Willemite. Apatite (some varieties.)

Blue.—Fluorite, in some varieties. Leucophanite in some varieties. Petalite in some varieties, and some other minerals.

Although only a series of minerals have been given and although for exhibition purposes the method and apparatus may be chiefly applied to minerals it is equally adapted to show fluorescence in other natural materials and dyed fabrics and papers and artificial preparations of numerous kinds. To apply this method practically for the exhibition of fluorescence, various arrangements or appliances may be employed according to the object in view. Thus fluorescent minerals or other specimens in museums may be kept on permanent exhibition if they be illuminated by a suitable permanent light filtered, if need be, through a blue or other suitably colored ray filter and observed by visitors through a suitable yellow or other colored eye screen, which may be the glass of the exhibition case, made of stained or colored glass or glass coated with colored varnishes as described. Under these circumstances they disclose a gorgeous beauty for the permanent exhibition of which no provision has heretofore been available and the presence or absence of which in gems serves admirably to distinguish them from ordinary imitations.

The case may be given the form of an ordinary X-ray fluoroscope. As shown in the annexed drawing the eyes are shielded by a yellow screen removable at pleasure and an opening at one side covered with the blue ray filter to admit the incident light concentrated by a lens if necessary, while through an opening on the opposite side provided with a door or a sleeve, specimens may be inserted within or withdrawn at pleasure. This appliance is convenient for the examination of specimens by daylight as well as by any artificial light.

For the detection of the presence or absence of fluorescence in small mineral specimens as gems or for the permanent exhibition of such specimens any of the above lights in conjunction with ray filters may be used but the most convenient is that of an acetylene bicycle lamp the lantern of which is provided with condensing lenses and a blue screen, and the object held near the focus of the light thus produced examined through a yellow eye-screen as above described. Small specimens may also be observed under the microscope, the eye-piece being provided with a transparent yellow diaphragm or cover and the object illuminated by a suitable active light.

Having now described my invention, what I claim and desire to patent is,

1. In an apparatus for examining fluorescent substances, the combination of a source of light, an inclosing box having a sleeved opening on one side and a removable cover for the introduction of the object to be examined, a ray filter upon another side to remove objectionable rays from the exciting light and an eye shield provided with an eye screen to arrest unused eflected rays of the incident rays substantially as described.

2. The apparatus described for facilitating the exhibition and examination of fluorescent substances by suitable wave frequencies consisting of a source of exciting rays, a container, to inclose the specimens under examination, provided with a ray filter to arrest undesirable rays from the source and an eye screen to arrest any unused incident rays reflected from the object under examination.

3. In an apparatus for examining fluorescent substances the combination of a source of light, an inclosing box having a sleeved opening on one side for the introduction of the object to be examined, a ray filter upon another side to remove objectionable rays from the exciting light, and an eye shield provided with an eye screen to arrest unused reflected rays of the incident rays substantially as described.

WALLACE GOOLD LEVISON.

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