A DEVICE FOR VISUALIZING THE SOLUTION OF GENETICS PROBLEMS

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Last year a paper was presented to the Academy in which the project method developed in the Biology Department at Loyola University was outlined. This year one of these projects will be presented in detail. This particular project involved the building of a device for visualizing the solution of genetics problems.

The construction of this device is simple, as the accompanying diagrams indicate. It consists essentially of a box 15¼"square. (See fig. 1.) This is made of one inch white pine fastened together with screws. The box is 6" deep. It has a solid back of one inch pine, recessed ½". This half inch space contains the wiring. There is a second, removable back of ¼" three-ply wood which conceals the wiring. Attached to the solid back on the front side are sixteen sockets containing sixteen watt bulbs. Partitions of ¼" ply wood separate these bulbs and form square inclosures, the dimensions of which are given in the diagram. This size was chosen because we use a 3¼" x 4¼" camera to make the transparencies.

The open front of these compartments is covered with a piece of ground glass 14¼" square. This slides in grooves cut into the sides of the box as shown. A piece of clear glass 13½" square fits into four brass guides bent into shape to receive it. There is a space of about 3/16" between the two glasses into which the transparencies about to be described fit.

A smaller box is hinged to the top of the larger one. Dimensions of this are given in fig. 1. It contains the sixteen switches used to control each individual light. The wiring is somewhat tedious,

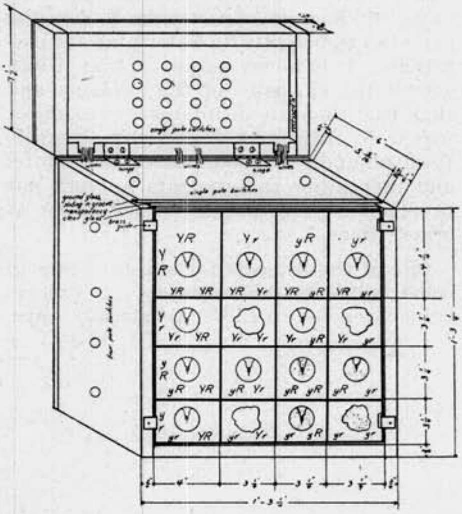

Fig. 1.

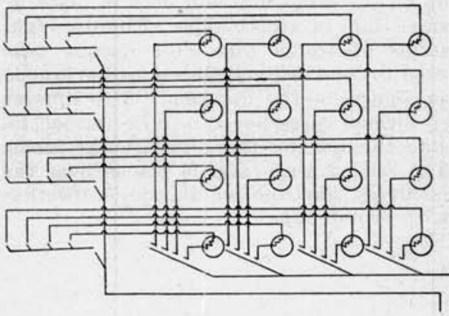

Fig 2.

but not very complicated. As the diagram (fig. 2) shows, four switches across the top of the box control one side of the lamps in groups of four. When these switches are closed, the sixteen switches in the upper box each control one side of a single lamp. The four switches on the left side of the box are four pole switches. Considerable difficulty was experienced in obtaining this type of switch, so they were constructed in the laboratory. They consist of a brass cylinder attached to a wooden knob. This cylinder slides in and out of a hole in the box. A wire from the line is soldered to the cylinder. Brass strips are soldered to each of four wires coming from a row of four lights. These strips are bent and screwed into place so that the cylinder, when pushed in, makes contact with all four at once. This type of switch is necessary to prevent current feeding back through the lamps, thus throwing several into series.

The transparencies are made of two pieces of x-ray film from which the emulsion has been removed by soaking in a dilute warm solution of sodium hydroxide. Such films may be obtained gratis from any hospital. They are cut into 13½" squares. On one, letters representing genes are printed as indicated in the example. We found that India ink has a tendency to crack off, so the type of opaque used by photographers in retouching was used. Appropriate drawings are made with India ink and copied on process film. From the negatives the desired number of positives are made on process film. These are colored with Eastman water colors. They are then lined up on the x-ray film and held in place by small bits of scotch tape. Finally, eight strips of scotch tape (the opaque type used to bind lantern slides) are arranged as shown in the diagram. The squares so formed correspond to those formed inside the box by the plywood partitions. The second x-ray film is placed over the positives, and the whole bound together with scotch tape.

A door covers the open front of the box. This was not shown in the drawing, in order to save space. It is hinged on the right, and fastens to the left side with a snap catch. The top also folds down and fastens to the door by another snap catch. A handle attached to the top permits easy carrying. The electric cord for power supply comes in near the bottom on the right side.

This project as such was very successful. It required the combining of information of very diverse kinds. A knowledge of genetics, physics, photography, and some practical carpentry were required. Not only were those actively working on it interested, but many others displayed a keen interest.

Besides the routine solution of problems, it is possible to demonstrate various other points. For instance, students often are unable to understand why a double recessive is used in test crossing. If a transparency is put into place, and the four egg switches closed, it is possible to demonstrate the utility of the recessive. If the switch controlling the sperm carrying both recessives is closed, four phenotypes appear. If any egg switch is opened, the ratios are changed, proving that only one possible female can give such results. If any other sperm switch is closed, then two, or even three egg switches may be opened without changing the ratio. This demonstrates that only the double recessive will reveal an unknown genotype. We have not had an opportunity to use the machine sufficiently to determine its usefulness. It is hoped, however, that it will arouse the curiosity of the students and thus lead them to an interest in a subject which is ordinarily considered abstruse. It is planned to demonstrate in lecture, and then allow the students to work out problems during laboratory periods or at other times.

One of the projects for several years to come will be the addition of various transparencies to those we already have.