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FOR THE HIGH SCHOOL SCIENCE TEACHER

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NATIONAL SCIENCE FAIR EXHIBITS BY TENNESSEE STUDENTS

At the National Science Fair for high school students which was held at Case Institute and Western Reserve University, Cleveland, Ohio, in May, 1955, ten finalists from five regional science fairs in Tennessee exhibited their projects. The following articles are brief descriptions of five of these exhibits by the Tennessee students who participated in the Fair. Descriptions of the remaining five will appear in a forthcoming issue of the Journal.

PROBLEMATICAL GRAPHIC EQUATIONS

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Graphs are diagrammatic representations of statements, of formulas, and equations. Graphical methods are increasingly employed in the solutions of everyday problems, and the presentation of the results of analysis not only in science, but in commonplace affairs. Simple examples of such diagrams are charts showing variation of temperature, the rise and fall of imports and exports, and volume of business. These charts are usually prepared on squared paper, and points defined with reference to these perpendicular lines. However, there are many more types of graphs than those used in business.

The simplest type of graph is the algebraic scale. This is a calibrated straight line, which may be used either vertically or horizontally. It is known as the algebraic scale because it locates points of negative value, which are not encountered in arithmetical practical problems. Next in order of complexity is the two-dimensional class. The scale used here is a set of axes composed of two perpendicular number scales. The point of intersection is zero, or the origin. Positive numbers progress to the right on the X-axis, upward on the Y-axis.

Graphs on the axes constitute a majority of graphs in common use. Simplest of two-dimensional graphs are linear. These are equations which involve two unknowns of the first power,

whose graphic shapes are straight lines, hence the name. Next are quadratic equations. These also have two unknowns, and are to the second power. Their graphic shapes are lines of one curve; this curve can be closed, as in circles and ellipses, or open, as in parabolas and hyperbolas. Cubic and quadratic equations have unknowns to the third and fourth powers, respectively. Graphs of cubic equations have two curves, of the fourth have three curves. Combinations of quadratic and linear equations are quite common, and consist of any equations having a common solution, or even, in special cases, having no common solution. Fourth are polar co-ordinates. These are drawn on special graph paper, which consists of equally-spaced concentric circles, and lines radiating from the center at degree intervals. The graphs shown in this model indicate r with reference to the sine and cosine of variant angle O.

Graphs of the trigonometric functions are drawn on ordinary graph paper, with the distance from 0° to 180° equal to one radian, or 3.14 times the distance from zero to one. Shown are the graphs of the functions sine, cosine, tangent, and cotangent, of angles 0° to 360°. Secant and cosecant, the respective reciprocals or cosine and sine, are not depicted. They will have a value of one when sine and cosine are one, or infinity when their reciprocals' values are zero.

Equations having three unknowns are the final dimensional group of graphs. These take many forms: plane, in which the three unknowns are in the first power; sphere; ellipsoid, formed by revolving a plane ellipse about either the X or Z axis; paraboloid, which may be formed by revolving a parabola about one of the three axes, in which case it is a paraboloid of revolution, or else prescribing an ellipse with its outer extremities, in which case it is an elliptic paraboloid (demonstrated); hyperboloid: of one sheet if the plane hyperbolas rotate about one of the axes of two sheets if each revolves separately about the axis; cone, formed, like the paraboloid, with a triangle.

Equations having more than three unknowns cannot be solved by graphic means, for it is beyond the limit of human capabilities to visualize more than three mutually perpendicular lines. Such equations must be solved with a system of equations.

The demonstration of these graphs is especially adapted for classroom use, making clear the relationships and differences of the various graphs.

BASIC POINTS IN THE CLASSIFICATION OF MINERALS

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My exhibit in The National Science Fair was entitled, "The Basic Points in the Classification of Minerals," and its purpose