THE GENETICS OF IDEAS IN THE REALM OF MATHEMATICAL PHYSICS

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This paper is written in an attempt to describe the mental processes by which a new idea is originated. The attempt to formulate these processes is made by the use of one or more well known analogies. In this way one can express the new idea in terms of old familiar ones. This method of analyzing and solving problems by analogies is used in mathematics and physics quite generally. The idea of expressing an idea in terms of old familiar ones is analogous to defining an unknown quantity in terms of known quantities and is the basis of all logic and mathematics. The new idea is the analogue of the dependent variable and the old familiar ideas are the analogues of the independent variables. However, in this case the familiar ideas need not be independent (unrelated).

The most common case seems to be the one in which there are only two familiar associated ideas and the new one which depends upon them. The two associated familiar ideas correspond to a mathematical function of two independent variables and the new idea corresponds to the dependent variable. All other cases can be reduced to the one just mentioned.

The process by which new ideas are originated seems to be related very closely to processes in the field of genetics. This statement is amplified by the fact that the association of two ideas can result in the suggestion of a new idea. This concept of "a new idea originating from two old ones" is very closely related to the concept of "a child and its two parents." In fact the process by which ideas are originated is analogous to that of "conception and birth" in the case of animals. This brings us to the subject of the paper, namely, "Genetics of Ideas."

If one follows out the analogy as stated, an original idea represents the child of two parent ideas. In order to follow out this analogy and speculate as to how new ideas are originated, it will be necessary to observe some familiar cases of parent ideas and their offspring.

The series of mechanical quantities—mass, displacement and time provide the parent ideas and the series of derived quantities—speed, acceleration, force, work, power, momentum, and action furnish examples of the offspring. The two series are arranged in the following table:

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Parent Ideas		Offspring
Displacement	Time	Speed
Change in speed	Time	Acceleration
Speed	Mass	Momentum
Change in momentum	Time	Force
Momentum	Displacement	Action
Force	Displacement	Work
Work	Time	Power

It has been said that necessity is the mother of invention. In other words, the need for a certain thing impels one to find a way to get it. One knows what he wants before he seeks for it. This is precisely the case in the breeding of stock where parent stock is selected which will produce offspring with the desired characteristics. In carrying out our analogy in this case the invention which necessity has mothered is the offspring with certain desired characteristics. The original idea which we call an invention in this case must be bred from parent ideas which should produce the desired characteristics in their offspring. The following example illustrates this case:

It is necessary to measure the angle of inclination of an inclined plane. Invent an inclinometer. We will select two parent ideas, one of which has the quality of indicating vertical or horizontal lines and the other has the quality of indicating angle. The two ideas are associated in a mental picture with the result that a first suggestion comes to mind of using a spirit level and a protractor in some combination to measure the angle of inclination. Probably after trying the level a second suggestion comes to mind of improving on the level by using a plumb line attached at the center of the protractor. It is seen that the parent ideas, "plumb line" and "protractor" are selected because they should produce an offspring with characteristics common to both. The developed invention is a protractor with a plumb line attached to its center of arc.

In analyzing and solving problems, one generally knows the general characteristics of the answer before hunting for it. The solution of a problem consists of a statement in terms of known quantities. One must find the known quantities which are related to the answer before it can be fully determined. This is like trying to find the parents of a child by knowing its physical characteristics.

Take for example the problem of finding what acceleration a body will have if it were allowed to fall freely at the surface of the moon. We know the general characteristics of the child, and are required to find its two parents. Since we know that force of attraction produces acceleration, and that all bodies attract each other, we can find the identity of the parents through these relations. First, mass times acceleration is a force which is equal to the force of attraction and the force of attraction is proportional to the product of the two masses divided by the square of the distance between them. Hence, gravity is proportional to the ratio of the mass of the moon to the square of its radius. The

two parent quantities are therefore the mass of the moon and its radius squared

$$F = M_1 g = G \frac{M_1 M_2}{(r^2)}$$

$$g = G \frac{M_2}{r^2} \quad \text{(G is a proportional factor)}$$

The relation between gravity and the mass of the moon is that the moon attracts a body and produces the acceleration while the relation between gravity and the square of the radius of the moon is that the attracting force is inversely as the square of the distance between the attracting bodies and thus reduces the force and accordingly the acceleration.

Let the Lorentz system of co-ordinate transformations represent the new original idea, then the two parent ideas are first: the idea of a moving reference system having constant velocity, second: the idea that the laws of nature are independent of speed (if constant). When these two ideas were associated mathematically by Einstein, the special theory of relativity was originated. That is to say, the mathematical deductions based upon these ideas gave Lorentz's transformation directly.

If the analogy between breeding animals and originating ideas is carried on logically, it leads to many interesting concepts. The most interesting one is that of conception and birth of ideas. Analogously it is the uniting of the "life cells" of the parent ideas to start the development of the embryo idea. The birth of the new idea consists in the complete statement of it in terms of the known parent idea. Just what the life cells of ideas are and how they can be united to form an embryo idea is an unanswered question. When an original idea is conceived, a person says that he has a "hunch," or a suggestion. But naming a thing does not define it. Perhasp psychology can tell what mental processes go on during the act of associating ideas which will lead to a more rapid breeding of new ideas, or perhaps we might say to a formula for the mass production of them.

In the field of Mathematics and the physical sciences the following generalization or formal method for the analysis and the solution of physical problems has been used with great success. Probably the method is used a great deal without a knowledge of its formulation. First, the problem at hand must be clearly stated so as to know as nearly as possible the characteristics of the desired solution, namely, the unknown quantity or function to be found. Second, quantities or functions must be found which have some relation to the answer, or to each other. These relations are generally known as laws of nature or mathematics. If as many independent relations can be found as there are unknown quantities involved, a solution is possible. Third, as many algebraic equations as there are unknowns must be written, and by eliminating the unknowns, express the answer in terms of the known quantities.