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Nobel Prize in Medicines 1935

Hans Spemann

The Nobel Prize in Physiology or Medicine 1935 was awarded to Hans Spemann"for his discovery of the organizer effect in embryonic development".

When the Staff of Professors of the Caroline Institute decided that Professor Hans Spemann should be considered pre-eminently for this year's Nobel Prize it was the first time that a representative of that branch of physiology which is called developmental mechanics was to receive this award.

Developmental mechanics seeks to establish the inner causal connection between the developmental processes. Wilhelm Roux founded this branch of science at the end of the 80's of the last century. Although Roux himself, Driesch, and many others have enriched our knowledge with interesting facts, it was really Spemann and his school who first established developmental mechanics as a current branch of science which has revealed laws and relationships which encompass the entire biological world.

In his technical work, Spemann can be called a micro-surgeon. His instruments are simple: glass rods drawn to a point, glass tubes which can be used as fine pipettes, or loops of children's hair. His experimental material consisted of the eggs of newts and frogs. An

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egg cell of this kind is a little ball of living matter with a diameter of 1-1,5 mm. Normally after fertilization it develops by continued segmentation until it changes into a small hollow sphere whose wall consists of small cells. Subsequently this hollow sphere invaginates rather as if you were to take a burst rubber ball and squeeze it together in the hand; only the difference is that the walls grow together so that the orifice of the now double-walled sphere will be small and cleftshaped. After that, a further layer of cells grows between the two walls of the sphere. These three layers are called ectoderm, mesoderm, and entoderm from outside inwards respectively. The orifice is called the blastopore. Then in front of this blastopore there arise from the ectoderm the primordia of the brain and spinal cord. Beneath the primordial brain an invagination of the ectoderm against the entoderm is formed, later to become the mouth. The mesoderm will form the skeleton (in the first place the dorsal strip, then the notochord) and muscles. The entoderm forms gut.

Much thought has been given to the nature of the forces and causality regulating this development. It is at this point that Spemann's researches begin. He used eggs of various animal species which differ in colour, and with his simple instruments transplanted small pieces of tissue in different stages of development. By this means he was able to establish that, for example, a cell mass normally destined to become ventral epidermis - Spemann calls it presumptive ventral epidermis -could develop into nerve tissue if it were put in the place where the spinal cord was to develop. Hence, the course of development of these cells was not laid down in advance or it could - if such was the case - be altered by transplantation; so that the transplanted portion adjusted itself to its new environment. When Spemann then transplanted the anterior lip of the blastopore of an embryo into the ventral side of another embryo it grew a new brain and spinal cord. This brain and spinal cord did not arise from the transplanted cell material, but from the presumptive ventral epidermis whose course of development was thus altered by the presence of the blastopore. From this Spemann could ascertain that the blastopore had an organizing influence on its environment. The cell material which was grafted into the ventral epidermis and caused the development of the new spinal cord was actually of the kind that, developing normally, would have given rise to the notochord. Further experiments showed that it is the notochord primordia which organize the development of the primordial spinal cord, while, on the other hand, the mesoderm in the head causes the development of a primordial brain. Near this arise the so-called optic vesicles which are the origin of the retina of the eye. Where these approach the ectoderm of the head they organize the development of the lens of the eye. Or, to take another example: the anterior end of the primordial gut (the oesophagus) organizes the development of a primordial mouth and primordial teeth inside it. Thus, we now see how cell masses originally undifferentiated have the course of their development laid down by the influence of rudiments of organs formed earlier. Thereafter, a cell mass such as this can assume the role of organizer in relation to its environment.

In this way we begin to understand how the laws of development work. We begin to perceive why a primordial head arises at the anterior end of the embryo, why a brain always arises in the head and never anywhere else, or why the mouth always has its place below the primordial brain and never elsewhere.

When the main principles of normal development become clear we may indeed hope that we shall soon come to understand abnormal developmental processes and how malformations arise. In his experiments Spemann has already succeeded in producing individuals with «situs inversus»: those peculiar malformations in which the relationship of the organs to left and right is the opposite of that in a normal individual. Such cases are also known among human beings: people in whom the heart is mainly on the right side, the stomach on the right, the main mass of the liver as well as the appendix are on the left side, to name only a few organs. Perhaps - and as doctors we hope so - Spemann's researches may also lead to a better understanding of the development of those strange and fateful structures known as tumours. For these can actually be regarded as the result of a disorganization of normal development and of normal conditions within the tissue.

Be that as it may. Even if our hopes on this score are not to be fulfilled, nevertheless Spemann has revealed conditions in the developmental process which are of deep significance. A mountain of difficulties rears up before him who seeks to wrest from Nature, secrets connected with the origin and development of a new individual. Spemann has opened this mountain and has brought to light rich treasures of knowledge. Moreover, a group of disciples has followed him, who can carry his thoughts forward and continue the work at such time as the master himself grows weary. As evidence of the great esteem in which they hold Spemann's merits the members of the Staff of Professors of the Caroline Institute have awarded him this year's Nobel Prize for Physiology or Medicine.

Herr Geheimrat. You are a student of Theodor Boveri, and occupy the Chair once held by Professor August Weismann. These are two names of vast reputation evoking feelings of gratitude and admiration in anyone engaged in biological research. They are, however, also names imposing on the student and successor responsibilities for carrying on a great tradition. You, Herr Geheimrat, have been successful in upholding this proud scientific tradition. You have, with new tools, continued where Weismann and Boveri had to stop, and have paved new ways in biology. August Weismann managed, although ignorant of Mendel's observations, to outline the significance of the nucleus as bearer of heredity; Boveri laid, together with Oscar Hertwig, the foundation of our knowledge of the fertilization phenomena; and you, Herr Geheimrat, have discovered secret forces regulating the early development of the fertilized egg. You have also created a school of scientists from whom Science can expect further valuable contributions. As a result of this you have occupied a place in the first rank of great cultural personalities in which your country is so rich.

As a token of its great appreciation of your scientific achievements, the Staff of Professors of the Caroline Institute has decided to confer upon you the Nobel Prize in Physiology or Medicine for this year. I ask you to receive the prize from the hands of His Majesty the King.

For more details please visit:

http://www.nobelprize.org/nobel_prizes/medicine/laureates/1935/press.html