GENERAL SCIENCE

Unborn Guinea-Pigs Now Aid Study of Disease Resistance

Animals Before Birth Grow Less Susceptible to Infection; All React in Same Way as Their Parents

GUINEA-PIGS do not even wait to be born, now, before they go to work in the laboratory, as the living instruments of scientists in their unceasing search for the causes of human ills and means for their prevention and cure. At the University of Ohio a group of bacteriologists have been using unborn guinea-pigs and rabbits to gain better knowledge of how germs attack and how living cells and tissue defend. At the meeting of the National Academy of Sciences, their leaders, Drs. Oram C. Woolpert and N. Paul Hudson, described their research and outlined some of the preliminary results.

By a relatively simple surgical procedure, performed under anesthesia, the Ohio biologists introduced the causal organisms of tuberculosis, infantile paralysis, cowpox, and several other human diseases into unborn guinea-pigs and rabbits at various stages of development. After a number of days or weeks, they brought them into the world by means of cesarean operation, and studied the results.

Dr. Woolpert summed these up briefly, as answers to six questions:

Six Questions

(1) Are unborn animals generally susceptible to infection? "Yes. We have found that the effects of inoculation can be uniformly related to the specific infectious organism employed and that they are usually proportional to the concentration of the inoculum. In all instances the fetuses have proved as susceptible as adults of the same species and in many instances they have appeared definitely more susceptible." The only exception found was in the resistance of unborn rabbits and guinea-pigs to the virus of infantile paralysis; but this may be explained by the resistance shown by the adult animals as well.

(2) Why are unborn animals often more susceptible? To this question Dr. Woolpert did not make a categorical answer, but suggested, first, the considerably lower number of phagocytes or germ-killing cells in the blood of unborn and very young animals, second, the known susceptibility of all young and rapidly-growing tissues, and finally, the lack of any stimulus to build up resistance, such as is furnished to adult animals by the constant insidious attacks which they must as constantly throw off.

(3) Are younger fetuses more susceptible than older ones? "Certain of our experiments . . . lend support to the view that the more immature the fetus, the more susceptible it is. It is unlikely that any tissue is entirely without resistance to infection, but we suspect that resistance is minimal in the youngest embryos and that during fetal growth the potentialities of resistance gradually increase."

Same Reaction

(4) Are the reactions of unborn animals to infection attacks different in kind from those of the adult? They do not seem to be. Tubercles appeared in guinea-pig fetuses inoculated with tubercle bacilli, and in other ways the unborn animals reacted along the same patterns as their parents, the differences being quantitative rather than qualitative.

(5) What relationship is there between immunity in the mother and in her unborn young? "This probably depends very largely on the species of animal considered, as well as the fetal age. In certain animals, e.g., man and rodents, the placental tissue barrier between maternal and fetal circulations is more tenuous than in others, e.g. herbivora and carnivora. Also, as the placenta matures it becomes more permeable; thus the younger the embryo the more effectively it is isolated from maternal influences. Another reason thus presents itself for inferring that younger fetuses should prove more susceptible than older ones."

(6) Are bacteria and disease viruses changed in any way by having lived in fetal tissues? "The infectious agents which we used were not greatly modified by transfer through series of fetal animals, though there are minor exceptions to this statement."

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PHYSIOLOGY

Hearts Are Efficient; Stomachs Are Not

HEARTS are efficient machines. In fuel economy they are twice as efficient as modern steam or gasoline engines. A healthy mammalian heart can convert 20 per cent of the energy latent in its supply of food fuel into useful work. The best fuel efficiency of a steam engine is 10 or 11 per cent; under ordinary working conditions steam engines usually function at about 5 or 6 per cent. A good internal combustion engine realizes a fuel efficiency theoretically about as high as that of the heart—20 per cent or even better—but under usual working conditions its actual output also drops to about half its theoretical possibilities. But the good sound heart still keeps on pumping away at 20 per cent fuel efficiency.

The high mechanical efficiency of the heart was discussed by Prof. Maurice B. Visscher, of the University of Minnesota Medical School, before the National Academy of Sciences.

Prof. Visscher was able to isolate living hearts of laboratory animals in such a way that he could measure the oxygen going in and the carbon dioxide coming out. This gave him data on which the fuel consumption of the heart could be calculated.

Among other things, he discovered that in one type of failing heart, the effort was made to keep constant the amount of blood pumped by dilating more and more, thereby greatly reducing the mechanical efficiency. Doses of the standard heart remedy, digitalis, corrected this tendency by "tightening up" the heart muscle fibers as they grew slack. A heart undergoing this type of failure could suffer a loss of efficiency to a point as low as one per cent, as compared with the 20 per cent efficiency of the normal healthy heart.

Not Good Factories

The stomach and pancreas are not particularly efficient chemical factories, Prof. Martin E. Hanke of the University of Chicago informed the academicians. As measured by the amount of energy intake, the stomach is only about ten per cent efficient in producing hydrochloric acid used in digestion, and the