

munications, this is simply a matter of convenience, to illustrate the point made. Calculated in this way, the energy consumption during exercise in the methylene blue experiments averaged 2.59 gm. cal. per kg. of work, which is 43% higher than the exercise metabolism in the "basal" experiment. In other words there was complete summation of the metabolism of work and that of the calorogenic action of the methylene blue, showing that none of the latter could be used to provide energy for the oxidative phase of muscular exercise—another instance of specificity, that is, the failure to use certain exothermic oxidative reactions, in this process.

In the experiments of Rapport<sup>1</sup> it appeared that the calorogenic action of carbohydrate was abolished during exercise. In the present experiments the calorogenic action of methylene blue was, as shown by the R.Q., predominantly at the expense of the oxidation of carbohydrate, yet this "waste heat" persisted when the animal exercised. It seems to follow that the calorogenic action of the methylene blue is not due to the so-called specific dynamic action of sugar, and also that the latter is not due to "waste" necessarily accompanying its oxidation.

### 8659 C

#### Structures Developed in Amphibians by Implantation of Living Fish Organizer.

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The study of mutual interactions between developing fish and amphibian tissue was tested by implanting parts of fish blastulae into the blastocoele of developing amphibians. This method applies also to the study of the capacity for differentiation of isolated embryonic cells of the teleostean. Halves of blastulae of the eggs of *Danio rerio* (the Zebra fish), isolated from their yolk an hour before the commencement of the visible processes of gastrulation, were implanted into the blastocoele of *Triturus torosus* eggs. The hosts were fixed after 10 days of development.

The developing fish and amphibian cells are mutually compatible during gastrulation and the stages immediately following. Thus

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developing tissue of young embryos from different classes of vertebrates at first possess considerable tolerance, even though a marked tissue specificity characterizes the adults. In the present series of experiments, the implanted fish material developed wherever located: in the center of the yolk, between yolk and epidermis, or surrounded by amphibian mesenchyme. The fish mesenchyme mingled with that of the amphibian to form a composite tissue. The tremendous difference in size between the fish and the amphibian cells is an aid in distinguishing the source of the tissue.

The amphibian epidermis is always locally thickened adjacent to an implant. In some cases there were extensive epidermal proliferations, sometimes richly provided with chromatophores though formed from normally unpigmented belly ectoderm. One of these bore an extension simulating in structure an amphibian dorsal fin.

In contrast to these cases of doubtful induction, another embryo shows a true one. Fish notochord induced the formation of amphibian nervous tissue from amphibian ventral ectoderm. It is clear that the processes which normally take place in the organizer-region of the fish can stimulate amphibian cells to differentiate specifically. The fish-organizer did not induce the formation of a complete embryonic axis, but rather a single localized portion of the nervous system. The induction consisted of well-differentiated unilateral medulla, an auditory ganglion and an auditory vesicle. The induced medulla formed by the amphibian cells was similar in configuration to normal amphibian medulla; it was coextensive with the fish notochord in length. In contrast to this, the induced auditory vesicle was situated anterior to the fish notochord and the induced amphibian medulla, and probably was induced directly by the amphibian medulla.

The organizer-region of the *Danio* gastrula is only about one twenty-fifth the size of the *Triturus* organizer. The induced medulla was similar in size to the normal *Triturus* medulla and considerably larger than the medulla of the *Danio* embryo. The fish organizer has stimulated a specific reaction, the differentiation of medulla, from a mass of tissue far greater than would have been involved in comparable differentiation in the *Danio* embryo. The qualitative action of the organizer is thus clearly independent of precise size-relationships between the masses of stimulating and reacting cells.

In addition, the qualitative action of the organizer is independent of the precise age of organizing and reacting cells to a surprising degree. In the *Danio* eggs comparable in stage to the donors of

the implants, all of the processes of gastrulation and the formation of the primitive embryonic structures (somites, gut, nervous system and optic vesicles) were accomplished within the 12 hours immediately following the implantation operations. During this 12-hour period, the *Triturus* eggs barely completed the latter part of the processes of gastrulation. The differentiation of the induced *Triturus* structures was stimulated by an organizer in which the developmental processes were proceeding at a greater rate and at a more advanced period of time than the corresponding processes in the *Triturus* organizer. It may be inferred that the rate of reaction of the differentiating cells is inherent within those cells, whatever the rate of action of the organizing system. Further experiments are necessary to answer the problems concerned with time-relationships between organizing and responding cells.

Many of the problems formerly attacked by xenoplastic grafting can now be subjected to new analyses by interclass embryonic grafting. The demonstration of the compatibility between embryonic fish and amphibian cells and the capacity of fish-organizer to induce amphibian structures renders possible further attack upon interrelationships between the organizer and the cellular system responding to its stimulation.

### 8660 C

#### Quantitative Relation Between Follicle Stimulating and Luteinizing Effects in Castrate and Menopause Urine.

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We have reported<sup>1</sup> the observation that both follicle stimulating and luteinizing effects could be produced with urine obtained from castrates and women past the menopause. Numerous investigators (Zondek,<sup>2</sup> Hamburger,<sup>3</sup> Leonard and Smith,<sup>4</sup> and Col-

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<sup>2</sup> Zondek, B., *Hormone des Ovariums und des Hypophysenvorderlappens*, 2nd Ed., Wien, J. Springer, 1935.

<sup>3</sup> Hamburger, C., *Acta Path. et microbiol. Scandinav.*, suppl., 1933, **17**, 1.

<sup>4</sup> Leonard, S. L., and Smith, P. E., *Am. J. Physiol.*, 1934, **108**, 22.