dant in sufficient quantities to demonstrate that this program has the possibility of establishing fundamental levels of biostratigraphy. The finding of Jurassic sediments with a considerable thickness of older sediments beneath points up the fact that studies of radiolaria need to be advanced because these have been represented in the fossil record since at least Paleozoic time, while coccoliths are not known prior to Jurassic nor forams prior to late Jurassic.

The sediments and their properties were discussed by A. Beall (Continental Oil Co.) and A. Fischer (Princeton). It was observed that the sediments at depth were in a reduced state and in some instances showed evidence of having been deposited under stagnant conditions. Of particular interest were examples of diagenesis in deep-sea sediments including cementation, dolomitization, and silicification.

Birch commented that a long distance separated geophysical results and the nature of the rocks, and noted that the importance of a drilling program as a beginning of greater understanding of these could not be overemphasized. He gave as an example the remarkable correlation between heat flow and heat production in New England, in which the observed flow could be attributed to that produced by a 6-km thickness of rock with the equivalent uranium content of that of the surface rocks. If the radioactivity of the oceanic basement were equivalent to that of granite it could make a significant contribution to the heat flow through the ocean floor.

Bullard mentioned that the new tool has become available at just the right time since ideas about the origin and development of the oceans have only recently become established. We are now seeing only the last stages of the development of the oceans but, with properly chosen sites, we should be able to decipher much of the earlier history. He discussed many of the current problems which require explanation and pointed out the need for geologists working on land to produce a picture which is compatible with current thoughts about the ocean.

The program concluded with comments by Hollis Hedberg (Gulf Oil and Princeton) who noted that some 2 million holes have been drilled to depths from a few hundred feet to more than 5 miles on land and the contribution of these to geologic knowledge has been immense. If this is the case on land where outcrops are abundant, how much more so it must be in the oceans where outcrops are few. He looked forward to an exciting new era in the earth sciences.

During the following discussions a number of interesting points were raised. E. Baker (Mellon Institute) reported that preliminary studies of the oil sample from Site No. 2 indicated that it was of marine origin, of Cretaceous or younger age, and that it had not been subjected to thermal stresses. The gas samples (J. Hunt, WHOI) showed a complete spectrum of hydrocarbons. Nierenberg, in response to a question, gave some preliminary results from Leg 2 which he had obtained from M. Peterson and N. T. Edgar (SIO), co-chief scientists on *Glomar Challenger*. Basement was reached in the three holes drilled between Bermuda and the Mid-Atlantic Ridge. The age of the sediments immediately above basement was, from west to east, Lower to Middle Cretaceous, Middle to Upper Cretaceous, and Miocene, respectively. It should be noted that these ages are not in disagreement with current thinking about the development of the Atlantic Ocean basin.

Jones concluded the seminar by citing the drilling program as another example of a project, too big for a single institution, being managed as a national program.

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Enzyme Regulation in Mammalian Tissues

The Seventh International Symposium on Regulation of Enzyme Activity and Synthesis in Normal and Neoplastic Tissues was held at Indiana University School of Medicine in Indianapolis on 30 September and 1 October 1968. A. Szent-Györgyi (Institute for Muscle Research) discussed the steric separation of enzyme and substrate which underlies the regulation of enzymic systems connected with the repair of mechanical damage. He suggested, tentatively, a very simple theory of cancer—a cancer cell is a cell which is unable to bind its glyoxalase.

The regulation of pyruvate kinase in the rat was described by G. Weber (Indiana University School of Medicine) as operating through both control of enzyme biosynthesis and control of enzyme activity. The mechanisms of inhibitory action of free fatty acids, acetyl-coenzyme A, adenosine triphosphate (ATP), and reduced nicotinamide-adenine dinucleotide (NADH) and the competitive inhibition of liver pyruvate kinase by L-alanine and that of brain pyruvate kinase by L-phenylalanine were described. In man, during prolonged starvation, administration of exogenous L-alanine results in a prompt hyperglycemic response, suggesting that provision of precursor substrate is an important rate-limiting step in the control of hepatic gluconeogenesis under these conditions (G. F. Cahill, Jr., Harvard Medical School).

Adenyl cyclase, in "ghosts" prepared from isolated fat cells from rats fasted and then fed, has higher specific activity and increased sensitivity to epinephrine (T. Braun, American Medical Association Education and Research Foundation's Institute for Biomedical Research, Chicago). The activity of tyrosine transaminase in rat liver shows markedly time-dependent variations that appear to be generated by the interaction of an endogenous factor (the tendency of the animal to eat cyclically) and an exogenous factor (the presence of protein in the diet) (R. J. Wurtman, Massachusetts Institute of Technology).

The perfused heart system differs from adipose tissue preparations in that insulin is without antilipolytic activity in the heart although it inhibits activation of lipolysis in adipose tissue (J. Ashmore, University of Massachusetts). Vitamin K_1 stimulates *de novo* synthesis of prothrombin and possibly other clotting factors which are dependent on vitamin K in isolated perfused rat liver (R. E. Olson, St. Louis University).

The control of protein synthesis in protoplasts of *Escherichia coli* infected with bacteriophage T4 was studied in a two-part incubation in which the processes of transcription and translation were separated by the use of inhibitors of RNA and protein synthesis (J. M. Buchanan, M.I.T.). The allosteric regulation of the catalytic activity of tryptophan oxygenase is accompanied by changes in molecular architecture (P. Feigelson, Columbia University).

At branching points of metabolism, control processes operate by competi-

tion of two or more enzymes for a common substrate. Measurements in several tissue homogenates and in artificial mixtures in pure state of the enzymes pyruvate kinase, enolase, and alkaline phosphatase lead to identification of enzyme competition (G. Siebert, University Hohenheim, Stuttgart-Hohenheim, Germany). With an injection technique, glycolytic oscillations can be induced in yeast extract with hexoses, glucose-6-phosphate, fructose-6-phosphate, but not fructose-1,6-diphosphate, with an average rate corresponding to a respiratory quotient for glucose of 70 (per intact cell) (B. Hess, Max-Planck-Institut, Dortmund, Germany).

Glucokinase, citrate cleavage enzyme, and glucose-6-phosphate dehydrogenase may be induced by protein and glucose in the intact rat, but require glucose and insulin in the diabetic. Animals fed a high-protein diet show marked increases in serine dehydrase and ornithine transaminase which is not affected by the chronic administration of insulin (H. C. Pitot, University of Wisconsin School of Medicine). D-Fructose-6-phosphate aminotransferase in rat liver is inhibited by *N*-acetyl-6-diazo-5-oxo-L-norleucine (Duazomycin), and injection of glucosamine with Duazomycin A completely protects the enzyme against inactivation (R. E. Handschumacher, Yale University School of Medicine).

Levorphanol, a synthetic morphine, specifically inhibits the nucleolar ribosomal RNA synthesis in rat liver, but does not affect messenger, transfer, nor any other nucleolar RNA synthesis (Y. Miura, Chiba University, Chiba, Japan). Qualitative estimates were made of the relative amounts of active complexes of RNA polymerase and DNA, of ribosomal RNA cistrons, and of other DNA templates in rat liver and Novikoff tumor nuclei and nucleoli (R. B. Hurlbert, M. D. Anderson Hospital and Tumor Institute).

Evidence for the existence of at least two different cytochrome P450's concerned with corticosteroid hydroxylation was presented by B. W. Harding (University of Southern California). In bovine adrenal cortex mitochondria, the source of reduced nicotinamide-adenine dinucleotide phosphate for mixed-function oxidation is the mitochondrial malic enzyme activity, implying a specific evolutionary development to meet the requirements of steroidogenesis (R. W. Estabrook, Southwestern Medical School at Dallas).

Late fetal rats and early metamorphic tadpoles accumulate glycogen in their livers which is then depleted immediately after birth and during the last stages of metamorphosis, respectively. In fetal rats, as in tadpoles, thyroxine enhances the formation of glucose-6-phosphatase and of arginase (O. Greengard, Harvard Medical School and New England Deaconess Hospital).

Evidence was presented that the decarboxylation of L-ornithine by a specific, soluble, pyridoxal phosphate-dependent enzyme is the principal pathway for the biosynthesis of putrescine in the prostate. Enzymes degrading putrescine, spermidine, and spermine could not be demonstrated in rat ventral prostate. Large, rapid increases in the activity of both ornithine decarboxylase and the putrescine-dependent *S*-adenosylmethionine-decarboxylating system occur during the early phases of prostatic growth induced by testosterone in orchiectomized rats (H. G. Williams-Ashman, Johns Hopkins University School of Medicine). The five isoenzymes of brain aldolase have an ascending sequence of the substrate ratios of fructose-1-phosphate to fructose-1,6-diphosphate, which suggests a four-subunit structure for these aldolases. Rat testes and ovaries have only four aldolases, a fact more conveniently explained on the basis of a three-subunit structure. Immunological studies suggest that there are two muscle aldolases, with possibly a compartmental distribution (D. N. Baron, Royal Free Hospital of Medicine, London, England).

A quantitative and reproducible system for obtaining carcinogenesis in vitro with carcinogenic hydrocarbons in cell cultures derived from adult C3H mouse ventral prostate was described by C. Heidelberger (McArdle Laboratory for Cancer Research). Shields Warren (Harvard Medical School and New England Deaconess Hospital) reviewed the relationships of form and function in neoplastic cells.

The aminoacyl transfer RNA patterns in normal rat liver and Novikoff ascites tumor cells were almost identical with respect to the amino acids threonine, histidine, methionine, glutamic acid, and tyrosine. Minor deviations in the aminoacyl transfer RNA patterns of the two cell types were seen in the valine series and with serine (A. C. Griffin, M. D. Anderson Hospital and Tumor Institute). Changes in enzymes of thymidine triphosphate metabolism noted during 3'-dimethylaminoazobenzene carcinogenesis might reflect shifts in liver cell populations rather than altered regulation of enzyme activity or synthesis. A theoretical model incorporating this concept was presented by V. R. Potter (McArdle Laboratory for Cancer Research) and discussed with respect to the metabolic diversity of hepatomas.

As usual, the Special Symposium Lecture of Sir Hans Krebs (Radcliffe Infirmary, Oxford, England) provided a climax and highlight of the symposium. Sir Hans described the equilibrium relations between pyridine and adenine nucleotides and their roles in the regulation of metabolic processes. The network of near equilibria in which the pyridine and adenine nucleotides participate is likely to be a fundamental component of the energy-transforming mechanisms in the liver cell. It establishes a basic level of the redox states of the two pyridine nucleotide couples in the two main cell compartments where the energy-transforming mechanisms are located and it links the redox states to the supply of ATP. It sets the cytoplasmic level of the NAD-couple to be suitable for both glycolysis and gluconeogenesis. Furthermore, it sets the cytoplasmic redox state of the NAD-couple at a much more reduced level so as to be effective in reductive synthesis such as that of fatty acids.

The symposium was sponsored by Indiana University School of Medicine, Burroughs Wellcome and Co., Hoffmann-LaRoche, Eli Lilly and Co., Merck Sharp & Dohme, Squibb Institute for Medical Research, and Upjohn Company. The full text of the papers, edited by the chairman of the conference, George Weber, will be published in the spring of 1969 as volume 7 of *Advances in Enzyme Regulation* (Pergamon Press, New York and Oxford).

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Seaweed

The study of seaweed as a natural resource is becoming increasingly important. Accumulated knowledge was reviewed, and current research problems were discussed at the 6th International Seaweed Symposium at the University, Santiago de Compostela, Spain, from 9 to 13 September 1968.

The manurial value of liquid seaweed products was discussed by E. Booth (Scotland) both as to manufacture and some unusual properties, such as