found to have no expression in the deeper crust. They appear to be purely sedimentary features perhaps carved by the speedup of currents around the seamount as a bottom obstacle.

R. Verma and H. Narain (India) reported on detailed paleomagnetic studies of Indian rocks. The results are consistent with India being positioned in the southern hemisphere from Permian to Eocene time. Continental drift of the Indian subcontinent seems to have occurred mostly from Jurassic to Miocene times covering a distance of nearly 4000 miles. The impingement of India against Asia apparently played an important role in the uplift of the Himalayas. The geomagnetic field probably was reversed during the Lower Cretaceous while it was normal during the Upper Permian.

A rather remarkable development over the past decade has been the growing realization, paced by radiocarbon dating, that even around the diastrophically active Pacific margin eustatic sea-level oscillations (and especially a Recent rise of perhaps 120 meters) generally have overwhelmed diastrophic uplift and subsidence. But in the symposium on Pacific margin sea-level changes, George Plafker and Meyer Rubin (U.S. Geological Survey) reported that, in the Gulf of Alaska, tectonic displacements locally have been orders of magnitude greater than the postulated sea-level changes. Radiocarbon-dated samples in coastal areas affected by tectonic movements during the 1964 Alaska earthquake indicate: (i) uplift relative to sea level of as much as 55 meters in the past 7650 years and subsidence of at least 4.5 meters in the past 2800 years; (ii) 40 meters of relative uplift of Middleton Island in five major upward pulses during the last 4500 years, the most recent pulse probably having been less than 460 years ago; and (iii) a gradual general submergence of the coast for several centuries before the earthquake, at rates as high as 4.3 meters in 400 years. Striking evidence of continued active diastrophism along the Gulf of Alaska was provided by the regional coastal uplift of as much as 11.5 meters and the subsidence of 2.3 meters that accompanied the 1964 earthquake.

The next Pacific Science Congress will be held in 1971 at Canberra, Australia.

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Gastrointestinal Circulation

More than 15 years have passed since there has been an international meeting devoted to the gastrointestinal circulation. In the interim, advances have occurred in our understanding of the physiology of the circulation in salivary glands, stomach, and the intestine. Simultaneously, knowledge has been accumulating about other areas of the circulation and in methodological fields upon which research into the circulation must depend.

A meeting of investigators representing four continents met at the Lake Arrowhead (California) Conference Center on 5–9 September 1966. There was a total of 13 topics covered, and these fell into two general categories: first, subjects in the area of rheology and advanced methods of measuring blood flow and, second, topics relating to specific regional circulatory problems. The format of this conference was such that there were two formal speakers for each subject to present opposing points of view where possible, yet more than half of the formal meeting time was devoted to open discussion and questioning by all participants. The meeting opened with a paper entitled "Bioenergetics, why?" by Wilfried Mommaerts (UCLA School of Medicine), which was a philosophical essay on the nature of life from the point of view of a biochemist. Mommaerts takes issue with that school which would define life solely in terms of a double-helical molecule. He also managed to prick the balloon of those whose apparent aim is to replace the irritations of existence with a vegetable state held together by artificial organs. His neoclassical redefinition of biology will be reassuring, at least to a medical reader.

The first technical paper was a broad review of the rheology of blood flowing in the microcirculation by Harold Wayland (Caltech). Among the interesting concepts Wayland developed and presented evidence for was the hypothesis that there is a dynamic structuring of blood as it flows through the microcirculation. This structuring appears to consist of an interaction between red cells as they aggregate and dissociate reversibly. Both Wayland and his formal discussant, Donald McDonald, agreed that the magnitude and importance of the plasmatic zone at the intimal lining of microvessels has been greatly exaggerated in both size and importance.

Michael Taylor (University of Sydney) approached the relationship between the physical structure of arterial walls and the role played by the arteries in the circulation from a novel point of view. He considered what the characteristics of the arterial walls should be if the workload upon the heart were to be minimized. He ended his discourse confirming the wisdom of the body at least with regard to engineering specifications of arterial walls. The discussant, Allan C. Burton, noted that the entry of the engineer into biology may not solve the problems of the life sciences, but it should provide engineering with many new ideas that could be applied to industrial needs.

The Fick principle has been applied in many ways to the measurement of blood flow in regional areas. One of its most recent applications was the isotope fractionation method developed by Leo Sapirstein (Stanford). Using organ uptake of radioisotopic potassium or rubidium, simultaneous estimation of blood flow in many regions can be carried out. The errors and limitations of this variation of clearance methodology were pointed out by Robert Pitts.

Alvin F. Sellers and Alan Dobson of Cornell presented a paper intended for those who employ the chronically implanted electromagnetic blood flowmeter. The authors categorized the sources of error with the instrument and described a preparation which allows evaluation of the artefacts. A major question raised by Alexander Kolin related to whether these artefacts are due to poor commercial products or whether they are an inherent flaw in the principle of this instrument.

A respiratory physiologist, Robert Forster (University of Pennsylvania), investigated the possibility of using gas exchange methods for the measurement of blood flow in the intestine. He developed a model of the enteric hollow organ and the criteria of a suitable gas, carbon monoxide. In the companion article, Selkurt and Wathen (Indiana University) gave their results with xenon-133 uptake in the intestine. Blood flow values, using these two methods, differed by a factor of 10.

John Grayson (University of Ibadan) discussed the theoretical basis underlying the use of the heated thermocouple to estimate tissue blood flow in solid organs. While taking care to define the limits of this instrument, he cited likely applications of the technique. Loren Carlson amplified the list

of potential areas where the heated thermocouple may be used.

The two classical views of the control of the salivary circulation are that of Claude Bernard, Bayliss, and Dale, on the one hand, who believed in parasympathetic vasodilator nerves; and of Barcroft, who contended that metabolic intermediaries were responsible for a functional hyperemia. Two contemporary antagonists who presented opposing views in paired essays were Melville Schachter (University of Alberta) and Graham Lewis (Ciba Laboratories, England). Schachter gave his evidence for a cholinergic mediation of vasodilation in the salivary glands, and the results of his recent work which raised serious question about the existence of a functioning dilator mechanism involving the kallikrein-bradykinin mechanism. In the companion essay by Lewis, the evidence was put forth to support the metabolic dilator hypothesis in the salivary glands involving the plasma kinins.

A preparation for measuring blood flow to the stomach in the conscious animal with simultaneous determination of gastric secretory activity was described by Jacobson, Swan, and Grossman. The results of their studies indicated a complex relationship between secretion and blood flow in the stomach. Eugene Grim suggested some of the methodological limitations inherent in the study.

Björn Folkow (Göteborg, Sweden) presented some of the recent work from his laboratory and several novel concepts relating to the circulation of the gut which his group has developed, including autoregulatory escape, the physiological redistribution of blood flow within the wall of the intestine, and the countercurrent exchange mechanism in the gut. Benjamin Zweifach raised questions about the countercurrent hypothesis based upon structural considerations of the microcirculation.

The concept that variations in arteriolar dimensions depend upon changes in blood flow, whereas precapillary sphincters appear to be influenced by intravascular pressure changes was presented by Paul Johnson (Indiana University). This view appeared to be a compromise between the so-called metabolic and myogenic explanations of autoregulation. The discussant, Lerner Hinshaw, in discussing this new view, objected to Johnson's critical experiment, namely, the

elevation of venous outflow resistance in order to vary intravascular pressure and blood flow in opposite directions.

Francis Haddy and his colleagues (Michigan State University) considered the role played by visceral smooth muscle in the intestinal vascular responses to a variety of naturally-occurring vasoactive agents. This muscle factor in the wall can be used to explain otherwise puzzling findings in the intestinal circulation. Harold Green expanded the consideration of hemodynamic responses to the naturally-occurring agents.

Jacob Fine (Harvard) set forth his concept of the pathogenesis of irreversible shock: the stress of shock prompts sympathetic nervous hyperactivity which results in splanchnic ischemia; prolongation of this inadequate perfusion of the gut and abdominal reticulo-endothelial system permits a state of endotoxemia. This combination of factors pushes the shocked animal into irreversibility. Hiroshi Kuida criticized certain aspects of this hypothesis in the discussion paper.

Detailed studies of the circulatory events in canine endotoxic shock in which events in various segments of the splanchnic circulation lead to characteristic systemic circulatory effects were described by Fuad Bashour. A companion paper by Richard Lillehei covered added conceptual material and stressed a unitary view of the hemodynamics of many shock states.

Proceedings of this conference will be published as a special supplement in the journal *Gastroenterology*. The symposium was sponsored by the department of physiology of the UCLA School of Medicine and was supported by a grant awarded by the National Heart Institute (HE 10561-01).

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Forthcoming Events

January

2–6. **Endocrinology**, 3rd Asia and Oceania congr., Manila, Philippines. (L. S. Villadolid, Dept. of Medicine, College of Medicine, Univ. of the Philippines, Herran, Manila)

3–7. **Chemistry**, 4th Caribbean symp., Univ. of the West Indies, Mona, Kingston, Jamaica. (W. R. Chan, Chemistry