port) that they were going to present three papers necessitated considerable readjustment of the schedule; fortunately, three Russian interpreters from the Library of Congress, Boris Mandrovsky, Daniel Pyle, and Christopher Dodge, were in attendance and performed admirably. The Russians, an integral part of Soviet space research, were O. G. Gazenko, V. V. Antipov, and M. M. Kazenkov. They arrived from New York sitting across the aisle from Scott Carpenter (from Houston), without mutual recognition until they went down the ramp to face the news cameras and the welcoming committee headed by Hubertus Strughold, chairman of the meeting.

The main concern of the Russians was weightlessness. Gazenko related individual differences in response but stated that most cosmonauts had felt strange reactions to the condition; while sometimes pleasant, it also became uncomfortable. Illusions of body motion and deconditioning of the circulatory system similar to that suffered by the bedridden were noted. Inner ear effects and functional reactions of the central nervous system, metabolism, and cardiovascular system lasted as long as a week in some cases.

V. V. Antipov related fruit-fly experiments which were the precursors of manned space flight; overproduction of females was first thought to result from weightlessness, but is now believed to be caused by heavy cosmic-ray particles. Kasenkov, a mechanical engineer who became interested in visual problems in space, reported that weightlessness had little effect on vision, but that stress beyond $2g$ did.

Space cabin atmospheres also came into the discussion. The Aerospace Medical Division was concurrently conducting a closed-system experiment using a mixture of oxygen and helium. Gazenko admitted that the Russians had been restricted to simulation of Earth's atmosphere. "In future flights," he said, "a new type of gas environment must be used."

Respect for the arts and humanities was voiced by banquet speaker Martin Goland (Southwest Research Institute) who decried the concept of manned spaceflight as the opportunity to put a better computer aboard:

"The tragic paradox of our times is that our technological experiences have added imbalance to our lives. Science and technology rush forward while ethics and the humanities advance only at their prespace historic slow pace. It may seem absurd at first glance, but we should consider sending artists, poets, and philosophers into space. Man and not instruments alone must be our guide as we search out the secrets of the heavens."

The proceedings of the symposium, 33 papers, will be published during 1965, probably as an Air Force document.

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Lactic Acids: Chemistry and Metabolism

It is not always fully appreciated that lactic acid is a mixture of two isomers, each of which is disposed of in a different manner by the body and which therefore need to be studied separately. The chemistry and metabolism of these isomers were the subject of a conference held in New York City 12–14 November 1964.

The first speaker, L. B. Lockwood (Miles Chemical), reviewed and corrected available information on the physical chemistry of lactic isomers and polymers. Infrared absorption spectra of various hydroxy acids were presented as evidence of the existence of an ethylene oxide form when free lactic acid is present in solution, as originally proposed by Bancroft and Davis in 1931. Downward correction of the value of the pK_a of lactic acid to 3.73 at 25°C was proposed on the basis of data obtained with purer preparations of lactic acid than were previously available. The phenomenon of spontaneous polymerization in lactic acid solutions with concentrations greater than 30 percent was emphasized. This raised the practical problem that the 40-percent, or 85- to 90-percent lactic acid which manufacturers persist in supplying as a commercial reagent must be depolymerized before use. There is current interest in potential applications of larger polymers of lactic acid.

Attention was directed to the properties of lactic dehydrogenase (LDH) enzymes. D. Dennis (Brandeis) presented evidence for two mechanisms of racemization of lactic acid in bacteria, one proceeding directly and the other via pyruvate. The values for Michaelis's constant (K_m) were identical for each of the lactic isomers in the former case. J. McD. Armstrong (Harvard University) discussed the complex L-LDH system of yeast that was crystallized by Appleby and Morton and is known as cytochrome b_2; this is a hemochromogen containing flavin mononucleotide. Since the enzyme converts lactate to pyruvate quantitatively, in the assay of L-lactate it has advantages over the mammalian enzymes dependent on nicotinamide adenine dinucleotide (NAD).

T. Fondy (Brandeis) reviewed the properties and roles of the five molecular forms of NAD-linked L-LDH enzymes from various species. This subject merits more consideration by workers studying L-lactate metabolism in the whole animal, who frequently tend to regard L-LDH as a single entity. It was brought out in discussion that intracellular distribution of the different forms of L-LDH has not yet been studied.

E. S. Kline (Medical College of Virginia) introduced the ticklish subject of induction of enzymes in *Escherichia coli*, using L- and D-LDH as examples; evidence presented showed that L-LDH is an inducible enzyme while D-LDH is not. More surprising was the observation that D-lactate is even more effective in inducing L-LDH than is the natural substrate, L-lactate.

Moving on to metabolism in higher systems, P. K. Tubbs (Cambridge, England) presented a stimulating historical review of lactate metabolism, with emphasis on the "unnatural" (for higher organisms, at least) isomer D-lactate. He amplified his previous reports on the mammalian mitochondrial enzyme D-LDH and provided valuable orientation on possible roles for the enzyme in the metabolism of certain amino acids. This theme was emphasized by Gordon (Monsanto), who reported on pathways for L- and D-hydroxy acids that could serve as precursors for certain essential amino acids. M. Brin (Upstate Medical Center, Syracuse, N.Y.) described a method of synthesizing D- and L-lactic acids labeled with C^{14} and discussed their utilization by mammalian and avian tissue slices from various organs. Most intriguing was his finding that several tissues used the D-isomer at rates much faster than could be explained by the appearance of the C^{14} as CO_2, suggesting, perhaps, that most of the product formed from D-lactate was used in a pathway of synthesis. O. N. Miller (Tulane) discussed the possible sig-

nificance of propanediol and the isomers of lactaldehyde in intermediary metabolism.

The next session was concerned with relations between NAD-linked dehydrogenases in mammalian cells and the validity of the concept that the ratio of L-lactate to pyruvate (L/P) in the blood represents the state of reduction of the NAD systems within the cell. H. J. Hohorst (Marburg, Germany) presented detailed data supporting the concept that the NAD systems in the cytoplasmic compartment of the hepatic cells of the rat are in a steady state; the extracellular L/P was in good agreement with intracellular L/P for the liver cells. Endocrine effects on the ratios of reduced to oxidized forms of the substrates in the liver cells were profound, but the intersubstrate relations were maintained. Hoberman (Albert Einstein College of Medicine), using preparations of lactate labeled with H^3 and C^{14} in perfused rat liver, showed that the tritium equilibrated between lactate and malate within 10 minutes but that isotopic equilibration between the H^3 of lactate and glycerol-1-phosphate was much slower. The first observation supported Hohorst's hypothesis, while the second implied that glycerol-1-phosphate and dihydroxyacetone phosphate as a pair are not major contributors to the transfer of hydrogen across the mitochondrial membrane. H. Schimassek (Marburg) reported on extensive studies on relative substrate levels in perfused rat liver and the perfusion medium; hormonal influences on this preparation were of particular interest. Glucagon and epinephrine corrected the changes in glucose-6-phosphate and fructose-1,6-diphosphate that occurred on removal of the liver and increased uptake of L-lactate, while prednisolone decreased lactate uptake and increased L/P.

N. R. Alpert (University of Illinois), using normal and hepatectomized dogs, attempted to correlate the excess oxygen consumption of the recovery period with the removal of excess lactate. Although correlation was fairly good in normal dogs, the hepatectomized group had similar oxygen consumption in the presence of a greatly reduced rate of removal of excess lactate. Alpert's conclusion was that the two events were not causally related.

In the final session, devoted to clinical problems, R. H. Dunlop (Cornell) reported on the implication of D-lactic acid in the pathogenesis of a disease in ruminants that follows excessive con-

sumption of feeds rich in starch or sugars. Bacterial fermentation in the rumen yields large amounts of L- and D-lactic acid in a hypertonic solution; D-lactate accumulates in the blood, leading to acidosis. D. I. Peretz (Vancouver General Hospital) correlated the severity of lactic acidosis with the irreversibility of shock in humans; isopropylnorepinephrine appears to be beneficial in some cases. J. B. Dossetor (Royal Victoria Hospital, Montreal) reported two cases in which the hyperlactatemia of pathological hyperventilation was alleviated by inhalation of 5 percent CO_2. L. S. James (Columbia University College of Physicians and Surgeons) discussed lactic acidosis in prenatal and newborn infants.

The conference was sponsored by the New York Academy of Sciences.

ROBERT H. DUNLOP
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Forthcoming Events

January

25–26. **Fundamental Phenomena in the Material Sciences**, 3rd annual symp., Boston, Mass. (D. B. Fay, Ilikon Corp., Natick Industrial Centre, Natick, Mass.)

25–26. **Viruses of Laboratory Rodents**, symp., Atlanta, Ga. (R. Holdenried, Natl. Cancer Inst., Natl. Institutes of Health, Bethesda, Md. 20014)

25–27. American Inst. of **Aeronautics and Astronautics**, New York, N.Y. (J. Bidwell, AIAA, 1290 Avenue of the Americas, New York 10019)

25–28. American **Meteorological** Soc., annual, New York, N.Y. (K. Spengler, AMS, 45 Beacon St., Boston 8, Mass.)

25–28. American Society of **Heating, Refrigerating and Air-Conditioning Engineers**, Chicago, Ill. (R. C. Cross, 345 E. 47 St., New York 10017)

25–28. Modern Methods of **Analytical Chemistry**, 18th annual intern. symp., Baton Rouge, La. (P. W. West, Dept. of Chemistry, Louisiana State Univ., Baton Rouge)

25–28. **Cardiovascular Diseases**, 2nd natl. conf., Washington, D.C. (C. H. Maxwell, 9650 Wisconsin Ave., NW, Washington, D.C. 20014)

25–29. American **Mathematical** Soc., Denver, Colo. (G. L. Walker, AMS, 190 Hope St., Providence, R.I.)

25–29. American Soc. for **Testing and Materials**, steel meeting, Mexico City, Mexico. (H. H. Hamilton, Public Relations, ASTM, 1916 Race St., Philadelphia, Pa. 19103)

25–30. American **Library** Assoc., Washington, D.C. (D. H. Clift, ALA, 50, E. Huron St., Chicago, Ill.)

26. Quasi Stellar **Radio Sources**, American Inst. of Physics, New York, N.Y. (E. H. Kone, AIP, 335 E. 45 St., New York)