vation and interest in the forthcoming class lecture. The "open program" technique was suggested as a method to make new and larger subject areas of knowledge amenable to programmed instruction.

K. Kroner (Federal Republic of Germany) evaluated an architect's impressions about school buildings in Detroit, Chicago, St. Louis, San Francisco, Los Angeles, Texas, New Orleans, and on the East Coast. He emphasized the versatility of purpose in American school architecture; new teaching approaches such as team teaching; advanced equipment such as tape recorders, radio, film, and TV; and space planning for provision of teaching machines; and the excellence of school libraries, with computers to be located in them in the near future. However, Kroner found no teaching machines in U.S. schools.

R. W. Schirm (Federal Republic of Germany) argued that most programs concerned with continuing education copy the techniques of programmed instruction for school children and hence impose too much guidance on the adult. Thus, such programs negate the professed advantage of this instruction—choice in following individual response. W. Zielke (Federal Republic of Germany) reported on a successful experiment with programmed instruction in industry. Joint use of conventional and programmed instruction techniques (that is, lectures followed by auto-instruction) reduced the learning time of 200 individuals from 20 to 8 hours, yielding 96 percent correct answers in subsequent tests.

Various aspects of work in programmed instruction in Czechoslovakia and Bulgaria were described. J. Kubálek (Czechoslovakia) classified learning and teaching media from the viewpoint of information theory. Several Czechoslovak experiments in programmed instruction of school children and adults were described; very favorable results have been obtained in a 3-year experiment to teach Czech grammar to 11-year-old students. As a result, the experiment is being extended to cover 700 students, according to M. Milan (Czechoslovakia). W. Hubner (Federal Republic of Germany) outlined a technique for compiling, through specially designed tests, an "error index" which eliminates unnecessary and improbable branching in program writing.

A. Šatánek (Czechoslovakia) described a fairly comprehensive effort in programmed health instruction in Czechoslovakia in which several audio-visual and programmed teaching devices that he developed are being used. Experimentation with programmed instruction and learning at the University of Economics in Prague, emphasizing auto-instruction in foreign languages, was outlined by V. Štěpán.

A. Heipcke (Federal Republic of Germany) attempted to approximate deductively the empirical learning function of Hull [*Principles of Behavior*, New York (1943)] and to define its range of validity; the resulting generalization may possibly be relevant for more complex learning processes. A large-scale effort (K. Günther) has been under way in East Germany for several years to collect data from theoretical and experimental studies; certain phases of learning and teaching foreign languages can now be formalized. These are formulated in terms of didactic and methodological guide rules, said to be based on proven scientific premises, which find application in teacher education.

The program of the working groups was less formal in the sense that it concerned itself at least partially with problems of narrower scope, often limited to the experience or practice of an individual group or situation. Included were several demonstrations of locally manufactured devices and experimental products, most of them relatively unsophisticated and inexpensive.

In practice, programmed instruction is still in the experimental evaluation stage in the Federal Republic of Germany. However, plans are being discussed for its more formal introduction on a broader scale, primarily at the precollege level. There are many inexpensive devices for auto-instruction. Work on more complex learning devices is being done at the Center for New Learning Processes at the University of Tübingen, and at such private institutions as the I.L.S. Economic Institute for Learning Systems, Inc., in Frankfurt. All the teaching universities of the Federal Republic of Germany are in some measure concerned with programmed instruction, especially the German Institute for International Pedagogical Research in Frankfurt. No evidence was found of any large-scale system of computer-aided instruction either in existence or being implemented, or of any significant work in the design of question-answering systems such as has gone on in the United States for the past 5 years.

The European interest and work in the area of programmed learning and teaching indicate that future symposiums may become an annual international event of major importance in this field in Europe.

My attendance at the symposium was made possible by a travel grant from the National Science Foundation. It is a great pleasure to acknowledge this support, and the opportunity it provided to review the activities in this field in Europe.

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Mental Retardation

Many cases of mental subnormality resulting from infectious diseases seem to escape the epidemiologists today. More exacting techniques of epidemiology and more precise measurements are required. The incidence of iatrogenic brain damage needs to be reduced. Also, there exists a large gap between knowledge and utilization of preventive techniques.

These subjects were the main topics discussed at a recent research conference on the Prevention of Mental Retardation through the Control of Infectious Diseases, held in Cherry Hill, New Jersey, 9–11 June 1966. This conference was the first of a series to be held on the recommendation of the President's Panel on Mental Retardation. Participants represented the United States, Mexico, Sweden, Denmark, and Austria.

In surveying the literature, Berendes (National Institute of Neurological Diseases and Blindness) said there is considerable knowledge about many infectious agents that contribute to mental retardation but little precise information on the incidence. Mild forms of retardation are considerably more frequent than severe cases but are rarely reported, and the data even for severe cases are not precise since information about infectious disease is often based on recall. Many infections, particularly viral ones, present a mild or atypical clinical picture, and often are not recognized. Berendes cited three attempts to estimate infectious disease etiologies in groups of men-

tally retarded, institutionalized children. In these, infectious processes are listed as the cause in 9, 7, and 4 percent of the cases. One study of children with cerebral palsy showed that infectious diseases were responsible for 21 percent. In another, of 143 children with acquired cerebral palsy, infections of the central nervous system were listed as the cause in 67 cases, or 60 percent.

Maternal and fetal infections from such viral agents as herpes simplex, hepatitis, cytomegalovirus, rubella, and vaccinia and from bacteria such as *Escherichia coli, Pseudomonas aeruginosa, Staphylococcus albus, Proteus vulgaris*, and pathogenic cocci dominated discussion by John Sever (National Institute of Neurological Diseases and Blindness), Kurt Benirschke (Dartmouth Medical School), and Heinz Flamm (Vienna). Between 10 and 20 percent of delivered placentas show an acute inflammatory infiltration in the fetal membranes, and less often in the umbilical cord, said Benirschke. In what he termed the amniotic sac infection syndrome, Benirschke said this leukocytic migration usually is in response to an infectious agent within the amniotic fluid which has gained access from the vaginal-cervical tract either before or after rupture of the membranes. Thus, the pus can be aspirated by the fetus. It is far more frequent in premature deliveries, and Benirschke believes the inflammation often is the cause of premature labor. Conceding that the topic is controversial, Benirschke also believes the evidence is in favor of an infectious etiology even though a majority of newborns with an inflamed placenta show no clinical evidence of infection and have an uneventful neonatal course. Babies dying of bacterial infections in the neonatal period or having a clinical infection are invariably associated with an inflamed placenta, he said. Flamm said the means of entry of viruses into the fetus is not yet clear, but is believed to be similar to that of bacteria. Bacteria infecting the fetus can originate in the maternal blood, in local processes in the genital region or abdominal cavity, or can be introduced by criminal abortion or rupture of the membranes. Sever commented that development of vaccines with even short periods of immunity could greatly assist in overcoming disease in the fetal area of infectious processes and the resulting central nervous system sequelae.

Eichenwald (The University of Texas Southwestern Medical School) emphasized the importance of long-term follow-up in evaluating the results of infections. He reported a series of 17 premature infants with mild diarrhea of proven viral cause. Five years later, 16 showed severe neurological damage, whereas in a control group of 28 premature infants, 7 showed minor neurologic changes.

Raymond Adams (Massachusetts General Hospital), outling mechanisms of neuropathologic reaction, said only in early embryonal life will tissue damage cause maximal damage to the nervous system without an inflammatory response. In the antenatal period the nervous system is most vulnerable to infective agents, and infection may result in fetal death and miscarriage or in survival with variable injury to the nervous system. The majority of fetal infections are viral, treponemal, or protozoan. One of the most treacherous infections in early infancy is bacterial meningitis, because diagnosis may be delayed and thus much damage results. In early childhood, the whole range of direct infective inflammation, post-infectious auto-immune processes, and toxic encephalopathies consequent to systemic infection appear. Each is capable of seriously injuring the nervous system and resulting in mental retardation. Adams pointed out that only by understanding the mechanisms will ways of preventing or interfering with the processes be found.

R. Walter Schlesinger (Rutgers Medical School) noted increasing evidence implicating viruses in the genesis of chronic degenerative diseases, congenital malformations, and malignant tumors. He suggested that viruses may play a larger than suspected role in brain damage. Schlesinger said the direct attack of isolating, identifying, and culturing viruses and reproducing pathological lesions may uncover only some of the possibilities of the role of viruses and other intracellular pathogens in mental retardation, and may miss possibilities in other areas of research. The production of infectious progeny virus is not a necessary *sine qua non* of infection or cell damage, he said. Schlesinger asked if it is possible that viruses, acting as bearers of genetic information, may play a role in the genesis of those hereditary or acquired mental deficiencies for which a biochemical basis has been found.

Knox Finley (San Francisco) said postnatal infections as a cause of men-

tal subnormality would be considerably more common than presently considered if a broader definition of subnormality were used, and if all such cases were identified. There are differing opinions over differential diagnosis between febrile convulsions and convulsions due to encephalitis. He said etiology remains an open question, but fever convulsions should not be overlooked as a warning of an otherwise subclinical encephalitis that is a potential contributor to mental retardation. Frederick Robbins (Western Reserve School of Medicine, Cleveland), deplored the tendency to think of mental retardation in gross terms and urged that consideration be directed toward those with less evident degrees of loss of mental capacity. In the latter category would be persons who do not necessarily fall below what is considered normal today, but what may not be normal for those individuals. Frederick Gibbs (University of Illinois School of Medicine) discussed the use of electroencephalograms and described the slowing of brain waves during acute infectious episodes as a potential means of predicting sequelae in the central nervous system. However, Albert Sabin (Children's Hospital Research Foundation, Cincinnati) and others in the audience questioned whether present criteria are adequate to make such measurements meaningful.

Sequelae of postnatally acquired direct and indirect infections of the central nervous system in infants, and effects on the fetus of therapy of infectious processes in mothers, were considered by Saul Krugman's (New York University Medical Center) panel. Krugman commented that in the previous 4 months he had observed five cases of measles encephalitis, 3 years after the introduction of a safe and effective vaccine. He said there is need for more education, not necessarily of the public but of physicians, who think that naturally acquired measles is benign and who are not aware of the incidence of measles encephalitis. Laurence Finberg (Montefiore Hospital and Albert Einstein College of Medicine, New York City) said that problems associated with water and electrolyte imbalance in indirect infections, specifically infectious diarrhea, are of far greater consequence in damage to the central nervous system than those of direct infections in the nervous system. Management of physiologic disturbances in in-

fantile diarrhea is more important in salvage and prevention of brain injury than specific treatment. Finberg said hyponatremic dehydration accompanying infectious enteritis is common in poorly developed countries, and evolutionary development has given considerable protection for the brain against this challenge. But in more developed countries with what are considered advanced eating practices, hypernatremic dehydration is more common. It accounts for 16 to 25 percent of hospitalized dehydration problems in Europe and North America. Evolution has provided very little in the way of protective mechanism for the brain against this hazard of civilization. The two most important mechanisms through which damage to the central nervous system occurs in infectious diarrhea are hemorrhaging and alterations of the colligative nature of intracellular solute, Finberg said. While mechanisms of nervous system damage are generally agreed upon, management and prevention remain controversial. Philip Dodge (Massachusetts General Hospital, Boston) commented that in some areas of the United States infant diarrhea is one of the most important measurable causes of mental retardation; much of this damage could be eliminated by application of current knowledge. Several participants commented that sources of public health funds are not as sympathetic to programs which would combat brain damage from diarrhea as they are for statistically lesser problems such as phenylketonuria.

Julius Richmond (University of the State of New York College of Medicine, Syracuse), considering cultural and social factors, said that 20 to 30 percent of the U.S. population lives in poverty, and that in many underdeveloped areas of this otherwise overdeveloped country illiteracy frequently is a factor working against the prevention and control of infectious diseases. In less developed countries, said John Gordon (Massachusetts Institute of Technology), failure of the population to grow is primarily one of multiple repeated infections. Herbert Birch (Albert Einstein College of Medicine) and Leon Eisenberg (Johns Hopkins) contributed discussion on the influence of nutrition and cultural factors on the incidence of mental retardation and infectious disease and pointed out some of the problems encountered in cross-cultural studies.

Hilary Koprowski (Wistar Institute,

Philadelphia) pointed out that rabies incubates up to 2 years and scrapies up to 6 years; he said there may be many more unidentified, slow viruses responsible for destruction, proliferation, or dysfunction of tissue. He said the recent development of a syndrome resembling kuru in four chimpanzees suggests that a slow viral agent may be implicated in kuru and other nervous system diseases of as yet unknown etiology. Geoffrey Edsall (Boston) said many causes of mental retardation, perhaps totaling 20 percent, are completely unexplained. Sabin, summarizing the discussion, said it is still unclear what proportion of mental retardation is caused by infectious diseases, alone or combined with other processes. Estimates range from 5 to 10 percent or more. Sabin pointed out that not only is there a need for further research, but that application of knowledge already accumulated would lead to a sharp reduction in the toll of mental retardation.

The conference was sponsored by the National Institute of Child Health and Human Development, the Department of Pediatrics at the University of Texas Southwestern Medical School, and Children's Medical Center in Dallas. Heinz Eichenwald (University of Texas Southwestern Medical School) was general chairman.

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Forthcoming Events

September

26–28. **Organic Geochemistry**, 3rd intern. mtg., Imperial College of Science and Technology, London, England. (G. D. Hobson, Geology Dept. Imperial College of Science and Technology, London S.W.7)

26–28. **Point Defects in Non-Metallic Solids**, mtg., British Ceramic Soc., Falmer, England. (J. P. Roberts, Houldsworth School of Applied Science, Univ. of Leeds, Leeds 2, England)

26–30. **Animal Care Panel**, 17th annual mtg., Chicago, Ill. (J. J. Garvey, 4 E. Clinton St., Joliet, Ill. 60434)

26–30. **Health Physics**, 2nd autumn symp., Pecs, Hungary. (Eötvös Loránd Fizikai Társulat, Szbadság ter 17, Budapest 5)

26–3. **Bionic Models of the Animal Sonar System**, symp., Frascati, Italy. (R. G. Busnel Laboratory of Acoustical Physiology, Domaine de Vilvert, Jouy-en-Josas, Seine-et-Oise France)