equilibrium established by a variety of reducing agents, which led Wainio to conclude that different forms of this cytochrome exist, at least in his preparation.

Kamen ended the symposium with a short discourse, in which he stressed the importance of the structural and immunological implications of the recent elaboration of the tertiary structure of cytochrome *c* and c_2. He expressed the hope that primary sequence determinations of cytochrome *c* will lead eventually to the elucidation of its structure, or to its chemical synthesis, and that the chemical synthesis of other cytochromes would be achieved as well. Kamen reminded the gathering that the difficulty in interpreting the results from various preparations of the oxidase extracted from cells and tissues still remains.

A full publication of the Symposium will be edited by Kazuo Okunuki and Martin D. Kamen. It will be published by the University of Tokyo Press.

BRITTON CHANCE
School of Medicine,
University of Pennsylvania,
Philadelphia 19104

Phenotype: Postnatal Development

An international symposium on the Postnatal Development of Phenotype was held 18–22 September 1967 at the castle of Liblice, Czechoslovakia, under the auspices of the Czechoslovakian Academy of Science. The organizer of the conference was Jiri Krecek (Institute of Physiology, Prague) and the general chairman was R. A. McCance (Infantile Malnutrition Research Unit, Uganda) who was awarded the Purkyne Medal by the Czechoslovakian Academy of Science during the meeting.

In one of the opening papers, Krecek described his Institute's research program on the effects of early weaning in rats; he stated the thesis that the period of weaning in mammals is a critical one inasmuch as several basic physiological processes are being reorganized at this time, particularly those involving salt balance, general nutrition, and fat intake. Other workers described the results of early weaning (defined as weaning at 16 days of age). V. Novakova reported that rats who were weaned early elaborated a conditioned reflex less rapidly than those weaned at 30 days of age and also that the adult brains of these animals showed deficiencies of RNA content in certain neurons. M. Kraus reported that aldosterone regulation was affected by early weaning, and V. Palaty reported that androgenic activity in males is adversely affected. Thus there is objective evidence that the period around 16 days of age in the rat is a critical one for several processes. Not all effects are as definite as the above, as P. Wiener found with studies of gastric erosion. S. Kazda described a pilot study of human adults indicating that reproduction and certain kinds of pathology may be affected by early weaning.

An earlier period of development, namely the first few days after birth, appears to be a critical one in rats for the development of normal sexual behavior and reproduction. Papers by C. A. Barraclough, N. Takasugi, G. Mayer, and I. Ostadalova demonstrated that females can be sterilized by injections of either estrogens or androgens at this period, and that males are sensitive to estrogen which causes involution of the seminiferous tubules and inhibition of growth later in life. J. M. Tanner presented a series of diagnostic stages for measuring skeletal maturation in rats as a technique for measuring some of the effects of sex hormones. H. Peters reported that the mouse ovary is unusually sensitive to x-rays between 14 and 21 days of life and that a single dose of 20 roentgens at this time will cause the development of ovarian tumors and consequent sterility in adult life.

The physiological responses of the adrenal cortical stress mechanism in response to infantile stimulation were discussed in detail in papers by Levine, Denenberg, Zarrow, Ader, Angermeier, and Kincl. S. Levine showed that the release but not the synthesis of steroid by the adrenal is refractory to corticotropin from 3 to 15 days of age. M. X. Zarrow and V. H. Denenberg emphasized the ability of the adrenal gland of the 2-day-old rat to respond to ACTH and to systemic stressors with increased corticoid release. Thus the impact of early handling could be mediated by means of the corticoid release of the neonatal rat. These authors emphasized that the ability of the gland to respond was a continuation of the embryological development seen in the fetus. Another significant paper was that by I. A. Arshavski, who found that growth can be stimulated both before and after birth by appropriate and moderate stress conditions which result in increased physiological activity and hence better nourishment. This suggests a physical mechanism through which the effects of early stimulation on growth could act.

Another group of papers by E. M. Widdowson, G. C. Kennedy, J. Cravioto, J. MysPivecek, H. A. Waisman, J. Lat, and K. V. Shuleikina dealt with undernourishment and various nutritional factors on the development of the young organism. Of particular interest was the study of undernourished children by Cravioto. He reported that children whose height had been seriously affected by undernutrition also showed a deficiency in tests involving geometric form recognition. Widdowson (in pigs) and Waismann (in an unusual human case) gave evidence that considerable recovery of growth can follow early starvation. If there is a critical period for this effect, it is quite long. Shuleikina reported success with recording EEG's of kittens during feeding and other normal activities, an important technical advance in the recording of developmental changes in neurophysiology.

Another series of papers dealt with the development of the heart and problems of hypertension. K. Rakusan and O. Poupa reported that exercise plays a critical role in early development of the capillary circulation of the heart. Exercise in adults results only in an increase in size of fibers. J. Jelinek reported that the process of organization of the functional system regulating the homeostasis of water and electrolytes is active only before sexual maturation and therefore that there is a critical period for the development of salt hypertension. A. Grollman reported that administration of a variety of toxic agents during certain critical periods in pregnancy causes inhibition of development of the embryonic kidney and consequent gradual development of hypertension in adult life. H. Musilova noted that adult hypertension could be developed by treating young rats with DCA plus a high salt diet.

J. P. Scott summarized experimental evidence on the critical period for primary socialization in the dog and commented on the general theory of critical periods and its implications. This theory, that the time when an organizational process is proceeding most rapidly constitutes a period when it is most easily modified, will apply to organizational processes on any level. It follows that the analysis of a critical-

period effect depends upon the identification of the processes concerned. The major scientific progress reported at this conference came about largely because workers were able to identify and measure physiological organizing processes, with the result that periods of rapid organization and consequent critical-period effects could be easily recognized.

The proceedings of the conference are being edited by S. Kazda and V. H. Denenberg and will shortly be published by Butterworths (London) and Academia (Prague).

J. P. SCOTT
Bowling Green State University, Bowling Green, Ohio 43402

Systematics Workshop

Those interested in the future of systematics have been concerned because little emphasis is being given to the training of competent systematists by many universities. Indeed, several universities are said to no longer consider a taxonomic study worthy of a Ph.D. candidate. In addition, many present systematists are little versed in newer methods of determining genetic relationships. Proceeding apace with this is the fact that the number of systematists who are competent to deal with more than a minor part of any large major group of animals is small indeed. As a consequence of these facts, the responsibility for maintaining systematic knowledge and training systematists has in recent years shifted increasingly to the larger museum centers, one of the most important being the U.S. National Museum of the Smithsonian Institution. It was then entirely appropriate that the Smithsonian sponsored last summer a 3-week workshop in systematics, chiefly aimed at young professors who are not connected with a university which is now a major center in systematics. Twenty-five participants from 22 universities and colleges heard about new methods and results in systematics from 15 leading practitioners, chiefly from outside the Smithsonian, in morning sessions, and worked at the Museum with its resident staff in their specialties in the afternoons.

Two chief highlights of the workshop were in the contrasting of methodological bases for determining classifications of organisms, and in contrasting methods for obtaining systematic data. The sequence of events in genetic changes was emphasized by H. R. Stalker who determined the sequence of chromosomal inversions in *Drosophila*. This is a cladistic (or branching) approach toward forming a classification and markedly differs from the methodology of phenetics which emphasizes the degree of similarity independent of the way in which similarity was achieved.

A good example of new phenetic data was provided by C. G. Sibley who summarized his thousands of pieces of data on proteins in bird muscle and eggs. The protein data were treated in the same way as the more classical morphological data; a classification was derived based on degree of similarity. This phenetic approach was carried to its logical endpoint by R. R. Sokal who used computers to add up the number of characters held in common among taxa and then applied statistical techniques as a means to quantify degrees of similarity. The assumption is that those taxa with more characters in common are (probably) more closely related to each other than to others. The lack of concern by Sokal and other pheneticists for determining phylogenetic relationships (as opposed to a general classification) reduced the effectiveness of this approach for those whose chief interest in systematics is evolutionary history.

Very significant taxonomic data have come in the past decade from the field of animal behavior. For example, the extremely difficult questions surrounding field cricket systematics were greatly aided by analysis of cricket calls. At the workshop, R. D. Alexander told of this work, which led to a discussion of the possibility of sympatric speciation. Again, the fresh light thrown on this subject by behavior—this time from analysis of breeding periods—showed that ethology is of great importance for systematics.

As zoologists become biochemists, paleontologists are gradually filling the niche of those whose chief interest is the natural history of a major group of organisms. This has been generally true for several years for some major taxa (Foraminifera, Ostracoda, and some extant groups of Mollusca), but is becoming increasingly widespread (Dinoflagellata, Brachiopoda, and Ectoprocta). Indeed one of the workshop's most interesting presentations was by C. Ray who showed how reasonable hypotheses about the life habits of fossil mammals could be derived from data based on living species. The often-heard complaint that an inadequate fossil record prevents phylogenetic or ecologic analysis is often only an excuse for not making use of the vast amount of paleontological material which can be interpreted.

In summary, the workshop benefited the field of systematics in several ways. Most directly assisted were the participants who were brought up to date on newer methods, whose analytical powers were well tested, and whose students should be better trained. The Smithsonian benefited because systematists in general were made increasingly aware of its broad and fundamental interests in the development of their science. All who attended hope that similar workshops will be held in the future, possibly next time focusing attention on botanical systematics.

THOMAS J. M. SCHOPF
Marine Science Center, and Department of Geological Sciences, Lehigh University, Bethlehem, Pennsylvania 18015

PETER L. AMES
Museum of Vertebrate Zoology, University of California, Berkeley 94700

Human Histocompatibility Locus HL-A

Ten years have passed since the first human leukocyte isoantigen was recognized by in vitro techniques. The significance of that discovery was not fully appreciated until several years later, and only recently has it been proved that the first antigenic specificity, Mac, was one of many components of one very complex system.

Increasing numbers of investigators have become attracted to the study of leukocyte antigens because these antigens are also present on a wide variety of tissue cells. On the tissues, a number of these factors serve as, or are closely associated with, transplantation or histocompatibility antigens and are implicated in graft rejection. The investigations have been greatly accelerated by the discovery that the isoantibodies to leukocytes were present in serums from multiparous women. The introduction of simple computer programs made possible the comparison of large numbers of serums, revealing systematic differences and similarities.

Many leukocyte isoantigens have now been detected. From a consideration of the intricate relations among ten dis-