Riché on demographic problems of the High Middle Ages; J. N. Biraben on the population of French Canada from the seventeenth century to the present day; E. Vielrose on migration within the United States during the second half of the eighteenth century; K. Obermann on some statistics of the states of the German Confederation during the first half of the nineteenth century; and P. Galliano on infant mortality in the southern suburbs of Paris, both of the children born there and amongst those in charge of a wet-nurse, in the years 1774–1794. There is also a very interesting article by M. Couturier on the use of the computer in historical demography.

Readers of THE EUGENICS REVIEW will no doubt be especially interested in A. Armengaud's article on the working-class movement and neo-Malthusianism in early twentieth-century France. This deals with Paul Robin and his Ligue de la Régénération humaine and its impact on various left-wing groups. It appears that neo-Malthusianism had some support among the Syndicalists but that the Socialists were strongly opposed to it, although, curiously enough, it was never discussed at their party congress. The socialist opposition to neo-Malthusianism was put as succinctly as it ever has been by a certain Dr. Vargas, cited by Armengaud. "Le néo-malthusianisme", he wrote, "ne tend qu'a améliorer un état de choses dont l'existence n'est pas mise en question et qu'au contraire, nous, revolutionnaires, cherchons à détruire".

In addition to these articles, the *Annales* includes a number of book reviews and comments on recent events and developments in the study of historical demography. M. Reinhard, for instance, reports on the demographic history section of the Twelfth International Conference of Historical Sciences held at Vienna in 1965. P. Goubert does likewise for the colloquium on problems in the study of mortality held at the University of Liège in 1963. Amongst other items is a note by E. A. Wrigley on the work of the Cambridge Group for the History of Population and Social Structure.

This brief summary is sufficient to indicate that the *Annales* is by no means confined to French historical demography. This is also true of the splendid bibliography, of some 150 pages, of which about half covers either countries other than France or methodological works of universal concern. My only criticism here is one that can be directed at many bibliographies. One cannot be sure that the coverage is equally comprehensive in all areas, whilst on occasion it is difficult to see why some titles appear and others do not. The bibliography is divided between recent publications and important publications of earlier years.

The final feature of the *Annales* is a section devoted to documents. The current number contains some eighteenth and nineteenth century Czechoslovakian statistics: annual population totals from the Kingdom of Naples, Sicily and the towns of Naples and Palermo from 1790–1824 and a collection of baptism, marriage and burial statistics from Languedoc in the period of the French Revolution, designed to illustrate the extent of contraceptive practice at that time.

The *Annales de Démographie Historique 1966* is one of the most important publications of the year. It, and one hopes its many successors, should occupy a prominent place on the shelves of all who are interested in population history.

MICHAEL DRAKE

GENETICS

Cold Spring Harbor *Symposia on Quantitative Biology*. Volume xxxi. *The Genetic Code*. Cold Spring Harbor, N.Y., 1966. Laboratory of Quantitative Biology. Pp. xxii + 748. Price $15.00.

DURING THE FIRST WEEK of June 1966, molecular biologists from many countries met at Cold Spring Harbor for the Annual Symposium. They were gathered for what was, in

effect, a celebration of the elucidation of the genetic code. The Symposium also provided an occasion to celebrate the fiftieth birthday of Francis Crick, who had contributed more than any other individual to the solution of the problem. Serious attention to the nature of the genetic code had been made possible by the discovery, by Watson and Crick, of the structure of deoxyribonucleic acid (DNA) in 1953. This discovery led to the formulation of numerous hypotheses about the relationship between the linear sequence of bases, or base-pairs, in DNA and the sequence of amino-acids in proteins. The stages in the clarification of this question, outlined by Crick in a brilliant introduction to this Symposium volume, provide several interesting examples of clever, but wrong, ideas that pop up every now and then and achieve a hypnotic hold on peoples' minds.

The need to code for twenty different amino acids by means of a DNA language containing only four letters, the four bases, suggested that the base sequence was probably read in groups of three; this assumption has turned out to be correct. Groups of three bases can exist in $4^3 = 64$ possible configurations, more than enough to specify the twenty different amino-acids. Were all 64 possible triplets used to specify amino-acids, in which case several different triplets must code for the same amino-acid and the code was "degenerate", or were only twenty triplets "meaningful"? The famous "comma-less code", proposed in 1957, provided a most persuasive rationale for a model of the second kind and quickly gained widespread favour. We now know that this proposal is wrong and that the code is essentially completely degenerate. Crick writes in his introduction: "it seems highly likely that the 'comma-less code' would be widely accepted to-day if we did not have such good experimental evidence against it, simply because it can be derived in a very elegant manner from a rather sensible postulate". Other questions that had to be answered were whether proteins were assembled directly on the DNA template, whether base triplets were read in overlapping groups of three, and whether their specificity resided in a direct physical relationship between the triplet structure and the corresponding amino-acid. The answer in each case has turned out to be in the negative. Stretches of DNA coding for one or more protein products are first transcribed into ribonucleic acid (RNA) molecules and the sequence of bases in this RNA is then translated into proteins by reading successive non-overlapping triplets. The process of matching the triplets with the correct amino-acids depends on base-pairing between the "codon" triplets in the RNA and corresponding "anticodon" triplets on special adaptor molecules (transfer RNA) to which the individual amino-acids are attached. A major hurdle in cracking the code was surmounted by the demonstration that the RNA molecules acting as intermediaries between DNA and protein were not, as everyone had assumed, the ribosomes, but a previously unidentified unstable fraction of cellular RNA, the "messenger" RNA. This discovery was followed soon by the real breakthrough—the demonstration that a simple artificially synthesised molecule, polyuridylate, consisting of a repeating sequence of uracil nucleotides, could act as a messenger *in vitro*, and coded for the formation of the polypeptide polyphenylalanine. The subsequent elucidation of the complete code using more complex artificial messengers and other techniques took only a short time, due to the effort and ingenuity of several remarkably large groups of workers (the first three papers in the Symposium have an average of ten authors each.)

The astonishing variety of approaches which have been combined to yield a complete knowledge of the code are very well illustrated by the eighty-eight contributions to this Symposium. There are detailed reports of the *in vitro* studies with artificial messengers by the groups of Nirenberg, Matthaei and Khorana, and of the recent remarkable findings concerning the signals in messenger RNA that code for the initiation and termination of polypeptide chain formation. There are also reports by Yanofsky, Garen and others of the analyses of amino-acid replacements resulting from single-step mutations. These have been

particularly important in confirming the validity of the conclusions from *in vitro* studies and provide striking evidence for the universality of the genetic code.

A great merit of this Symposium volume is that the subjects are by no means restricted to the elucidation of the genetic code in its strict sense, i.e. the meaning of the 64-word language of the DNA or RNA base sequence. Detailed accounts are given of recently acquired knowledge of the biochemical mechanisms involved in the various steps in translation of RNA messages into protein, and of the structure of transfer RNA molecules and their interactions with messenger RNA. In addition, there are many excellent contributions devoted to the regulatory processes that control which segments of the totality of "information" stored in DNA are transcribed into messenger molecules under different environmental conditions and are thus expressed in the cell in the form of active proteins. These studies are particularly relevant to models of the mechanism of cellular differentiation in higher organisms.

This volume is not light reading but it should prove invaluable for anyone interested in the wide and rapidly progressing field which it covers.

JULIAN D. GROSS

Asimov, Isaac. *The Genetic Code.* New York and London, 1962 (original edition). Signet Science Library: New American Library. Pp. xiv + 187. Price 5s. Paperback.

THIS PAPERBACK BOOK sets out to explain to the general reader who has little or no background of biology or chemistry the "astonishing breakthrough" represented by the progress of molecular biology in recent years and to look at the possibilities of "genetic engineering" for the future.

Professor Asimov describes only those chemical features of molecules necessary to put together a coherent story of elementary organic chemistry and then describes the relationships between molecules by analogy with everyday relationships such as words in sentences. Building on this foundation he describes organic molecules, proteins, enzymes and the like. He puts the question as to how information about the organization and functioning of animal or plant body is passed from generation to generation. He locates the information in the chromosomes and continues the detective story by describing the structure of the nucleic acids by the same methods as before. This part ends with the structure and significance of the double helical constitution of the DNA in the chromosomes.

In the course of the story of protein synthesis he shows the relationship between DNA, messenger RNA and transfer RNA. He elegantly describes the idea that certain triplets of mononucleotides and their position in the DNA chain control the sequence of amino acids in a protein chain. He describes what is known about the correspondence between specific triplets and specific amino acids. Having thus outlined the "genetic code", Professor Asimov speculates as to the future and upon the possibility of repairing genetic deficiencies and even synthesising new proteins to control chemical reactions *in vitro*.

It may be objected that the book is superficial, containing little of real biochemistry and relying on a number of simplifications. But that would be to miss the point of the work which is to convey to the ordinary reader what has been going on in molecular biology. It is successful not only in this respect but also in conveying the great intellectual satisfaction and excitement generated by these discoveries.

K. W. WILKES

McKusick, Victor A. *Mendelian Inheritance in Man; Catalogs of Autosomal Dominant, Autosomal Recessive, and X-linked Phenotypes.* Baltimore, 1966. Johns Hopkins. (London, Heinemann). Pp. xvii + 344. Price 60s.