The final section of this first part deals with equipment and procedures, including also a comprehensive set of staining recipes. It brings together many methods and should prove to be a useful source of information on the multiplicity of enzyme staining systems now available.

The second volume of this series (Part B) is a summary of the state of knowledge of isozymes of twenty-one crops. Needless to say the information on some, such as maize, where seventeen enzymes controlled by thirty-seven loci have been examined, is a lot more than for example sunflowers, where only two enzymes with three genes involved have been surveyed. The majority of chapters review the various enzyme systems that have been examined within that crop, presenting where known, the genetic basis of any isozyme variation and in some instances the chromosomal location and linkage relationships of the controlling genes. These reviews should provide a most useful database for any future research worker wishing to ascertain the state of knowledge on specific enzymes over a range of plants. Whilst a standard nomenclature is available it has not been insisted upon by the editors, perhaps because authors were required to present paper in a photo-reproducible form. Apart from this minor criticism, the editors and their authors have produced two most useful volumes which will serve to be the basic reference works for any future student of isozymes in plant genetic research and breeding.

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ADVANCES IN HUMAN GENETICS VOLUME 13. Edited by H. Harris and K. Hirschhorn. Plenum Press, New York and London. 1983. Pp. xix+312. Price: $(US) 42.50

In this 13th volume the two medically qualified editors have done the profession proud for of the five topics selected four are of considerable clinical and practical importance. Furthermore, although the contributors have obviously been instructed to go into their subjects in depth yet they have also, I surmise, been told to begin at the beginning so that readers can gradually be led into the complexities which inevitably accompany rapidly developing subjects. For example, in "The Genetics of Blood Coagulation" (Graham *et al.*, Chapter 1) the end result must be a plug to stop the bleeding, but the steps involved in this are numerous—constriction of blood vessels, aggregation of platelets to damaged surfaces and finally the formation of fibrin clots. These are all regulated by enzymes which function as a cascade, each releasing an active factor from an inert precursor and all are under genetic control. Therefore at each step there may be abnormalities, and most of these mutants and variants have been recognised from a study of patients, haemophilia being the classical example (deficiency of clotting Factor VIII). But lack of "contact factors" may also inhibit coagulation, for example a defect in Factor XI which produces a bleeding disease found particularly in Ashkenazi Jews. Factor XIII, the last in the line, is responsible for the stabilisation of fibrin and its efficiency (controlled by an autosomal recessive gene) may lead to a faulty clot with the result that bleeding occurs from the umbilical stump a week or so after birth.

Fibrinolysis involves the activation of plasminogen to plasmin and mutants affecting the former may lead to thrombotic tendencies after trauma.

The future for clotting factors probably lies in molecular genetics, since, with the techniques there, the Factors can be produced in pure form.

This is a complicated Chapter but it is well introduced and full of useful information for haematologists.

Gillian Turner and Patricia Jacobs, "Marker (X)-Linked Mental Retardation" (Chapter 2), also led me gently from the beginning. Since the 19th century all surveys of the mentally retarded have shown a male excess of approximately 25 per cent. The next step was to recognise that the unusual ratio results primarily from genes inherited on the X-chromosome but that heterozygous expression in the female may contribute to the aetiology of mild intellectual handicap and learning problems in that sex.

Then came the discovery of a cytogenetic marker on the X which was clearly associated with mental retardation and a characteristic phenotype, including large testes. This was the fragile or marker X, the abnormality being in band 28q of the X-chromosome. It could however only be seen in a proportion of the lymphocytes of affected males and in a much lower proportion of the cells of some carrier females.

By 1981 it had been discovered that the marker X could be demonstrated in fibroblasts provided there was thymidine deprivation in the culture medium, which could be achieved by the addition of FUdR or methotrexate. This was a great advance as fetal cells (aminocytes) could then be tested for the abnormality.

Many aspects of the relationship between the marker and the disease are still unclear. It is never seen in all the cells of an affected male and rarely, if ever, in excess of 50 per cent. Because of the effect of culture conditions on the number of marker X chromosomes the authors have largely restricted their analyses of the effect of age and IQ on the proportion of marker X positive cells to data collected in their own laboratories under standardised conditions. As regards IQ they found no suggestion of any correlation between the level of retardation and the proportion of marker X positive lymphocytes, though analysis of the New South Wales sibships suggested that there was a *within sibship* correlation. The authors also found no significant effect of age on the proportion of cells showing the abnormality, the males tested ranging from between less than one year to over 65. Most remarkable of all, very occasionally the marker X has been found in apparently normal males, however we do not yet know whether such individuals have minimal symptoms of the disease or are truly asymptomatic carriers.

Chapter 3, on "Human Antibody Genes", (Ellison and Hood) is streets behind the other sections and I found it very disappointing, particularly as it was the one I had most looked forward to reading. My comments are as follows:

(a) It did not start at a simple enough level.
(b) The usefulness of the homologies between mice and men was not clearly explained, and it would have been helpful to have more examples of relevant disorders in both species. The authors' style of writing is uniminaginative—to say nothing of split infinitives.
(c) Agreed that molecular genetics has a lot to contribute to immunology but human monoclonal antibodies are scarcely news.

Danks and Camakaris (Chapter 4) write about mutations affecting trace elements in humans and animals, using a genetic approach. They deal principally with copper, which like the others is toxic in the free ionic form,

necessitating a carefully organised system of transport, moving the element from the intestinal lumen to the site of action and thence to the point of excretion from the body. These processes are under genetic control, and mutations in experimental anaimals or in tissue culture systems give or will give the clue as to the normal mechanisms.

Deficiencies in domestic animals have played a large part in the elucidation of the essential need for copper, cobalt, manganese and selenium, in rats for zinc, and in man for chromium since the introduction of total parenteral nutrition.

Wilson's disease (an autosomal recessive where there is toxic accumulation of copper in the liver and elsewhere) is discussed in detail, and the contradictory findings between the success of liver transplants—suggesting that the defect is only in the liver—and the fact that fibroblast cells from skin biopsies show abnormalities of copper handling, make it a condition still full of interest.

Menkes' disease, like Wilson's occurring about once in 100,000 live births, is X-linked, but it has now been shown not to be its mirror image—*i.e.*, it is not the result of an overall copper deficiency but is due to a defect in copper transport affecting most cells of the body.

Iron has never struck me (nor my general physician colleagues) as being a trace element, but a chemist pointed out to me that we were wrong— iron is so efficiently utilised in the body that only minute amounts need to be ingested (anyhow in males). Mice become iron-deficient if they carry the X-linked "mottled" mutants and the defect is in the placental transport of the metal and it is readily curable by parenteral injections (compare Menkes', above).

Finally zinc, where acrodermatitis enteropathica (AE) was recognised in man because of its resemblance to zinc deficiency in animals. Though the basic defect in neither is known, the condition is curable by supplementing the diet.

Two out of three infants born to a woman with untreated AE were malformed, one has anencephaly and one skeletal abnormalities, so there is a possible relationship between zinc-deficiency and neural tube defects.

Chapter 5 on phenylketonuria (PKU) and its variants, by Seymour Kaufman, is a masterpiece and an excellent example of the more you know about a disease the more there is to know—and it has taught different lessons to different groups of investigators. The geneticists found in it the earliest and most complete evidence in favour of Garrod's thesis of the disorder caused by the inherited deficiency of a specific enzyme. The biochemists elucidated where the block lay—in the conversion of phenylalanine to tyrosine. Then lastly the neuroscientists; they pointed out that though brain damage was *the* feature of PKU the primary enzyme defect lay in distant organs, the phenylalanine hydroxylating system being located exclusively in the liver and kidneys. The doctors, however, being practical souls found an effective therapy for the condition long before the pathogenesis was worked out.

Most recently has come the discovery of the variant forms of PKU. These are the result of defects in the metabolism of the pterin cofactor and a study of patients with these variants may teach us something about their other roles possibly including those which are essential to normal brain development.

A practical general point is the timing of the PKU tests in infants. Though the elevation in the blood phenylalanine is the earliest chemical change yet the alteration is minimal at birth but rises steadily thereafter, reaching a peak at 24 days. Thus the earlier a PKU infant is screened, the more likely it is that the blood phenylalanine will not be elevated and the condition missed. Furthermore there is a sex difference, coupled with the drive for earlier and earlier screening (which in turn stems from the desire for early initiation of a phenylalanine free diet) probably accounts for the recently discovered predominance of male PKU infants over females. Where the surveys are carried out on retarded PKU children there are equal numbers of males and females with PKU.

However beyond this tricky period immediately after birth, an increased phenylalanine level in the blood *is* a reliable diagnostic criterion for PKU or one of its variants.

A useful feature is that the authors were given the opportunity of updating their sections at the proof stage by the inclusion of addenda, but the whole book was for me a most welcome refresher course—roll on the next volumes, where we can anticipate such topics as the lethal neonatal chondrodystrophies (not so long ago a muddle) and advances in pre-natal genetic diagnosis.

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CURRENT TITLES IN THE BIOLOGICAL SCIENCES: BIOLOGY 83. Stephen Edwards, Managing Editor. Association of Systematics Collections and Allen Press, Lawrence, Kansas. 1983–84. Volumes 1–4. Pp. 839. PB. Prices: in USA; individuals $40.00, Institutions $80.00. Canada; $50.00/$95.00 (US). Elsewhere; $55.00/$95.00 (US)

This is a useful citation system published four times per year. In each issue all publications are listed alphabetically by senior author and also by general subject area, *e.g.*, behaviour, and by taxonomic grouping, *e.g.*, Arthropoda. Within the subject and taxonomic listings, each paper is again listed alphabetically by senior author without the full citation but with a series of key-words, some of which refer to other sections in both indices. It is therefore very easy to identify current papers in a specific area.

This journal series is aimed primarily at systematists but any geneticist working in the area in which evolution, population biology, ecology, systematics and behaviour overlap should find it useful but it will be of little use to microbial or molecular geneticists. Although the indexing system appears complicated at first sight, it is very efficient and with practice easy to use. At a time of increasing pressures on funds for journals, it is not clear whether any library would be able to justify the expense of this series for such a narrow area, let alone whether an individual could afford it.

Shortly after writing this review, I received a letter from the publishers announcing that the series had been discontinued because they had been unable to attract sufficient subscriptions to maintain publication. However, complete sets of the 1983 issue will still be available from the publishers.

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