separated by gel electrophoresis in agarose, DNA bands were seen in the male digest which were absent from the female digest, suggesting the unique presence of a repeated sequence containing the *Hae*III target site in male and therefore in Y chromosome DNA. Since this large fraction of Y chromosome DNA is not included in the It-Y DNA recovered by Kunkel *et al.*, it must now be supposed that it is sufficiently homologous with DNA present in the female to be removed by reassociation analysis. From my own observations, Cooke's DNA fractions are located essentially in the fluorescent region of the Y along with the It-Y DNA.

Highly repeated simple sequence (satellite) DNAs in man are also concentrated in the fluorescent long arm of the Y as well as being widely represented in many other human chromosomes. The relationship of the satellite DNAs to the other Y-repeated DNAs is not known at present and their quantitative contribution to the Y DNA as a whole is also not determined. It seems however that most of the Y chromosome long arm is composed of repeated DNA and that of this, only It-Y DNA is unique to this chromosome. The implication of the finding that It-Y DNA maps to the fluorescent long arm of the Y is that the entire repeated DNA of the remainder of the chromosome, including that in the region which contains the sex-determining gene(s) is sufficiently homologous with DNA present elsewhere in the genome to be included in the fraction which reassociates with female DNA in the conditions of Kunkel *et al.*'s experiments. This is perhaps not too surprising since the X and Y chromosomes were presumably homologous at some early period in their evolution, and it has been suggested that they are derived by a process of translocation from structural homologues (see Lyon *Nature* **250**, 651; 1976).

The significance of the high concentration of repeated DNA on the Y chromosome or indeed of the significance of most non-transcribed repeated DNA is unknown. According to Miklos and Nankivell (*Chromosoma* **56**, 143; 1976) satellite DNA may play a part in controlling the frequency of crossing over between homologous chromosomes. By crossing over, pairs of chromosomes remain largely homologous through the frequent interchange of DNA. Conversely, chromosomes which fail to cross over will tend to evolve divergently. Some change inhibiting crossing over would therefore seem to be a primary requirement for the evolution of specialised sex chromosomes.

Snake's eye view

According to Singh *et al.* (*Chromosoma* **59**, 43; 1976), in the snakes, which exhibit the entire process of evolution of sex chromosomes, the first discernable change is in the repeated DNA structure of one of a pair of chromosomes bearing the sex determining gene(s). Within the snakes there is a range of forms from primitives with no defined sex chromosomes through intermediate forms with definite, though morphologically identical, sex chromosomes, (called ZW in the female, which is heterogametic, and ZZ in the male which is homogametic) to forms with highly differentiated, morphologically dissimilar Z and W chromosomes. The primitive snakes show no difference between male and female in highly repeated (satellite) DNA whereas the intermediate forms show very obvious differences involving the appearance of novel satellite DNA in the female. This novel DNA maps exclusively, by *in situ* hybridisation, to the W chromosome (which is the functional equivalent of the Y in mammals) where it is spread over the entire length. The identical-looking Z chromosome lacks this DNA. The W chromosome also shows a different cycle of DNA synthesis from the Z, as is frequently the case in other satellite-DNA-rich chromosomal regions. Singh *et al.* suggest that this interferes with pairing between the Z and W thus predisposing to their divergent evolution and accounting for the fact that in the most evolutionarily advanced group of snakes the W (like the Y in man) has become greatly reduced in size and modified in form relative to the Z. The modified W chromosome nevertheless has conserved the satellite DNA sequences found in the W of the intermediate group, as determined by molecular hybridisation, as well as its allocyclic DNA synthesis pattern. From this it may be suggested that in the human Y chromosome the plethora of simple sequence DNAs reflects the molecular end consequences of the mechanism which played a part in its specialisation. Once a chromosome, like the Y, is genetically isolated, the constraints on acquiring, or amplifying, additional non-transcribed (functionless) DNA sequences are probably lost. The Y chromosome is therefore likely to be loaded with "junk DNA" (Ohno *Hoechst Symposium;* 1972) which no longer serves a useful purpose. At a practical level, however, it now seems a feasible and exciting prospect to use the It-Y DNA as a handle to fish out covalent Y chromosome DNA sequences by some type of DNA affinity chromatography. This will shed further light on the structure and evolution of the human Y chromosome and it may ultimately permit a direct approach to the molecular basis of sex determination at the DNA level. □

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A hundred years ago

In the debate on the education estimates, on Tuesday night, Sir John Lubbock, speaking on the extra subjects which had been made compulsory, said he doubted whether under any circumstances it would be desirable thus to stereotype one form of education for the whole of England; but surely we ought not to do so unless we were very clear as to what is the best system. There was, however, very great difference of opinion on this head. The first authority to which he would refer was that of a committee of that House. It was presided over by his hon. friend the member for Banbury, and after careful enquiry they reported that in their opinion "elementary instruction in the phenomena of nature should be given in elementary schools." The next authority which he would quote was the Royal Commission, presided over by the Duke of Devonshire, which unanimously recommended that more substantial encouragement should be given to the teaching of the rudiments of science in our elementary schools. In Scotland, too, great dissatisfaction was felt with the present system. At the last conference of elementary teachers, held in London, which was very numerously attended, it was resolved that the system of payment "embodied in the Code is unsound in principle and injurious to the progress of true education." The inspectors of schools differed greatly as to the most suitable subjects. Even in regard to geography they were not unanimous. It was said as a subject to lend itself very much to "cram." One of the inspectors gave in support some very amusing answers. For instance, in answer to a question of "What are mountains and rivers?" one girl replied "Mountains in some parts of the world are very useful. In Africa, for instance, they shoot out gold." Of rivers she had not so favourable an opinion, though she thought "they were all very well in some countries where there was very little rain." He confessed, however, that he thought geography a very good subject, though he was not convinced that it ought to be continued during the whole course to the exclusion of other subjects. The mere skeleton of history taught in our elementary schools contained little more than dates, wars, and murders; but dates and crimes no more constituted the history of a nation than sinews and bones made a man. Men of science must be grateful to Sir John Lubbock for so constantly urging upon Government the importance of scientific education.

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