A STUDY OF CHROMOSOMES IN LEUKAEMIA

by

MARGARET ANNE KINLOUGH

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INTRODUCTION

Improved cytological techniques developed over the last few years have led to an improved understanding of the human cell nucleus and its chromosomes. Through the years many workers have attempted to solve the problem of chromosome number and structure, but it was not until 1956 that anything like the correct answer was obtained.

Arnold (1879), one of the first workers to direct attention to human cytogenetics, saw chromosomes clearly, but his preparations were not suitable for even a rough estimation of either cell complement or morphology. A little later, Flemming (1881-82) described mitoses from normal tissue but again, because of the poor quality of preparations no accurate conclusions were drawn. In 1889, however, with the aid of better equipment, he restudied his material and this time cautiously concluded that somatic cells had certainly more than 22 and probably less than 28 chromosomes, and that 24 seemed to be the true number. A succession of later investigators offered opinions with counts ranging from 8 to 40, but most inclined towards 24 as being the correct number.

Winiwarter (1912) came nearer to the right answer when he reported 47 chromosomes in material prepared from human testes, and 48 in the cells from the ovaries of females. He suggested that man belonged to the XO/XX type of sex determining mechanism and concluded that the cell complement of 47 chromosomes consisted of 23 pairs of autosomes and an unpaired X chromosome.

Very little significant work was done then until 1923 when Painter reported that the human chromosome complement was 48. He too, concluded

that there were 23 pairs of autosomes but in those preparations from males he saw a small partner to the X - a Y chromosome. This then made the sex determining mechanism XX/XY.

The diploid number of 48 and the XX/XY sex determining mechanism was readily accepted, until Tjio and Levan (1956) prepared cultures from four therapeutically aborted Swedish embryos. Surprisingly, they found that a chromosome number of 46 predominated, with no less than 261 cells showing a cell complement of 46 and only a very few cells containing 47 or 48 chromosomes. Confirmation of their findings was presented by Ford and Hamerton (1956b) who analysed the spermatogonia and spermatocytes of testicular biopsy specimens from three adult men, and found in all three, that the chromosome complement of each cell was 46 composed of 23 pairs. The only recent conflicting report (Kodani, 1958) of a diploid number other than 46, has not been confirmed.

Soon after this early work, attention was directed towards mongolism which had been puzzling clinicians and geneticists for years. Lejeune et al. (1959) showed that mongolism was associated with trisomy of autosome 21, and with the demonstration of this numerical abnormality and the known fact that mongol children were more liable to develop leukaemia (Stewart et al., 1958) interest was immediately aroused in the chromosome situation in leukaemia. This has been the subject of a few studies since then and much valuable information has been collected regarding the chromosome changes which occur.

The present study has been designed to examine the chromosomes from individuals with leukaemia using, instead of the culture techniques employed by other centres, a direct non-culture technique specially developed for the purpose, in the belief that the results obtained would be more representative of the actual in vivo situation.