These considerations should not, however, blind us to the book's virtues. Within its own limits it meets a real need and it will continue to be used both widely and profitably by students, and, we may venture to think, sometimes by more mature plant breeders also. The new edition is well produced and indeed comparison in this respect with its predecessor shows how far we have come from wartime and post-war shortages. We can also see how far we have moved in another respect, for the price in Great Britain has more than doubled. KENNETH MATHER.

FACTS OF LIFE. By C. D. Darlington. Allen and Unwin. Pp. 467. 40s.

Excuse for the appearance of a further review of Professor Darlington's book so long after publication may be found in the magnitude of the task, and in the importance of assessing its message.

The first two sections of the book are directed to setting out modern knowledge of reproduction and heredity by the historical method. The development of accurate notions of heredity has been a difficult matter as compared with the ease with which the physical sciences have progressed. Both the means of investigation and the logic of experimentation and inference had to reach a somewhat sophisticated level before decisive results could be got. But there is another reason, in some ways more serious (especially in that it still has implications for the present day). Darlington finds this in what may broadly be called " superstition " or a confusion between biology and morals. The facts of conception, birth and inheritance touch us all both more deeply and also more familiarly than, say, do the Gas Laws. One result is that vulgar ideas are hard to dislodge " Everybody already knows too much about it ". Another result is that all these topics are emotionally charged and a Freudian " resistance " makes us hold to preconceptions, which are often misconceptions. This happens in part by taboo ; in part because we are reluctant to follow out ideas to the point where we might need to question the relevant laws of Church or State : our own personal interpretation (sustaining our morale in daily life) of our relationship as individuals to the rest of Society is often based on suppositions which concern genetics.

Darlington's history of genetics thus has several themes. It disentangles the interactions between prejudice and discovery. It is an essay in scientific method and also in the sociology of science. And it analyses the philosophic bases of the notions of the great theorists.

We now reach modern genetics, with material genes and chromosomes, and a materialist theory of life and inheritance. The author now considers the general consequences of this theory.

In the first place, it should be noticed that Darlington renders a service to epistemology by his analysis of the notions involved in " indeterminacy ". Instead of this hackneyed and multivalent word, he uses " uncertainty " as descriptive of the random element in biological processes. This random element no more derives from a lack of causality than do the roulette wheels at Monte Carlo. It is a determinate consequence of understood mechanisms.

On this basis the mechanism of heredity though material is not simply determinate. Assortment and recombination imply a large scale uncertainty in inheritance. This uncertainty provides variation. Selection operates on variation. " Evolution does not arise from a property of progress or

improvement inherent in life ". It arises from the selection of uncertainty. Thus the relation between determinism and uncertainty on the species level is a dialectical one, and the continued maintenance of genetic uncertainty in the scheme of things must be ascribed to this relationship. However, in the case of the individual life-history once the zygote is formed, uncertainty is almost ruled out. Development of embryos is strictly regulated and with equal environments uncertainty enters only in the form of rare errors, or minor variation which is unimportant to the functioning of the organism.

The rest of the book, except for an Interlude on the Lysenko scandal, is concerned with applying genetical findings to the serious problems of human life. If we have subscribed thus far to Darlington's statement of biological realities (and if pressed most professional geneticists would, like myself, feel bound to do so), we must acknowledge that the inheritance of acquired characters is exceedingly rare. The germ plasm of a stock is not changeable by nutrition, education or social conditioning *per se* but only in so far as these environmental factors operate selectively. Thus environmental influences, physical or intellectual or emotional, directly affect at most the personal development of the individual. Their indirect effect is confined to selection modifying the germ plasm of a stock. Thus two lines of enquiry are marked out in the human field. To what extent has selection operating in prehistoric and historic times produced important genetic differences between human groups? In what proportions do genotype and environment respectively contribute to an individual's personality?

Taking the second question first, the study of twins shows us the cardinal importance of genotype. Our potentialities are given at conception. Darlington, however, does not minify the role of environment. He points out that in the human field it is not obvious (even if at first sight it may seem so) " which is the necessary or favourable environment for a particular genotype. . . . Environments no more than genotypes are to be arrayed in an objective scale of values. Our judgment is as much warped by our own prejudices, our own snobbery, in assessing the one as the other ". There is a warning here that the evolution of the Welfare State may have unexpected effects on the character of its social classes.

Is there anything also in the personality besides the genotype and its reaction to environment? Is there Free Will? Darlington comes down against it, and I agree with him. This view of the matter does not in any way diminish the imperative to maintain our responsibility for our acts. Rather it should increase it. The genetic findings, on the other hand, make nonsense of the punitive approach to errors, crimes and deviant morals. The notion of punishment as distinct from disciplinary control and training is one which will have to go from any society that aims at regulating its affairs with scientific understanding.

Many will agree similarly with the view that " It is now time that the State based its intervention in marriage not on confused myths and traditions but on authentic knowledge and explicit reasons. A society which is bound to maintain itself by sexual reproduction is more likely to survive if it seeks to understand the facts of life and apply that understanding to its customs and its laws ".

But now Darlington poses us other riddles. What he has to say is a

corrective to the repudiation of heredity in the social sciences. This repudiation may be dangerous, not only in day-to-day problems such as delinquency, but in the long-term problems of population change.

One of the end products of the book is a " biological interpretation of history " written with a proper (and I think entirely justified) respect for Marx. Darlington is careful to stress that an interpretation is not a " formula, or the demonstration of a simple pattern which will describe the course of history and predict the future ". The biological interpretation reinstates the submerged part of the genetic iceberg as a leading agent in social change. The top of the iceberg is the complex of economic, political and social conditions. This superstructure has of course its own dynamic and is to a certain extent autonomous. The genetic substructure, however, conditions historical events in various ways. One mode of action is to introduce uncertainty into history. Chance throws up from time to time the rare genotype. If also the historical situation is particularly unstable we get the conjunction of the man and the hour : Lenin comes to the Finland Station.

There is a discussion of the origin of social class. Classes both for Marx and Darlington have evolved for positive social reasons. Each class owes its position to the fact that at one time at least it performed some function in society. Marx would say that as the relations of production change, the role of the ruling classes may become obsolete or even negative. This contradiction between the class structure and the economic realities results in decline or crisis. Darlington would add " The fitness of a race or class for its allotted work must always be changing, for neither genotype nor environment can be kept stable. Genetic recombination changes all groups, especially small and isolated groups such as those empirically described as imperial races and governing classes. They derive their dominant position from the fitness of their genetic character to the conditions they find or make for themselves. They also owe their later downfall, . . . to changes in their genetic character, or in their external situation, or more usually in both ". And later he says, " It is the purpose of all governing classes to protect themselves against natural selection. The intelligence they may use in doing so, and the lengths they will go in sacrificing their society as a whole to their own interests to avoid their own destruction are both variable. The examples of Spain, France and England show a gradient, . . . between situations in which Marx is largely right and largely wrong, a gradient which is itself genetically determined ".

I have tried to sketch Darlington's principal themes according to my own understanding of what he is saying. I have had to summarise his conclusions and I have not done justice to the complexity of the argument. This complexity is inherent in the facts. It is an achievement to have carried it through, as he has done (in a not especially lengthy book) without clarity or interest failing at any point. An heroic book of this sort is bound to generate the most diverse reactions in its readers, or even in the same reader. It will *épater le bourgeois*, and the *anti-bourgeois* also. No doubt a minority of readers will feel it is all true enough, but what then, is it not all a truism ? This will be because they have missed one of the points. It is one thing to receive a theory, it is another to take it into one's self so that each problem is examined in its light. A. R. G. OWEN.