procedures. Furthermore, since the two testers have given consistent results relating to the magnitude of D and H components for these traits, the group of homozygous varieties included in the present study seemed to be in linkage equilibrium, particularly for the trait(s) for which the tester used was not an extreme phenotype. Under such a situation, this test cross design, with any arbitrarily chosen inbred line as tester, not only provides information about the kind of gene effects involved in the control of a trait but can also be regarded as a means of supplying unbiased estimates of additive and dominance components.

On the other hand, the estimates of D and H components for 100-kernel weight and yield per plant were biased to an unknown degree by the presence of epistasis. But, since both kinds of estimates were highly significant for these traits in both the experiments, it seemed likely that these traits were controlled by all three kinds of gene effects (epistatic, additive and dominance). Therefore, standard selection procedures should not be used in improving such traits in wheat.

As regards the trait final plant height, since epistasis was significant for this trait at the 5 percent level in only one of the four cases, it is more probable that the trait was governed by additive and dominance gene effects only. Jinks and Perkins (1970), in their backcross data of 1960 and 1961 of the cross 1 × 5 in tobacco and Ketata et al. (1976), in winter wheat, also found this trait controlled by additive and dominance effects only. However, Chapman and McNeal (1971) recorded highly significant epistatic effect for this trait in spring wheat in their 1967 data. This effect disappeared, however, the following year.

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Book Reviews

Herwig, E.; Hübner, S. (eds.): Chancen und Gefahren der Genforschung. Protokolle und Materialien zur Anhörung des Bundesministers für Forschung und Technologie in Bonn, 19. bis 21. September 1979. München, Wien: R. Oldenbourg 1980. XX, 397 pp., 6 figs. Soft bound DM 48,–.

This volume contains the documentation of a hearing of the minister of Research and Technology of the Federal Republic of Germany. The purpose of this hearing was to provide the information required to decide whether recombinant DNA work necessitates special regulations in order to protect the public against potential danger resulting from this work.

The meeting was dedicated to essentially 4 different topics dealing with (a) Application of recombinant DNA techniques in research and in industry. (b) Benefits (c) Risks 1) for the use of E.coli 2) for other host-vector systems, 3) ecological and evolutionary risks. (d) Research, state and society. (e) Guidelines and laws.

Each topic was treated in one or several sections. Prepared statements of invited speakers introduced the particular problem, which then were followed by discussions. Additional material, which could not be presented because of a shortness in time, is supplied in the addendum of the documentation. The speakers include scientists from different countries working in molecular genetics, population genetics, microbiology, cancer research, cell biology, plant physiology and other concerned fields of biology, one theologist, representatives from German workers Unions and of Employer's Unions, representatives from EMBO and the European Community, representatives of the ministry and of the parliaments as well as science journalists.

The active participants of the hearing represent a balanced selection of the various opinions with respect to attitudes against recombinant DNA work. This statement however leads to a first evaluation of the results of this hearing: the entire documentation does not contain anything new. The statements made by the various speakers have been made over and over and can alle be taken from relevant reports from other countries, in particular from the U.S.A. This was to be expected since the speakers invited have been active in this field for years (Szybalski, Chargaff, amongst others). There might in fact be only one point during the entire discussion which has not raised fundamental controversies: In general there appears to be agreement that research should be encouraged which leads to an improvement of risk assessment. All other topics remained controversial.

The majority of experts agreed in the conclusion that recombinant DNA research involves low actual risk, if any at all. Working with pathogenic micro-organisms is generally accepted to be more dangerous, and it was repeatedly pointed out that in this field no regulations comparable to the regulations of recombinant

DNA work are valid, in spite of more or less frequent accidents with pathogenic material, which, however, did not become evident to the public. Arguments for the low risk of recombinant DNA work include the fact that vectors with inserted DNA sequences are very unstable and cannot be maintained without special selective pressure. They would not persist in natural environments. The contrary argument is that it cannot be excluded that pathogenic material might once be produced. The question of the benefits of such research were considered most controversially.

In a general evaluation of potential risks and benefits of recombinant DNA work and its consequences, one will rate the risks much lower than has been assumed for some time. Clearly, nothing can be done without any risk at all. But, as has been pointed out by several speakers, many benefits of modern medicine would not be in existence if restrictions to working with material of unknown dangers (such as antibiotic producing organisms, vaccines, etc.) had been introduced in the past. Clearly, the most immediate danger, if there is any at all, would exist for the research workers themselves. Most scientists working in molecular biology laboratories or in related fields know already that they are subject to increased risks from chemicals or other such potentially dangerous material. This danger must generally be considered higher than what is now thought true for recombinant DNA work.

Two points of this discussion, however, might be worth recalling for more detailed inspection. A major concern of several speakers of the hearing was that many workers in recombinant DNA research are not sufficiently trained and experienced in microbiological work, especially in working with pathogens. In my eyes this might be an important aspect for any further regulations of recombinant DNA work. In an extreme view it was proposed to create special laboratories which are certified to do recombinant DNA work and which are equipped with selected researchers with appropriate experience. Although this would definitely raise extensive restrictions, it might be an alternative to the present situation if other pressures force us to introduce more restrictive controls. However, the present situation might have to be changed if further restrictions in funding research occur. The second point concerns industrial use of recombinant DNA techniques. Here, definitely protection would be required. All experiences from the past indicate that chemical industry does not take care to protect their workers. None of the speakers raised substantial objections against these conclusions, drawn by the representatives of the unions and also by scientists themselves. It should not be overlooked that the representative of the pharmaceutic industry strongly expressed their willingness to observe all regulations introduced and to keep to their acceptance of the presently valid guidelines. This might, of course, in part be a consequence of fearing restrictions from pending legislation.

A consense of probably all contributors was that the public should be better informed about the background and intentions of recombinant DNA research. Evidently, strongly emotional arguments are still used in the debat on recombinant DNA. These are, at least in part, due to a misleading of the public by wrong information, often promoted by journalism trying to sell sensations. In this context one likes to ask what the purpose of all the efforts of this meeting was. Although the experts, with all their controversial opinions, were available, the rather short discussions were mainly between the speakers. The actual auditory part of the hearing, i.e. representatives of the ministery and the parliament, was either silent or absent. The only insistent inquiry, as far as is documented in the volume, came from a lady representing the social democratic fraction of the parliament. Other representatives of the state appeared to be either overwhelmed by alle the information or totally aware of everything, thus having no reasons for questions. As teaching staff of European universities, we are more and more concerned about the inactivity of the present day students in our teaching programs. But can we expect it to be different if the representatives of the public and the state, in charge of the welfare of the country, display such a poor expression of their responsibilities to try understanding basic phenomena concerning our daily and future life?

One of the central impressions one obtains from this documentation is that two main questions about recombinant DNA research have to be asked. The first of these questions is whether there are any direct risks connected with the technique as such. Most people are inclined to deny this. The second question is what the general implications for the society and for the environment will be. I believe that much of the controversy about recombinant DNA techniques could be easier handled if both questions are clearly recognized and separately treated. While some of the speakers did not touch the second question at all, or even tried to circumvent it, others used arguments resulting from the considerations connected with the second question to attach problems connected with the first question. This sometimes lead even to personal arguments (which certainly arose prior to this meeting).

One fundamental reservation one has to make is, that in order to discuss general implications of recombinant DNA technology, an entirely different form would be essential. It might, in contrast to what some speakers maintain, not even be a topic to be treated by governmental institutions, but rather by a wide range of individuals feeling responsible for the maintenance and conditions of life on earth. This obviously is a task not to be treated by a few experts on recombinant DNA work. This topic is really only an incidental problem if we consider all the other problems in the human community. Such approaches to dealing with the fundamental problems of future human life on the earth can only be done on an international scale. The outcome of such a discussion could be that certain restrictions are also introduced into applications of recombinant DNA techniques.

It is more or less of local interest that the speakers representing administrative or governmental positions as well as unions generally vote for a legislation on recombinant DNA research while the majority of the rest of the speakers assumes that guidelines according to the respective state of knowledge will be more than sufficient to exclude dangers for individuals or for the public. There exists anyway a more general legislation which could be applied to the work with recombinant DNA.

If one tries to summarize the quality of representations and discussions one feels that the discussion was in most instances not very informative and in general rather restricted by the time available. One would like to hope that the people responsible for making decisions, took the time for more private communication with the speakers who came from all over the world to attend this hearing. In some rare instances the discussion extended into personal confrontations, certainly many of which were based on prior animosities. One seriously unqualified statement concerns the necessity of providing insulin in sufficient quantities and of high purity. Novel laureate Dr. G. Ward argues that the discussion on the production of insulin is an artificial argument of the industry in order to find sources for making profit. He further argues that people with diabetes suffer much, just because they do not like to keep to diet, which could solve most of their problem. Everybody who knows individuals suffering from diabetes will consider this statement to be a display of rather bad taste and ignorance about the actual problem.

The documentation as provided might be considered as a useful basis for further discussions because it contains probably all essential arguments for and against recombinant DNA techniques and their application. As a documentating of efforts of governmental institutions to deal with problems concerning legislation, it appears to be a discouraging example.

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