Gene Conservation*

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THERE is no doubt that the number of different poultry strains and breeds is at present still a considerable one. But, on the other hand, the strains used by poultry breeders in developing and producing types for commercial production has become more and more limited in number during the last two decades.

The great reproductive capacity of poultry allows a very intensive utilisation of these few sources. It is well known that millions of a single hybrid type can be produced year after year. Their breeders are very proud to say that these birds—for instance hybrids between inbred lines—are genetically very uniform. And we don't hesitate to displace our indigenous breeds by these highly productive strains.

A very impressive example in this connection might be the present situation in Europe.

An investigation carried out last year by the sub-committee "Breeding and Stock-testing" of the European Federation of W.P.S.A. proved that in most of the European countries up to 80 or 90 per cent of the yearly replacement of poultry stocks is made by strains originally produced by American breeders. The great exceptions are Great Britain and the Netherlands. But in these two countries, where officially there are still indigenous breeders, the greatest amount of breeding work is also done by a very modest number of big breeding companies. That means that there also the genetic basis is rather narrow and it may even be that the work of these independent breeders is partly inter-related.

The question whether such a concentration is not leading to a loss of germ plasm therefore seems quite reasonable.

The problem of gene conservation has already been discussed in the last few years on different occasions. We recently dealt with this at an FAO conference in Rome, for instance, where also the problem of adaptability was pointed out.

The danger of losing populations which are especially adapted to unfavourable conditions of climate and management, must be considered

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in spreading out all over the world the highly developed commercial strains of western countries. The problem of genotype-enviroment interactions can be very important in building up new populations in developing countries for instance. The introduction of modern hybrids is not always an adequate solution.

Although we still have a great diversity of phenotypes and almost certainly also of genotypes among the world poultry population, it is a matter of fact that, at present, commercial poultry breeding is based on a very restricted sample of germ plasm available and that further development is very rapidly eliminating genotypes which could also make an important contribution to commercial breeding work in the future.

The Cornish breed might be only one example of how a fancy breed can contribute to new developments in the field of commercial breeding. It is not impossible that other types could help in solving new problems; as for instance, the development of disease resistance.

What can or should we do to prevent irretrievable losses of germ plasm? Some people are persuaded that the big breeding companies in their own interest are already taking all the necessary precautions by keeping various breeds and strains without using them directly in their breeding program.

Unfortunately we do not know exactly what is really done in this field. But I feel uncertain whether the few breeders capable of this task, and working mainly in one of the five continents only, can be made responsible for covering the future genetic requirements of poultry breeding in all the other parts of the world, including Europe.

The problem is a general one and it should be solved on a world wide basis.

Of course we cannot conserve all the different strains and breeds still existing and probably in danger of extinction. It may be of some value if local breeds or varieties are kept by fancy breeders or collected in zoos, but I don't think that in this way the whole problem will be solved. Also the creation of gene pools, simply collecting and preserving samples of different breeds and strains, does not seem entirely satisfactory, although it will cost a lot of money.

The big problem in all such programs will be the principal question: What are we conserving? We may possibly have a lot of different phenotypes, but we do not know if we also have a corresponding genetic variation.

In establishing a germ plasm bank we should know about what we are preserving there. That does not mean that collecting and reproducing samples of breeds would not be a reasonable contribution in conserving germ plasm, but it should be completed in a more active way by developing and collecting known and measured genotypes. The best way to get them is by *selection*.

The special features of such a selection program would be:

— an initial population with a great genetic variation, for instance a pool of different strains
— clear, and possibly physiologically simple, breeding aims
— within the same program, starting with one parental population, at least two different lines which are selected in clearly different, preferably opposite, directions.

These experimental lines consequently cannot aim at economically positive characters only. The danger of an ordinary selection program is rather that it may lead to an accumulation of genes with desirable effects relative to a special economic situation. But we are never sure if the undesirable and excluded allels could not be valuable in another, perhaps future situation, or if they are correlated with effects we would also be interested in.

Ideally each ordinary selection program should be accompanied by another one, going in the opposite direction. In fact this proposition is not a very practical one and the genotypes produced in this way would be as complex as those we already get in the breeding schemes actually used.

What we need in conserving germ plasm is a collection of clearly differentiated genotypes in order to know what we are preserving.

An example might illustrate this idea: In 1960 we started at the Institute for Animal Husbandry (Prof. Dr. H. Lortscher) in Zurich a selection experiment in opposite directions. The initial population was a mixture of eight different hybrid and Leghorn-type strains. The only character considered in selection was the egg weight of the first ten eggs of a bird. The population size of the two lines unfortunately was very small: Ten sires and about 50 hens with a progeny of four pullets each per generation and line. But in the third generation the two lines were already phenotypicaly clearly differentiated:

	+ line (high eggweight)	— line (low eggweight)
initial egg weight	51·7 g	44·0 g
egg weight after 5 months of production	58·2 g	50·0 g
hatchability	73·0 %	89·0%
age at 1st egg	173 days	167 days
production	67·9%	73·8 %
adult body weight	2207 g	1862 g

The experiment is still going on and the difference in the egg weight of the first ten eggs has reached more than ten g in the fifth generation.

Besides these phenotypic differences the genetic differentiation of the two lines is very interesting:

— the response to selection in the two directions is not the same

— the genetic parameters—the heritabilities as well as the genetic correlations—change differently from generation to generation in the two lines
— the sire- and dam-components especially show quite a different reaction
— in the later generations it seems to be possible to distinguish the two lines by testing some blood groups.

Taken all in all the experiment led to two genetically different populations with different gene frequencies. At the same time other precious information was obtained concerning the characters controlled.

A report on the first stage of the experiment is already published in "Zeitschrift für Tierzüchtung und Züchtungsbilogie" and a more detailed one will follow soon.

With this example I would only suggest one possible way of dealing with the problem of gene conservation. I do not think that it should and could be done by commercial breeders only. But there are at the present time a number of testing stations in various countries the capacities of which are not fully utilized by their testing program.

On the other hand, it would be very desirable to have on each station a random bred control population, built up on the basis of a broad mixture of various strains, forming to a certain extent a gene pool. Going out from such a poulation and, if necessary, from additional strains, each station could develop by the selection of a few lines with clearly distinguished breeding aims.

I could imagine that after a certain time even big breeding companies would be very interested to use one or the other line, available on these stations.

In taking over this task, the Random Sample Test Stations, which at present seem to have a decreasing importance, could make a new and very valuable contribution to poultry breeding.

There is no doubt that the whole program needs coordination on an international level. The World's Poultry Science Association or another suitable international organisation could possibly take over the necessary lead and responsibility.

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