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Efficiencce économique des programmes d'amélioration génétique

OPTIMUM USE OF BEEF SEMEN IN A DUAL-PURPOSE OR DAIRY BREED

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The investigation has been made to evaluate the economic consequences of varying replacement rates and varying use of beef semen in a dual-purpose breed (*Swedish Red and White Cattle*).

The investigation showed that crossbred calves (*Charolais* and *Hereford* sires, *Swedish Red and White* dams) are superior to purebreds (*Swedish Red and White*) in commercial beef production, which in economical terms amounts to about 200 sw. Cr. It was also found that there is a considerable capacity for beef crossing in dairy herds. When the replacement rate is 20 p. 100, the percentage of cows available for beef crossing is 45 p. 100. At the replacement rate 40 p. 100, 2 p. 100 of the cows are available for beef crossing. However, the possibility of utilizing this capacity in small herds is limited if the replacement heifers originate from the same herd.

Milk yield as well as the number of calvings is increased with an increased culling level. However, with the current prices for the products and for pregnant heifers in Sweden, there is an optimum economic level of culling. Five per cent culling for yield above inevitable culling produces the best profitability in milk production if crossbreeding is disregarded.

Based on the calculations of the crossbreds economic superiority in beef production and of the economic consequences of varying culling for yield the optimum use of beef semen has been calculated. The conclusion was that the best economic result is obtained when no culling for yield takes place and when the whole capacity for beef crossing is exploited.

Also genetic effects if varying intensity in culling was analyzed. It was found that the genetic gain is affected only to a very small extent by the level of culling.

If heifers are used for crossbreeding the genetic gain in milk yield of the population is adversely affected. Instead older cows with average or below average yield should be used for crossing which also reduces detrimental effect of e. g. *Charolais*-crossbreeding on calving difficulties.

DETERMINATION OF THE STRUCTURE
OF CATTLE PRODUCTION WITH LINEAR PROGRAMMING

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The aim of the investigations based on calculations and experimental findings was to determine which are the most effective productive types for the production of the two main products of cattle, milk and beef.

In cattle breeding the industrial production processes have encouraged the forming of specialized productive types. The structure of the stock has to be planned in the light of the requirements.

In the present study 10 populations were examined according to 9 objective functions. The comparisons of the populations were carried out on the basis of products obtained with the same starch equivalent quantities. It can be stated that the optimal population structure generally consists of one milk producing and one beef producing stock. The most favourable result is from the population in which the heifers not needed for replacement are used for beef production by means of commercial crossing (*Hungarofries*). Also those dual purpose populations were favourably classified in which the milk production required can be achieved with simple hybridization and beef production with triple crossing. The beef requirements in excess of the beef production from milk producing stock have to be produced by specialized beef cattle types.

Modern breeding methods have the same role in the establishment of optimal population structure, as varied production types. The method of progress is not the construction of new breeds alone. Specialization in production on separation of technologies are at least as important as the forming of specialized types.

ZUCHTPLANUNG IN DER RINDERZUCHT AUS ÖKONOMISCHER SICHT

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Aufbauend auf ausführlichen Kalkulationen zur Ermittlung der ökonomischen Gewichtung von Leistungseigenschaften beim Rind wurde versucht, die Auswirkungen verschiedener Kombinationen der Bestimmungsfaktoren des züchterischen Fortschritts auf die Effektivität der Zuchtarbeit zu quantifizieren und eine aus ökonomischer Sicht optimale Kombination dieser Faktoren zu finden.

Von besonderer Bedeutung ist dabei die Wahl der Methode zur Berechnung der Wirtschaftlichkeit der Zuchtplanung. Als Massstäbe zur Messung des wirtschaftlichen Erfolges der Zuchtarbeit erscheinen der Nettosektionserfolg und die Dauer der Pay-Off-Periode geeignet. Der Nettosektionserfolg ergibt sich aus der Differenz zwischen dem jährlich erzielten Fortschritt, der in eine ewige Rente transformiert wird und den Kosten der Zuchtarbeit unter Berücksichtigung ihres zeitlichen Anfalles. Er wird mit Hilfe der Kapitalwertmethode ermittelt. Die Pay-Off-Periode gibt den Zeitraum der Kapitalwiedergewinnung an.

Die wichtigsten Ergebnisse der Kalkulationen sind in den folgenden fünf Punkten zusammengefasst.

1. Eine Selektion unter den Jungbullen im Anschluss an die Eigenleistungsprüfung auf Mastleistung ist nicht wirtschaftlich. Die Ergebnisse dieser Prüfung sollten jedoch bei der Ermittlung des Gesamtzuchtwertes des Bullen berücksichtigt werden.

2. Zur Erzielung eines guten wirtschaftlichen Erfolges sollte eine Mindestpopulationsgrösse von einer Million Tieren nicht unterschritten werden. Eine weitere Steigerung der Populationsgrösse erscheint trotz geringerer Zuwachsraten des Nettosektionserfolges wirtschaftlich.

3. Der optimale Anteil der Besamungen durch geprüfte Altbullen liegt etwa bei 60 p. 100.

4. Infolge des relativ geringen Anstiegs der Kosten und der Steigerung der Genauigkeit der Zuchtwertschätzung bei zunehmender Grösse der Nachkommengruppen je Testbulle ist die als maximal unterstellte Anzahl von 160 Töchtern je Proband anzustreben.

5. Der bedeutendste Einfluss auf die Höhe der Kosten der Zuchtarbeit geht von den Kosten der Spermakonservierung aus. Eine Reduzierung dieses Kostenfaktors ist die wichtigste Möglichkeit zur Verbesserung der Wirtschaftlichkeit der Zuchtplanung. In Abhängigkeit von dieser Einflussgrösse variiert die optimale Anzahl jährlich zu prüfender Bullen und die optimale Anzahl der je Bulle zu gewinnenden Spermaportionen.

COST-EFFECTIVENESS ANALYSIS ON THE INTRODUCTION OF PROTEIN SAMPLING IN MILK RECORDING SCHEMES

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A study was made to determine whether it is economically worthwhile to include fat and/or protein tests in milk recording schemes under given milk pricing systems. Goal is maximizing net income in breeding programmes for milk and milk constituents in dairy cattle. Consumers and the dairy industry could determine the price relations for milk, fat and protein according to their future needs. These would apply for producers price of milk and ranking of breeding animals. Seven milk pricing systems were applied assuming that milk alone or fat and protein in different relations determine the price of milk. This gives the price differentials for the components that go into the index. Four sets of genetic parameters representing different populations were used for milk kg, fat kg, protein kg, fat p. 100 and protein p. 100 :

1. Average values from literature ; 2. *Brown Swiss* (BERGMANN, 1969) ; 3. *Red Danish* (CHRISTENSEN, 1968) ; 4. Averages of 5 U. S.-Dairy Breeds (WILCOX *et al.*, 1971).

The calculations were made for a static population of 120 000 cows under AI programmes and milk recording using discount cash flow procedures. The expected interest rate on invested money was taken as a measure for effectiveness assuming that the breeding program is carried over twenty years. Costs per cow and year under present conditions in Switzerland are 41. — sFr. for recording and administration, 3. — sFr. for fat and 3. — sFr. for protein tests. The average milk price is 65. — sFr. p. 100 kg.

If milk is paid for kilogrammes only it is not economic to carry out fat and protein tests. The higher expected fat yield as a result of fat testing and including in an index in addition to milk alone leads to the same interest rate as milk recording alone which means that costs for fat test are just compensated. This holds only if fat is the main worth determining component. Including protein in addition to milk and fat results in small additional yields because of the high genetic correlations between amounts of milk, fat and protein. The costs for protein testing lower the interest rate by 1/2 to 1 p. 100. Even strong weighting of protein in the milk pricing system does not compensate costs for protein testing under the above conditions. Including protein in breeding programmes is only justified if costs for fat and protein testing can be cut to 3 to 4 sFr. per cow and year (central laboratories, simultan analyzers) and if protein has adequate weighting in the pricing system.

The analysis has shown that conclusions are not necessarily the same for sets of genetic parameters from different populations. While it seemed not worth to change the weighting from fat to protein for the danish data it can be economic for other populations.

THE EFFECT OF POPULATION STRUCTURE, BREEDING SYSTEMS AND ECONOMIC PARAMETERS ON THE BREEDING PLANS OF DUAL PURPOSE CATTLE

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In model calculations concerning genetic and economic optimalization the effect of population structure, breeding systems and economic parameters on breeding plans of the dual purpose cattle was investigated. In the present examination the factors population size, proportion of cows which are milk recorded, capacity of testing stations for bulls on daily gain, intensity of selection for yearling performance, and the discount rate of interest were varied. Attempts were

made to determine an advantageous breeding structure for three different breeding systems which maximized genetic improvement or economic return respectively. The income with regard to costs of breeding work was estimated from « breeding population size » and « commercial used herd ». It was supposed that all cows are inseminated with deep-frozen semen.

With respect to previous simulations the following aspects are to emphasize :

- The population size is important for return of breeding plans.
- If one assume operational breeding costs for milk recording the optimal proportion of the breeding population is depending on the number of cows in a population and on the choice of the discount rate per year. The value is 6 to 30 p. 100.
- It was shown that the return depends considerably on the genetic correlation between milk fat yield and monetary weighted net daily gain.
- The relative contribution of the two-gene-paths « sires-sons » and « dams-sons » to the return is less than to the genetic improvement.

COST STUDIES ON CATTLE BREEDING PROGRAMS

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The main breeding goals for the *Danish* dual purpose breeds are the improvement of butterfat yield and growth rate. In the breeding planning there is furthermore paid attention to other traits. This planning is based on the bull dam registration and selection and on the following characteristics of the system of testing, selection and differentiated use of bulls : performance testing and selection on growth rate, testinseminations from young bulls, storage of deepfrozen semen, progeny testing for milk productivity and milkability and selection of proven cow sires and bull sires.

Special attention is paid to the economic evaluation of alternative breeding plans. The net returns are considered the best measure for the comparable economic efficiency of the breeding plans. The principles for the calculations of this measure are developed.

The factors influencing the genetic gain and the net returns are divided in the following categories : biological factors, factors of breeding policy and market factors.

The optimum combination of the factors of breeding policy under Danish conditions are given. It is found that the economic efficiency is almost the same from 20 to 40 p. 100 elimination on growth rate at the performance testing.

The influence of changes in the size of some of the market factors on the optimum breeding structure and on the economic efficiency of the original optimum plan under the supposed changed conditions is studied. It is concluded that the net returns of the original optimum breeding plan under the following changes :

- Net income per one kg butterfat from 8 to 6 or 10 dKr.
- Netincome per one g daily gain from 1.0 to 0.8 or 1.2 dKr.
- Discount rate from 10 to 8 or 12 p. 100.
- Annual costs of bull maintenance from 4 600 to 3 600 or 5 600 dKr.
- Costs of the processing of deepfrozen semen from 0.14 to 0.02 0.07 or 0.21 dKr. per dose.

Only deviate slightly (0.1-0.5 p. 100 units) from the maximum obtainable under the changed conditions.

The changes in the three first mentioned factors will affect the optimum breeding structure to some extent but the changes in the two last mentioned factors will not affect this structure to any noticeable extent.

BETTER BREEDING PLANS

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The breeding goal is to select the most profitable cow. A better breeding plan is a plan that can be realized. In the Netherlands, analyses of actual selection learned that the change to a better breeding plan took a period of 10 years. Modal calculations for different breeding plans

revealed that it was profitable to use selected proven bulls on a very large scale (80 000 doses or more in a large population), BRASCAMP (*Zeitsch. Tierzücht. Züchtungs Biol.*, 1972, in press). From an economic standpoint, the contribution to profit is e. g. SS 27 p. 100 SD 37 p. 100 DS 26 p. 100 DD 10 p. 100 compared with the contribution to genetic progress : SS 45 p. 100 SD 25 p. 100 DS 25 p. 100 DD 5 p. 100. Calves from selected parents express earlier their profit than calves from selected grandparents.

In planning research at the new experimental farm with 200 cows (P. F. L.) it was decided to compare a random sample of calves born in 1970 and 1971 in two main breeding districts of *Dutch Friesians*. A group of 102 heifers calved at an age of 2 years and gave an average milk production of 180 kg ($\sigma = 250$ kg) in 100 days, fat-per cent : 4.03 ($\sigma = 0.27$), protein-per cent : 3.21 ($\sigma = 0.17$), live-weight, 100 days after calving : 480 kg ($\sigma = 48$ kg). Preliminary results gave a difference of nearly 10 p. 100 in milk yield between sub-populations, but no differences from heifers originating from high and low producing herds. These results can stimulate the introduction of better breeding plans. The next phase of this experiment, namely comparison of sub-populations from *Dutch Friesian*, *British Friesian* and *Holstein Friesian*, can give an extra stimulation for the realization of better breeding plans and may also affect the migration of breeding stock.

PROBLEME DER ZUCHTWERTSCHÄTZUNG VON BESAMUNGSBULLEN IN DEUTSCHLAND. ERSTER BEITRAG ZUM EINFLUSS GENETISCHER UNTERSCHIEDE ZWISCHEN ZEITGEFÄHRTINNEN AUF DIE ZUCHTWERTSCHÄTZUNG VON BULLEN

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Nach einer Beschreibung der in Deutschland gebräuchlichen Methode der Zuchtwertschätzung auf Milch wird auf spezielle Probleme eingegangen, die sich aufgrund der Analyse der Population in Bayern ergeben haben. Diese Probleme sind mit dem *genetischen Trend* und durch Unterschiede in der *genetischen Qualität der Vergleichstiere* umschrieben und werden heute in allen fortgeschrittenen Zuchtprogrammen diskutiert.

Der *genetische Trend* wird aufgrund der Regression der Bullentöchter auf die Zeit seit 1970 in der Selektion der KB-Bullen berücksichtigt. Ältere Bullen ohne Töchter aus dem 2. Einsatz haben je Jahr Abweichung vom gegenwärtig selektierten Jahrgang etwa 1 kg. Fett mehr an Töchterüberlegenheit zu bringen, während die Töchter aus dem 2. Einsatz die gültigen Mindestanforderungen erfüllen müssen. Hierdurch werden Unterschiede in der Zuchtwertschätzung, die durch den zeitlichen Trend verursacht sind, weitgehend ausgeschaltet. Eine Auswertung des je Besamungsgewogenen Zuchtwertes der geprüften Bullen, wobei der Prozentsatz der Besamungen mit geprüften Bullen ebenfalls berücksichtigt werden, zeigt erhebliche Unterschiede zwischen Besamungsstationen. Diese Unterschiede, die durch einen von Gebiet zu Gebiet varisierenden KB-Anteil verschärft werden, führen auf Dauer zu einer *Differenzierung der genetischen Qualität der Vergleichstiere*, die zu Fehlentscheidungen bei einer Selektion zwischen verschiedenen Stationen führen können. Zur Analyse dieses Einflusses wurde ein von BAR-ANAN vorgeschlagenes Verfahren angewendet, das die Hälfte des Zuchtwertes der Väter der Vergleichstiere berücksichtigt. Auf die speziellen Verhältnisse in Bayern angepasst, wurde dieser Effekt je Jahreszeit, Herdenniveau, Region, Altesklassen, Untergruppe, die die Basis der Vergleichstiere darstellt, von 1967-1971 an berechnet. Eine statistische Auswertung dieser *Vergleichsgruppendurchschnitte* zeigte hochsignifikante Einflüsse der Jahre, der Regionen, der Herdenniveau-Klasse, der Altersklassen, sowie der Jahr \times Regions- und Jahr \times Herdenniveau-Interaktion vor allem für die Milch- und Fettmenge.

Während in den Jahreseffekten der stärkere Selektionsdruck zum Ausdruck kommt, reflektieren Regionsunterschiede verschiedener Besamungsstationen. Mit steigendem Herdenniveau steigt die Qualität der benutzten Bullen deutlich an und die Wechselwirkung von Jahr und Herdenniveau gibt die Änderung der Zuchtgewohnheiten der Hochzuchtherden in Bayern wieder, die sich in den letzten 5 Jahren hinsichtlich der Benutzung der Bullen stark umgestellt haben. In der Interaktion, Jahr \times Region kommen die unterschiedlichen Tendenzen zwischen verschiedenen KB-Stationen zum Ausdruck, die durch den unterschiedlichen KB-Anteil noch verstärkt werden.

Die Analyse der einzelnen Laktationsleistungen innerhalb Jahren zeigt, dass 25-35 p. 100 der Varianz in der genetischen Überlegenheit mit Bullenmittelwerte gekoppelt ist und damit die

Selektion erschweren. Selbst innerhalb einer Region oder Besamungsstation sind 12-15 p. 100 der Variation der Zeitgefährtinnenunterschiede mit Vätern vermengt, die zu Rangfolgenunterschiede, die durch den genetischen Trend (d. h. die Zeit) verursacht sind, mit dieser Methode nicht ausgeschaltet werden, sollten diese Effekte zukünftig berücksichtigt werden, um Fehlentscheidungen zu vermeiden.

GENETIC ASPECTS OF CALF DROP CHARACTERISTICS

R. BAR-ANAN. — (*Israel*).

Heritabilities were estimated for the following calf drop characteristics : The sex ratio, difficult calving (DC), stillbirth, perinatal mortality (PM) and a deleterious calving index (DCI), which combined DC and PM. The data contained above 50,000 heifer and 100 000 cow calvings between the years 1964-1970 of the *Israeli Friesian* dairy breed. Each calving was identified by sire of calf (S) and its maternal grandsire (MG), all estimates were for S and MG, separately for heifers and cows. Three different models were deployed : a) A two-way simultaneous hierarchy for estimating the variance components of S and MG both on six years' data and separately for three consecutive two-year periods. b) A one-way model with sires nested in twelve year/management type blocks. c) Repeatability estimates by sires with more than 100 calvings. The calving by each sire were divided chronologically in subgroups of fifty and intraclass repeatabilities were estimated.

This procedure simulates a situation of sire proofs. Empirical heritability estimates (h_e^2) were then derived from the repeatabilities (R) :

$$h_e^2 = \frac{4R}{50 - 49R}$$

In heifer calvings h_e^2 for DC, PM and DCI by S were : 4.5 p. 100, 4.5 p. 100 and 6.3 p. 100 respectively ; by MG : 2.8 p. 100, 2.3 p. 100 and 3.4 p. 100. h_e^2 in cow calvings for DC, PM and DCI by sire were : 0.9, 1.4 and 1.7 and by MG : 0.5, 0.2 and 0.5. h^2 estimates by the alternative models were similar, but tended to be smaller. For 0.7 repeatabilities of sire tests for DCI 147 heifer calvings of mates and 275 calvings of daughters are required. In cow calvings 553 mates and 1864 daughters. r_g in DCI between heifer and cow mates was 0.52, r_g between DCI of heifer mates and growth rate of sons : 0.32 and 305 FCM yields of heifer daughters : — 0.42. Inbreeding increased PM by appr. 1 p. 100.

After the first results of sire testing for calf drop characteristics, there was severe selection among sires for heifer inseminations and the incidence of DC in heifer calvings dropped from 8.2 p. 100 in 1964-1966 to 3.4 p. 100 in 1968-1970. h^2 of DCI dropped in the same periods from 6.0 p. 100 to 2.5 p. 100. It was postulated, that the phenomenon of low h^2 and immediate selection response may indicate a situation of only a few loci involved in the determination of calf drop characteristics. A similar situation appears to exist in the sex ratio, h^2 was 0.4, but a few sire families diverged consistently from the mean. h^2 of twinning by MG was 2.4 p. 100.

It was suggested to test AI sires, which were plusproven for yields by 200 heifer matings.

SIRE EVALUATION IN ISRAELI DAIRY HERDS BY THE CUMULATIVE DIFFERENCE

R. BAR-ANAN and J. M. SACKS. — (*Israel*).

The contemporary comparison (CC) is based on the assumption of genetically static populations. Sire selection on CC and the use of AI violate this assumption. A sire's breeding value, as estimated by CC, is based on the phenotypic deviation of his daughters (\bar{D}_i) from the average yield of their herdmates ($\bar{H}\bar{M}_k$) multiplied by the heritability, which is particular to the test group size (h_i^2).

$$CC_i = (\bar{D}_{ik} - \bar{H}\bar{M}_k) \cdot h_i^2 \quad (1)$$

In terms of the linear model

$$D_{ij} = 1/2S_i + 1/2M_{ij} + h_k + e_{ijk}, \quad (2)$$

where

S_i = the sire's breeding value
 M_{ij} = the dam's breeding value
 h_k = the herd effect

The expected contemporary comparison becomes

$$E(CC_i) = (1/2S_i - \bar{S}_{(k)}) + 1/2\bar{M}_i - \bar{M}_{(k)} \quad (3)$$

In the absence of selection $\bar{S}_{(k)}$ may be assumed \bar{S} (base population),

In a genetically fluent population

$$S_i - \bar{S} = (S_i - \bar{S}_{(k)}) + \bar{S}_{(k)} - \bar{S} \quad (4)$$

The required adjustment is $1/2(\bar{S}_{(k)} - \bar{S})$, which is the average deviation of the sires of the contemporaries in herd k from the original herd level. The calculation was described by BARANAN (*Der Tierzüchter*, 24, 35, 1972). This procedure generates a matrix of estimates CD_{ij} , which is the cumulative difference of sire i in test period j . The average over the index j gives the current best estimate of the sire's breeding value in comparison to the base population, and the average over the index i can be used to estimate the genetic progress due to the selection program.

The within sire regression coefficients on time were obtained for CC and CD in 122 day daily kg FCM. The average yearly regression within sires of CC was $-.138$ kg daily FCM and CD $+.026$ kg, the latter not significantly different from zero.

In preliminary estimates of 305 day kg FCM, CD greatly reduced the negative trend in CC, but did not entirely remove it. The residual variances of CC and CD were similar. The CD estimates appear to be, for practical purposes, free of trends without reducing precision. The computing costs involved are negligible.

NEW PERSPECTIVES IN ANIMAL IMPROVEMENT

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The lecture discusses the fractionation of a metric character (milk proteins) in its discrete components. Differences in some Italian breeds of cattle are illustrated. Some Southern European breeds of cattle (*Maremma*, *Calabria* and *Modica* in particular) are closer to zebu cattle, perhaps because some alleles confer better environmental adaptation.

Second, it discusses galactopoiesis in a cow's population. Its time course can be represented by a harmonic oscillation having the year as period. The maximum ordinate varies with milk production level. Two deformations are described, one demographic in nature, the other due to micro-thermal variation.

Galactopoiesis and food efficiency of food energy utilization is described. It tends to vary harmonically during the course of the year but in opposite fashion of galactopoiesis.

Growth can be expressed by a logistic function

$$W_t = \frac{a}{1 + e^{\lambda + kt}}$$

Environmental conditions affect both the turning point and the asymptotic value.

AN APPEAL FOR A MORE WIDELY BASED MILK RECORDING SERVICE

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The Italian national breeding plan was based on nucleus or inbreeding selection for about 30 years. Fortunately, this has now been abandoned. However it is increasingly obvious that a lack of misunderstanding of the subject of selection has remained. Animal belonging to the nu \bar{t}

cleus period were used to form the herdbooks, and the recording service, established for the purpose of nucleus selection, now works in function of herdbooks. Herdbook is so fully protected in this country that a few years ago it obtained the legal monopoly to produce and sell animals for reproduction in private and cooperative herds by natural service and artificial insemination.

Herdbooks have contributed in the past in various countries to livestock production, but the author finds it is time to critically examine their services and costs, which are very high and in Italy are paid almost entirely by the state.

From the genetic point of view it must be observed that for any population it is advisable to contain a high amount of genetic variability. Both deliberate inbreeding, used in the past, and the strong restriction in the number of parents tend to reduce such variability. To get over this problem, it seems that decision makers are accepting the suggestion that the recording service should be enlarged. But the author fears that this is planned as a means of increasing the number of herds and animals to be registred in the herdbook. The author is afraid because this is not the right avenue, and will have little or no utility.

The avenue opened by his suggestion to enlarge the recording scheme is different, the principal aim is not that of culling low yielding cows, which is virtually wasteful, but the collection of data needed for progeny testing bulls for artificial insemination. There is of course the additional aim of helping all these herds to improve their environmental condition.

Genetically speaking, the bull bears half the responsibility for the production of low yielders, so better selection of bulls used in dairy herds is more effective and economic means of improving milk production and reducing costs, than the whole operation of registering after inspection and recording cows in herdbooks.

Geneticists have no greater competence than any other educated men on question of political action, but it must be clear they do have a unique competence, as well as responsibility where genetics itself is concerned.

OPTIMAL ESTIMATION OF BREEDING VALUES

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The success of modern AI dairy bull selection programmes has complicated the task of bull evaluation. The progeny of young bulls must now be tested in the presence of annual genetic change in the population, in competition with progeny of highly selected sires, and in a situation where farmers may be reluctant to use young bulls at all when top proven sires are available. These problems can be tackled by improving the statistical treatment of progeny test data or by altering the physical structure of the testing method.

Modern statistical developments in this area are briefly reviewed. They involve least squares estimation of bull breeding values in one or two stages from large-scale non-orthogonal data. By appropriate choice of constraints in solving the equations, the bulls can be evaluated in logical groups, and the estimates can be related to any chosen base.

Most countries base their testing on the normal milk recording programme. In some, it has become necessary to concentrate young bull usage in special herds. This facilitates the use of modern statistical methods and eliminates some biases. A possible intensification of this system is suggested, whereby testing would be concentrated in a special test sub-population.

GÉNÉTIQUE ET CONTRÔLES DE LA PRODUCTIVITÉ

A. DONATO. — *Associazione italiana allevatori, Via Tomassetti 9, 00161 Rome (Italie).*

La génétique quantitative a mis en évidence le fait que l'influence des gènes sur les caractères métriques est faible. Les différences de production entre vaches de même race, à l'intérieur d'un élevage, sont dues pour 70 à 80 p. 100 au milieu individuel de chacune, tandis que les

différences entre les exploitations sont dues pour 90 p. 100 environ aux conditions du milieu ambiant. On en déduit que les problèmes à résoudre sont essentiellement deux :

1. Approfondir l'étude des caractères de production.
2. Interpréter les différences de production par rapport au milieu physique.

En ce qui concerne le 1^{er} point, un schéma a déjà été tracé à l'occasion de la réunion de la Commission bovine de la F. E. Z. (Édimbourg, 1966).

Quant au 2^e point, l'*Association italienne des Éleveurs* en collaboration avec l'*Institut de Production animale* de Portici a mené des recherches dans les exploitations en utilisant les données des contrôles et/ou des données relevées dans les exploitations indépendamment des contrôles mêmes en procédant avec la méthodologie suivante :

a) Considérer l'exploitation dans son individualité par rapport à certaines structures (traite mécanique et manuelle, étable ouverte et fermée, exploitation irriguée et sèche).

b) Stratifier et analyser les exploitations par rapport aux structures examinées (ex. irrigation mode de traite, étable ouverte ou fermée).

L'analyse des résultats de la recherche met en évidence que d'importantes variations peuvent être obtenues en changeant les structures. Par une enquête menée dans une province il résulte par exemple que, dans la période s'étendant entre avril et septembre-octobre les vaches gardées en étable ouverte produisent 1,5 kg de lait en plus de celles tenues en étable fermée. Ces données sont confirmées sur quatre années successives.

L'Italie a un milieu très varié d'une région à l'autre, et l'influence qu'il exerce en déterminant la production est un problème qui nous intéresse vivement, tandis que pour d'autres pays où les conditions ambiantes sont plus uniformes, probablement l'argument a moins d'importance.

DIE SCHÄTZUNG DES GENETISCHEN FORTSCHRITTS IM KB-ZUCHTPROGRAMM BEIM ZWEINUTZUNGSRIND

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Die Anwendung der VON RENDEL und ROBERTSON (1951) abgeleiteten Beziehung

$$\Delta G = \frac{\sum I}{\sum L}$$

zur Schätzung des erwarteten genetischen Fortschritts entspricht in zweifacher Hinsicht nicht der tatsächlichen in der Reinzucht gegebenen Situation.

1. Orientiert sich die Zuchtwertschätzung der Prüfbullen am Populationsmittel zum Zeitpunkt des Abschlusses der Töchterleistungen und nicht am Populationsmittel zum Zeitpunkt ihrer Geburt.

2. Besteht das Populationsmittel in der Rinderzucht nur aus dem Leistungsdurchschnitt aller weiblichen Tiere, so dass der Beitrag der Bullenväter und der Bullenmütter zum Gesamtfortschritt erst über die weiblichen Enkel wirksam wird.

Um zu einer treffenderen Schätzung des erwarteten genetischen Fortschritts für die zur Diskussion stehenden Rinderzuchtprogramme zu kommen, wurde eine Beziehung entwickelt, welche sich direkt an der jährlichen Verschiebung des Populationsmittels :

$$\Delta G = \mu_1 - \mu_0$$

orientiert.

Um zu prüfen, welche Konsequenzen sich aus der direkten Schätzmethode des genetischen Fortschritts gegenüber der bisher angewandten Schätzgleichung nach RENDEL und ROBERTSON hinsichtlich der optimalen Bemessung der einzelnen Entscheidungsvariablen eines Zuchtprogramms ergeben, wurde eine umfassende Modellkalkulation durchgeführt. Die Modellkalkulation bezieht sich auf die Verhältnisse der Zucht eines milchbetonten Zweinutzungsrindes und unterstellt eine Indexselektion auf Milchfettmenge und tägliche Zunahme. Die Modellkalkulation zeigt folgende grundsätzliche Ergebnisse :

1. Bei der Anwendung der Schätzgleichung von RENDEL und ROBERTSON ergibt sich eine systematische Unterschätzung des zu erwartenden genetischen Fortschritts von ~ 0,3 kg Milchfett und von ~ 0,5 g tägliche Zunahme pro Jahr.

2. Beide Methoden führen zu übereinstimmenden Werten bezüglich der optimalen Bemessung der einzelnen Bestimmungsgrößen der Rinderzuchtprogramme.

3. Der Anteil der einzelnen Kategorien von Zuchttieren am Gesamtfortschritt ist bei der direkten Schätzmethode gegenüber der herkömmlichen Schätzmethode nach RENDEL und ROBERTSON für die Kuhväter und Kuhmütter deutlich erhöht.

Divers

CONSANGUINITÉ ET PARENTÉ, CHEZ LE PORC DE PIÉTRAIN

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L'auteur commence par rappeler dans quelles circonstances, le porc de *Piétrain* s'est développé. Tout porte à croire que ses caractéristiques ont été fixées relativement tôt, au cours de son histoire. La race connut son expansion définitive en 1950, c'est-à-dire à une époque où la supériorité de la valeur commerciale de sa carcasse était à son maximum. La création du premier Syndicat d'Éleveurs de Porc de *Piétrain* et du *Pig-Book* datent de la même année.

Le *Pig-Book* sera fermé en 1957. Les premiers reproducteurs inscrits au *Pig-Book* n'avaient pas de généalogie connue ; il était donc impossible d'évaluer la consanguinité pratiquée antérieurement. Se bornant à calculer la consanguinité d'individus dont au moins le père et le grand-père maternel sont connus, on constate que, pour les individus inscrits au *Pig-Book* de 1951, 1952, 1953, 1954 et 1960, le coefficient moyen de consanguinité a été respectivement de 14,8 p. 100, 8,2 p. 100, 8,1 p. 100, 8,9 p. 100 et 5,2 p. 100.

A partir des pedigrees, limités à cinq générations, de reproducteurs ayant participé aux concours généraux de 1958, 1962, 1966, 1970 et 1972, les coefficients moyens de consanguinité suivants ont été obtenus : 3,25 p. 100, 2,47 p. 100, 1,26 p. 100, 1,59 p. 100 et 1,94 p. 100.

Les performances du porc de *Piétrain* (fertilité, croissance, composition de carcasse) sont discutées à la lumière de ces chiffres de consanguinité.

MAST- UND SCHLACHTEIGENSCHAFTEN VON ZWEINUTZUNGSRINDERN UND VON GEBRAUCHSKREUZUNGEN ZWISCHEN ZWEINUTZUNGSRASSEN UND MASTRASSEN

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In der Rinderzucht müssen alle Möglichkeiten genutzt werden, die eine Vermehrung der Fleischerzeugung versprechen. Hierzu gehören Massnahmen, die eine Erhöhung der Zahl der Kälber ermöglichen, aber auch Massnahmen, durch die die Qualität der Kälber, d. h. ihre Mastei-gnung, verbessert wird.

Im Rahmen eines Forschungsauftrages wurden im Versuchsgut *Unterer Lindenhof* der *Universität Hohenheim* Kreuzungsversuche mit Zweinutzungs- und Mastrindern durchgeführt. Es wurden die vier Vatterassen *Schwarzbunt* (Sb), *Fleckvieh* (FV), *Romagnola* (Ro) und *Hereford* (Hf) eingesetzt, als Mutterrassen die beiden im Versuchsbetrieb gehaltenen Rassen *Schwarzbunt* und *Fleckvieh*. Die Kälber beider Geschlechter wurden zur Mast aufgezogen. Die Mastendgewichte der ♂♂ Tiere wurden auf 500 und 600 kg festgesetzt. Die ♀♀ Tiere wurden als Färsen vogenutzt. Sie wurden mit ♂ 15 Monaten belegt und bei einem Mastendgewicht von 450 kg geschlachtet. Insgesamt wurden 268 ♂♂ und 850 ♀♀ Schlachttiere erfasst. Die Kreuzungen Sb × FV haben in beiden Gewichtsklassen die signifikant höchsten Zunahmen, gefolgt von den Kreuzungen FV × Sb. Bei den vogenutzten Färsen erzielten die Kreuzungen Sb × Ro die höchsten Zunahmen. In der Ausschachtung waren die Unterschiede zwischen den einzelnen

Kreuzungsgruppen gering. Den grössten Rückenmuskelquerschnitt (Anschnitt *Musculus longissimus dorsi* zwischen 9. und 10. Rippe) brachten die Kreuzungstiere mit FV-Müttern die signifikant höchsten Ergebnisse. Die Differenzen zwischen den Anteilen der Pistole (Keule und Roastbeef und Filet) und des Roastbeefs erlauben keine eindeutige Aussage hinsichtlich der Überlegenheit einzelner Kreuzungstypen. Der Fettansatz, erfasst am intramuskulären Fett im *Musculus longissimus dorsi*, war bei den Kreuzungsbullen mit Sb-Müttern bei einem Mastendgewicht von 600 kg am höchsten.

INHERITANCE OF AN AGE-INFLUENCED CATTLE SERUM ANTIGEN DETECTED BY AUTOANTIBODIES

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While typing cattle sera for an allotypic specificity by double diffusion, a precipitation line was observed between two peripheral wells containing normal sera. Rocket-Ab (a bull which proved to be the source of the antibodies) and I 035 (a calf). When Rocket-A^b was tested against a serum sample of Rocket (Rocket-A^g) collected two years previously, a precipitation line developed between the wells containing the two samples of Rocket, thus suggesting the presence in Rocket-A^b of antibodies (R^{Ab}) against an antigen (R^{A^g}) present in Rocket-A^g. The reactive animals (23 out of 270 tested) had all the common characteristic of having an age varying from a few days to seven months, thereby suggesting the possibility that the antigen expression required for the animal not only the proper gene but also the proper age.

POLYMORPHISM IN ITALIAN WATER BUFFALO

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Fifteen red cell antigens, two polymorphic proteins, and four allotypic specificities have so far been identified in Italian water buffalo.

Blood factors A and C are controlled by allelic genes forming the AC system, analogous to the FV system in cattle. The B system is comprised of factors B-D-F-H-I and form several phenogroups, like factors of the bovine B system. Factors J-O-Q-T-U belong to a third system (J system) and are linked by a subgroup relationship (as the E' factor series in cattle). Because of the lack of suitable family data, factors E-G-M have not been allocated within systems. Evidence was found that the antigenic specificity A in some animals is not located on the surface of erythrocytes within them. To the authors knowledge, this situation has never been observed before.

Three phenotypes determined by two codominant alleles (*Alb^A* and *Alb^B*) have been detected in the albumin locus. Polymorphism of transferrins is also regulated by two codominant alleles (*Tf^D* and *Tf^E*).

The allotypic specificity A, identified by double immuno-diffusion (Ouchterlony technique) is common to both cattle and water buffalo. Specificities B and C have been identified by double immuno-diffusion, immuno-electrophoresis and passive hemagglutination. On double immuno-diffusion slides, specificity D appears as a spur. The genetic mechanism controlling these four specificities so far has not been studied.

GENOTYPE-ENVIRONMENT INTERACTION EXAMPLIFIED IN MICE

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In many countries the system of improvement of livestock is based on the use of pedigree stock in which the breeding standards are much higher. If the differences in feeding and husbandry conditions between improved and improving animals are very high it may be assumed

that the discussed system of improvement of the animals will not produce the expected results. This trial is intended to reconstitute the system of improvement of livestock in some countries.

Selection within litters of three mouse populations was carried out for live weight gains of animals between the third and sixth week of life. All the selected populations were of the same size, they comprised 10 parent pairs in four replications (together 40 ♂♂ + 40 ♀♀) and the offspring. Every experimental population had a corresponding unselected control population.

One of the populations of mice was maintained on a feed with a 20 p. 100 content of crude protein, the other on a feed with a 10 p. 100 content of crude protein, while in the third population females and their offspring were fed with the low-protein (10 p. 100) diet and mated with males from the first population maintained on the high-protein (20 p. 100) diet. This part of the trial has six selected generations.

The second part of the trial was performed with mice obtained from a different experiment. Selection of the mice was carried out on the same principles as in the first part of this trial, only instead of weight gains, the weight of 5 week-old mice was taken into account.

Animals were maintained on a diet identical to that given in the first part of the trial. After selection pursued over 13 and 14 generations (on the high-protein diet one extra generation was obtained) the females fed a low-protein 10 p. 100 diet were mated to males maintained on the high-protein (20 p. 100) feed, the offspring was then compared with the progeny of selected parents maintained permanently on the low-protein (10 p. 100) feed.

Present findings clearly indicate the mating of females selected on low-protein (10 p. 100 of protein) food with males selected on high-protein (20 p. 100 of protein) food not to be successful.

MANY-SIDED PROGENY TESTING OF BULLS

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Reasons for and possibilities to many-sided progeny testing of AI bulls have been considered on the basis of Finnish experiences. The present routine testing in Finland includes milk and fat yield and estimated live weight of daughters. Large scale efforts have recently been made to develop progeny testing methods for the following traits: protein content of milk (one sample per daughter), carcass weight of young slaughter cattle (slaughterhouse data), milkability, calmness, appetite and estrus symptoms (interview of herd managers), fertility (milk-recording and non-return statistics), frequency of stillbirth and frequency of diseases. In addition studies on the persistency of lactation and the frequency of paresislike leg faults have been considered.

Preliminary estimates on correlations between progeny tests for different traits, as well as of correlations between results of performance tests and progeny tests were also given. Some interesting or surprising correlations were found in both cases. For example, the average calmness of daughters showed a significant positive correlation (ca 0.3) with the bulls own growth performance at the station, i. e. the correlation is as high as the average age-corrected carcass weight of offspring. The correlation between milkability and calmness tests was 0.4. Fat content of daughters gave a negative (— 0.1) and milk yield a positive (0.1) correlation with bull's own growth performance.

GENETIC INVESTIGATION ON OXIDATION FLAVOUR IN MILK

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Oxidation flavour is an off-flavour in milk which has been known as a problem in the dairy industry for many years. Ordinary market milk may show such oxidation faults after only 24 hours that it — or products made from it — can hardly be accepted by most consumers. The problem is of increasing concern since structural rationalization has brought about bulk milk handling and a market chain longer both in time and distance. The milk is older when consumed and, therefore, the off-flavour has time to develop. (Furthermore, milk production is becoming

more and more intense and this by itself seems to result in a greater sensibility to oxidation faults.)

It is generally agreed that oxidized flavour of milk and dairy products is due to auto-oxidation of unsaturated fatty acids in the fat or phospholipid phases with the formation of mainly aldehydes and ketones, smelling and tasting badly.

The disposition of milk for oxidized flavour is higher in winter than in summer milk, but several observations indicate that within season the disposition varies between different breeds, different herds, different cows in the same herd, or within the lactation period of the same cow.

Until recently metal-induced oxidized flavour was the most important, as contamination of the milk with copper from milking machines, coolers, etc. was common. However, most of these contamination causes have now been eliminated and the importance of the natural content amount of copper as a possible cause of the occurrence of oxidized flavour has attracted the interest.

As a measure of the oxidized flavour in milk the thiobarbituric acid (TBA) test has been introduced as an objective measure of the oxidative deterioration of the milk fat. It is based on the formation of a red pigment which is determined spectrophotometrically at 530 m μ and which is the reaction product of malonic dialdehyde with the test reagents. The TBA test correlates well with the organoleptic quality of the milk, with 0.022 being the critical limit above which most people will recognize the milk as having oxidized flavour.

In 1968-69 an investigation on oxidized flavour was carried out on milk from cows at the Danish progeny test stations in order to study the genetic background of this character (TBA value), and its inter-relation to the copper content of the milk and the chemical make-up of the milk fat (refraction index). 1082 cows were included, there of 25 progeny groups with 455 cows of *Red Danish Cattle* (RDM), 15 progeny groups with 276 cows of *Black and White Danish Cattle* (SDM), 19 progeny with 351 cows of *Danish-Jersey* (J). In the course of the lactation 4 determinations of TBA, 2 determinations of refraction index and 2 determinations of copper content were carried out on individual milk samples. The cows were on average 50 days from calving at the first determination and about 135 days at the last.

The refraction index was nearly constant through the period studied, whereas the TBA values and the copper content were decreasing with time from calving.

SDM cows had milk with the lowest and RDM cows had milk with the highest TBA values. *Jerseys* were intermediate. The differences were significant, except between RDM and J. Significant differences were found between all breeds as to refraction index and copper content, *Jersey* milk being especially characterized by low refraction index and high copper content.

Based on calculations including all three breeds the coefficients of heritability for TBA values and copper content of the milk were found to be 0.4 ± 0.1 , while the coefficient of heritability for refraction index was estimated as low as 0.1 ± 0.1 .

The phenotypic correlation between TBA values and copper content was found to be 0.5. All other phenotypic correlations were not significant. Three significant genetic correlations were found. The genetic correlation between refraction index and daily butterfat yield was calculated to 0.57, while it was 0.66 between TBA-values and copper content, and — 0.46 between refraction index and copper content. No significant correlations were found between TBA-values and daily butterfat yield.

The investigations indicate that it is possible through breeding measures to improve the quality of the milk as concerns oxidized flavour. They confirm a relation between natural copper content (ceruloplasmin ?) of the milk and the disposition to oxidization of the milk fat, but apparently it is not a simple cause-effect relationship.

ÉTAT ACTUEL DE LA RECHERCHE IMMUNOGÉNÉTIQUE CHEZ LE CHEVAL

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Les recherches des groupes sanguins chez le Cheval durant la première moitié du xx^e siècle n'ont actuellement qu'un intérêt historique.

En 1950, la recherche des groupes sanguins des équidés, notamment du Cheval, fut entreprise par l'*Institut Pasteur* à Paris. Elle fut suivie quelque temps après par des chercheurs d'autres pays. Chacun d'eux utilisait sa propre nomenclature, ce qui rendait toute comparaison impossible.

Le besoin d'une nomenclature commune s'étant fait sentir, la première étude comparative des réactifs fut effectuée en 1960 à l'*Institut Pasteur*. Elle fut suivie, en 1962, de l'unification des nomenclatures de l'*Institut Pasteur* et du Danemark en prenant pour base celle de l'*Institut Pasteur*. Cette nomenclature fut acceptée par d'autres chercheurs.

Depuis, d'autres études comparatives furent effectuées ; la dernière eut lieu en 1971. Le nombre de réactifs envoyés par les 9 participants variait de 5 à 47. Quatorze seulement ont été découverts par au moins 2 laboratoires. Leur contrôle par le « test de référence » permettra de choisir des sérums-étalons. Les antigènes érythrocytaires connus actuellement appartiennent à 8 systèmes génétiques au moins.

La découverte, par SMITHIES en 1955, d'une méthode d'étude du polymorphisme biochimique a ouvert une nouvelle voie dans la recherche des constituants du sang. Parmi les nombreux systèmes déterminés génétiquement, 13 seulement ont été étudiés à ce jour chez le Cheval. Tous ces systèmes sont constitués par un certain nombre d'allèles codominants. Actuellement quinze Laboratoires de divers pays travaillent sur l'immunogénétique du Cheval.

Les applications des connaissances des marqueurs sanguins sont décrites : transfusion, prophylaxie de l'ictère hémolytique du nouveau-né, étude des jumeaux, ontogenèse, étude des gènes, identification de l'individu, contrôle de filiation, étude des populations.

A NOTE ON SOME BLOOD PROTEINS OF THE ITALIAN BUFFALO (*BUBALUS BUBALIS* L.)

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Blood samples studied on starch gel electrophoresis for Hb, Am, Alb and Tf variants, show two electrophoretic components for Hb (Hb₁ and Hb₂), but no polymorphism. Also for Am there is no genetic variation. Alb and Tf are on the contrary determined by two codominant autosomic alleles respectively. Each allele controls one band on starch gel, while Tf shows three large bands preceded by a weaker one. Frequencies of Alb^A, Alb^B, Tf^B and Tf^F were in our samples 0.329 7, 0.670 3, 0.230 8 and 0.769 2 respectively.

Data are discussed in comparison with those obtained by other workers on the genetic foundation that the buffalo raised in Italy, origins from India.

PRE- AND POST-ALBUMIN POLYMORPHISM IN BUFFALOES

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Pre- and post-albumins of serum in Buffaloes were studied with the technique of starch-gel electrophoresis of 660 buffaloes, reared in Campania and Latium, and belonging to seven flocks, was performed.

Three pre-albumins (A, B and O) and five phenotypes were evidenced. Gene frequencies were as follows : $q_A = 0.273\ 5$; $q_B = 0.633\ 3$; $q_O = 0.091\ 7$.

Two post-albumins (A and B) and three phenotypes were founded. Gene frequencies were as follows : $q_A = 0.714\ 4$; $q_B = 0.285\ 6$.

The genetic equilibrium test for the pre- and post-albumin systems showed a deviation from the binomial distribution.

The heterozygosis degree of pre- and post-albumin loci, calculated by De Finetti's equation, resulted higher than homozygosis.

PHYSIOLOGICAL ASPECTS OF CATTLE TRANSFERRINS. PRELIMINARY NOTE

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It has been observed that sera from animals possessing the Tf^B allele show a more intense yellow-brownish colour than those from animals not possessing this allele. Because differences of serum colour are mostly determined by different concentrations of the pigment bilirubin, although carotene and other pigments are contributing factors, the aim of this research was to study the relation between serum bilirubin content and transferrin types. For this purpose a

random sample of 328 sera from animals of the *Piedmont*, *Brown alpine* and *Rendena* breeds has been used.

The results obtained from this study indicate that significant differences in serum bilirubin content exist between breeds. By grouping the figures according to phenotypes within breeds, significant differences have been found in the *Piedmont* and *Rendena*. In this respect it should furthermore be noted that, on average, transferrin types AE and DE from *Piedmont* and *Brown alpine* animals show consistently higher figures for bilirubin content.

Although the sample examined in this research did not include phenotype Tf^{EE}, which has a very low frequency in the breeds we have considered, the results could indicate the existence of a relation between transferrin types and serum bilirubin content. This phenomenon, which will be further investigated on a larger sample, is in agreement with the results obtained by NEETHLING *et al.* (*Proc. XIth Conf. E. S. A. B. R., Warsaw, 1968, 171*) who found that red cells from animals possessing the Tf^E allele have a shorter half-life than those from animals of the Tf^{DD} phenotype. The implication of these phenomena on the animal basal metabolic rate is discussed.

CASEINS GENETICS : SEGREGATION AND LINKAGE AMONG α_1 ,
 β -AND κ -CASEINS IN *PIEDMONT* AND *VALDOSTANA*-CATTLE

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Using electrophoresis in basic and acid buffers we analyzed 1 050 samples of *Piedmont* and 700 samples of *Valdostana* cattle. In *Piedmont* the gene frequencies were : locus α_1 , D = .005, B = .817 and C = .178 ; locus β , A₁ = .287, A₁ = .554, B = .123, E = .001 and C = .035 ; locus κ , A = .615 and B = .385. This breed is characterized for the presence of β E, that in acid buffer present the same mobility of β A₁.

In *Valdostana* breed the frequencies are : locus α_1 , B = .894, C = .106 ; locus β , A₁ = .313, A₁ = .753 and B = .035 ; locus κ , A = .544 and B = .466.

The loci controlling polymorphism of α_1 , β and κ casein are « structural ». The linkage disequilibrium, observed in the gametic association, was measured by Δ (the sign of this parameter indicate the direction of association). For the *Piedmont* we found there values :

$$\begin{array}{ll} \alpha_1C-\beta A_2 & \Delta = + .051 \\ \beta A_1-\kappa A & \Delta = + .030 \\ \alpha_1C-\beta B & \Delta = - .030 \\ \beta C-\kappa A & \Delta = - .021 \end{array}$$

The first two appear in coupling while the others are in repulsion. In *Valdostana* the situation is different :

$$\begin{array}{ll} \alpha_1C-\beta A_2 & \Delta = + .027 \\ \beta A_1-\kappa B & \Delta = + .056 \text{ are in coupling while :} \\ \alpha_1C-\beta A_1 & \Delta = - .023 \\ \beta A_1-\kappa A & \Delta = - .031 \\ \beta A_2-\kappa B & \Delta = - .059 \\ \beta B-\kappa B & \Delta = - .015 \text{ appears in repulsion.} \end{array}$$

These values show a significant χ^2 .

The haplotype frequencies, calculated by by maximum-likelihood method, show that the combination $\alpha_1C-\beta A$ in *Piedmont* and $\alpha_1C-\beta A_1$ in *Valdostana* have a recombination frequencies nearly 0.

CONTEMPORARY COMPARISON VS
LEAST SQUARES IN THE ANALYSIS OF PROGENY TESTING DATA

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Progeny testing results in the field of AI-bulls for daily weight gain were analyzed both by contemporary comparison and least-squares procedures. 15-20 sons of each AI-sire are distributed at 2-3 weeks of age to several private farms, where they are fattened to constant finish at about

500 kg. In 1965-1966, 108 sons of 9 bulls were distributed to 12 farms according to a balanced incomplete block design (lattice-design). Contemporary comparison and least-squares analysis with sire and herd as main effects led to the same ranking of bulls. For practical reasons the balanced distribution of the progeny among herds was discontinued and, in 1969-1970, 662 sons of 45 bulls were randomly distributed among 26 farms. In some of the farms, the calves were castrated. The following least-squares model was applied.

$$Y_{ijk} = u + s_i + g_j + b_{jk} + c_{ijk}$$

where s = sire, g = sex (bull/steer), b = herd, c = error.

In a second analysis, in addition to these effects, regressions on the circumference of chest of the mothers and on age weight at first weighing were fitted. The rank correlation between the bulls rated by the different methods amounted to :

Contemp. comp.	Least squares without regressions	0.913
Contemp. comp.	Least squares with regressions	0.888
Least squares without regr.	Least squares with regressions	0.945.

The regressions on maternal circumference of chest and on age at first weighing were not significant. The regression on weight at first weighing was significant and responsible for a substantial amount of variation in daily weight gain. Least squares procedures were preferred to contemporary comparison because the estimation of constants for bulls and for other effects was accomplished at the same time.
