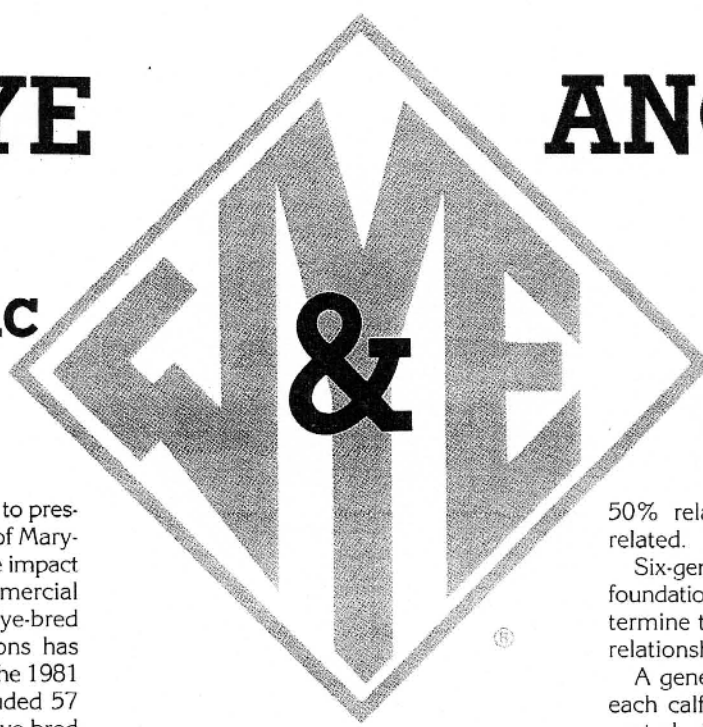


# WYE

# ANGUS

## The Genetic History



## Present Structure

During its long history from 1938 to present, the Wye Angus-University of Maryland Foundation herd has had a large impact upon the Angus breed and the commercial cattle industry. The heavy use of Wye-bred bulls along with sons and grandsons has been widespread across the nation. The 1981 Angus Sire Evaluation Report included 57 Wye-bred bulls and 34 sons of Wye-bred bulls.

Because of the herd's contribution, it is important to trace the genetic history of the herd and to relate this history to its present genetic structure. Information on the genetic history and present structure can serve as a base for future research studies and breeding plans.

Ownership and management of the herd was fairly constant over most of the time period covered by this study. Mr. Arthur A. Houghton Jr. was owner of the herd from its inception until 1978, when he presented the herd to the University of Maryland Foundation (UMF). Mr. James B. Lingle was manager of the herd from its beginning until his retirement in 1971. He was responsible for the purchase of all foundation animals and imported bulls as well as the selection and breeding program during that time. A descriptive history of the herd was given by Lingle in his book, "The Breed of Noble Bloods." Mr. Richard Whaley, assistant manager from 1957, became manager upon Mr. Lingle's retirement and remained in that position until the herd was given to UMF. Dr. Gordon Cairns, retired dean of agriculture, University of Maryland, served as advisor for the herd from 1978. Mr. Dwight Riggleman, herd manager, came to Wye in 1968. Mr. Richard Beck, present program manager, assumed duties in 1981. The cattle have remained at the same location, Wye Plantation, throughout the entire time period.

### DATA AND PROCEDURES

The data used in this study included complete pedigree information on all calves born from 1939 through 1981. There was a total of 5,990 calves born during this 42-year period, ranging from 9 calves in 1940 to 325 in 1975. Two hundred calves were born in 1981.

Inbreeding coefficients for each calf produced and coefficients of relationship among all animals were calculated. Inbreeding is usually defined as the mating of animals

by Dr. J.S. Brinks, Colorado State University and Dr. T.S. Katsigianis, University of Maryland

*"The inbreeding levels since 1952 are less than expected from the average relationship values if parents were mated at random, indicating that outbreeding was the desired practice for the most part . . . the Wye herd is probably somewhat less inbred than the average Angus herd in the U.S. at present."*

*" . . . the within-cow family relationship was only slightly higher than the average relationship among two randomly selected offspring from the 1981 calf crop . . . cows have contributed as much to other families as to their own family through the use of sons."*

*The results mentioned in these quotes indicate a few of the findings of Dr. James S. Brinks, University of Colorado. He spent the past academic year with the University of Maryland analyzing a wealth of figures and information on the Wye Angus herd. With the assistance of Dr. Ted S. Katsigianis, he conducted a detailed study of the herd's genetic history and its present structure; the following article summarizes their research.*

*Many cattlemen have assumed that Wye's closed breeding program led to a highly inbred herd—the thoughts and figures presented here provide insight for a different conclusion.*

more closely related than the average of the population. More precisely, an inbreeding coefficient is the probability that two genes at a locus are identical by descent (or the percent of homozygous loci by descent). When non-inbred parent X offspring matings are made, resulting progeny are 25% inbred. When half-sib matings are made, resulting progeny are 12.5% inbred. Relationship measures the percent of genes two animals have in common through common ancestry. Parent-offspring matings and full-sibs are

50% related, whereas half-sibs are 25% related.

Six-generation pedigrees were used for all foundation animals and imported bulls to determine the initial levels of inbreeding and relationships.

A generation number was calculated for each calf. All foundation animals and imported sires were assigned a generation number of 0 as the beginning point. The percentage of imported ancestry, that derived from the imported bulls, was also calculated for each calf born.

### FOUNDATION ANIMALS Domestic Cows

There were a total of 18 foundation cows purchased for the Wye Plantation program. A listing of these females is presented in Table 1.

These females were purchased in two groups. The first 10 were obtained from nearby Bennett's Point Farm, Queenstown. They were all born in 1937 and produced their first calves at Wye in 1939. They were all paternal half sisters by Blackcapper 24 of Page. In addition, four cows had a maternal grandsire in common, Blackbird Marshall of Page, and three others had a common maternal grandsire in Andelot Barkley. The average relationship among these 10 cows was 28.3%.

The last females introduced into the herd were eight heifers from the Kershaw herd, Muskogee, Okla. These heifers were all born in 1939 and produced their first calves at Wye in 1941. They were assigned numbers of 90 through 97. Four of these heifers, 91, 92, 93 and 95, were paternal half sisters by Earl Eric 28th; cows 92, 93 and 95 also had a common maternal grandsire. Cows 96 and 97 were paternal half sisters by Blackcaps Revolution 5th. Cow 94 was unrelated to all other foundation cows but was the most inbred of the cows (7.8%), having Barford as a maternal grandsire and as a paternal great grandsire. The average relationship among the eight cows was 8.5%.

The average relationship among all 18 foundation cows was 10.4% and their average inbreeding coefficient was .7%.

The number of progeny out of the 10 Bennett Point cows ranged from eight (cow 81) to 17 (cow 82), except for cow 86 who produced only one heifer calf born in 1939 and that calf became the bearer of the 86 chain

TABLE 1. DESCRIPTION OF DOMESTIC FOUNDATION STOCK

| CHAIN        | NAME                           | COW FAMILY              | NO. PROGENY | NO. GRAND PROGENY | PERCENT INBRED | % RELATED TO 1981 CROP |
|--------------|--------------------------------|-------------------------|-------------|-------------------|----------------|------------------------|
| <b>COWS</b>  |                                |                         |             |                   |                |                        |
| 61           | Pearl of Dorchester            | Florelle                | 13          | 22                | 0              | 8.6                    |
| 77           | Duchess 3 of Bennett's Point   | Lullaby Lottie          | 10          | 32                | 2.3            | 4.4                    |
| 79           | Pridista of Bennett's Point    | Pride of Aberdeen       | 12          | 36                | 0              | 4.2                    |
| 80           | Pride 5 of Bennett's Point     | Pride of Aberdeen       | 12          | 32                | 0              | 5.8                    |
| 81           | Proud Queen of Bennett's Point | Queen Mother            | 8           | 20                | 0              | 3.9                    |
| 82           | Capearl                        | Boghead Flora           | 17          | 123               | 0              | 9.0                    |
| 83           | Alexina Blackstar              | Alexina                 | 15          | 89                | .8             | 6.8                    |
| 84           | Prim Pride of Bennett's Point  | Mulben Pride            | 10          | 72                | 0              | 4.7                    |
| 85           | Pathfinder of Bennett's Point  | Lottie                  | 13          | 26                | 1.2            | 5.1                    |
| 86           | Hilda of Bennett's Point       | Jilt                    | 1           | 6                 | 0              | 4.9                    |
| 90           | Eulima of Muskogee 2           | Eulima                  | 5           | 17                | 0              | .2                     |
| 91           | Blackbird of Muskogee 121      | Ballindalloch Blackbird | 14          | 38                | 0              | .6                     |
| 92           | Blackbird of Muskogee 122      | Fourth Branch Blackbird | 5           | 13                | 0              | .4                     |
| 93           | Alma of Muskogee               | Clova                   | 6           | 13                | 0              | .4                     |
| 94           | Blackbird M.S. 5               | Hillhurst Blackbird     | 5           | 6                 | 7.8            | 0                      |
| 95           | Blackbird of Muskogee 120      | Second Branch Blackbird | 5           | 3                 | 0              | .4                     |
| 96           | Mayflower's Lass               | Golden Madge            | 6           | 14                | 0              | 1.1                    |
| 97           | Miss Copeland's Queen          | Miss Copeland           | 5           | 28                | 0              | 2.8                    |
| <b>BULLS</b> |                                |                         |             |                   |                |                        |
| 1            | Blakeford Buxton               |                         | 121         | 230               | 2.3            | 3.7                    |
| 11           | Manor Double Grenadier         |                         | 37          | 10                | 15.7           | .3                     |

number. Capearl (82) also had the most grandprogeny (123) of any of the foundation cows. She was the dam of Foremost, the first Wye-bred bull to make a real impact on the herd.

Each of the cows from Bennett's Point were similarly related to the herd in the early years. However, in the mid-to-late 1940s cow 82 along with 61 and 83 began to have more influence than other Bennett Point cows. This trend continued and in 1981 the average relationship to the calf crop for these three cows was 9.0, 8.6 and 6.8%, respectively. All other Bennett Point cows ranged from 3.9 to 5.8% relationship to the 1981 calves. The 10 Bennett Point cows made a larger contribution to the present herd than did the eight Kershaw cows.

The eight foundation cows (90-97) purchased from the Kershaw herd never were highly related to a calf crop. Cow 94 made no contributions after 1952; all of her direct descendants had left the herd by that time. Cows 97 and 96 made the largest impact with relationship values to the 1981 calf crop of 2.8 and 1.1%. All other cows were .6% or less related to the 1981 calves.

The relationships of all 18 cows to the present herd are fairly low even though no other females were introduced into the herd. Their influence was diminished through the heavy use of the imported bulls on their daughters, granddaughters, etc. over the generations. This is not surprising since any one female rarely contributes greatly to the genetic

makeup of any large herd.

#### Domestic Bulls

The foundation bull, Blakeford Buxton, was born in 1937 and was purchased from Blakeford Farm, Queenstown, in 1938. He was only slightly inbred (2.3%) and only slightly related (2.1%) to the 18 foundation cows. Another bull purchased from Blakeford Farm, Manor Double Grenadier, was born in 1949. He was slightly related to Blakeford Buxton (5.3%) and to the 18 foundation cows (.2%). He was 15.7% inbred, the result of mating paternal half-sibs by Queen's Grenadier GR.

Although Blakeford Buxton was used extensively, siring 121 progeny and having 230 grandprogeny, his contribution to the present herd was minimal (3.7% relationship). None of his sons were used extensively. His relationship to a calf crop was diminished to 4.0% or less by 1960 and has remained stable since that time. Again, the subsequent heavy use of the imported bulls diminished his contribution over the generations.

Collectively, the 18 cows and two domestic bulls that comprised the foundation herd in the early years accounted for only 20 to 22% of the genetic material in the 1981 calf crop.

#### Imported Bulls

There was a total of 19 bulls of imported ancestry (Table 2). Seventeen of the bulls were imported and two, Juryman of Wickwire and Puck of Wickwire were offspring of

recently imported parents. Both bulls were somewhat inbred (Juryman, 12.5%; Puck, 14.5%) and both resulted from matings of paternal half-sibs. However, Juryman and Puck were only slightly related to each other with a relationship coefficient of 1.6%.

None of the seventeen imported bulls were highly inbred; inbreeding values ranged from 0 to 7.4% (Table 2). However, several of these bulls were related to each other. Jalnac Eric, Janvren Eric and Prince of Malpas were all paternal half-sibs by Jumor Eric of Southburn. In addition, Janric of Dalmeny was a prominent common ancestor in all three pedigrees which added to their relationships. The average relationship among these three bulls was 32.6%.

Mulben Envost and Mulben Eclator were paternal half brothers by Black Launch of Derculich and both out of the Euthalla cow family. Their relationship was 28.5% and they were only slightly related to all other imported bulls.

Geordus, Valour of Ardrass and George of Swiftbrook were paternal half brothers by Prince Paul of Barnoldby and the average relationship among these three bulls was 29.8%. Geordus and George of Swiftbrook were more highly related (37.9%). Eldorado of Macaroni Downs was a half brother of Prince Paul of Barnoldby. The average relationships of Eldorado of Macaroni Downs to the other three bulls was 15.4%. These bulls were only slightly related to all other imported bulls.

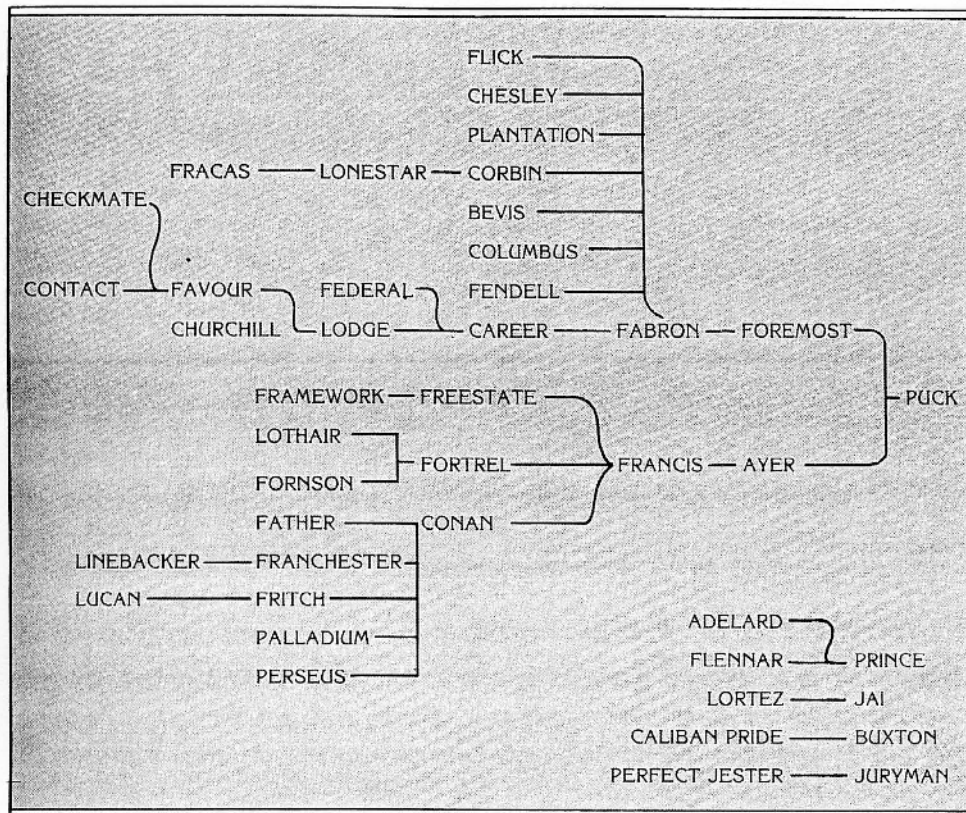


Figure 1. Paternal lineage of Wye-bred sires with 50 or more progeny or grandprogeny by 1981.

The other imported bulls, Elector of Shempston, Elimast of Ballindalloch, Buckmaster of Cairnfield, Vindicator of Milford, Ernest of Bolton, Edict of Wyndcrest, and Jai of Frampton were only slightly related among themselves or to all other imported bulls.

The average inbreeding value of the 19 bulls was 2.7% and the average coefficient of relationship among all imported bulls was 4.0%. The imported bulls were unrelated to the foundation cattle described earlier and therefore constituted new and unrelated sources of germ plasm for the herd.

Juryman was the first bull of imported ancestry to be used in the herd and sired calves from 1942 through 1951. He was followed by Puck who produced calves in 1947 through 1956. Among the bulls of imported ancestry, Puck sired the most calves (314) followed by Gaird (231), Juryman (210) and Prince (144). These four bulls also had the most grandprogeny and were the most highly related to the 1981 calf crop, even though the first three bulls listed were used early in the program (1942-1959). The four bulls have average relationship values with the 1981 calf crop of 12.0 and 21.9% (Table 2). Puck was the imported bull most highly related to the 1981 calf crop (21.9%) and contributed to the present herd almost as much as the entire 18 cows and 2 bulls comprising the foundation herd.

Juryman had a large impact on the herd in the early years when the herd was small and he was siring almost half of the calves. His highest relationship to a calf crop was 52.2% in 1946, Puck was used extensively on daughters of Juryman and his highest relationship with a calf crop was 29.2% in 1949. Gaird and Prince had their largest influence on a calf crop in 1952 (27.1%) and 1963 (23.7%) respectively. Elector, Geordus and Valour also made a significant contribution to the present herd with average relationships to the 1981 calf crop of 8.4, 8.8 and 10.5% respectively. All other bulls were less than 6.1% related to the 1981 calves.

All imported bulls had their largest influence on a calf crop when they were being used extensively. This initial impact was followed by a decline and then a steady influence during the past 10 years when pri-

TABLE 2. DESCRIPTION OF IMPORTED SIRES

| NAME                       | BIRTH YEAR | NO. PROGENY | BIRTH YEAR OF PROGENY | NO. GRAND PROGENY | % INBRED | % REL. TO 1981 CROP |
|----------------------------|------------|-------------|-----------------------|-------------------|----------|---------------------|
| Juryman of Wickwire        | 40         | 210         | 42-51                 | 585               | 12.5     | 12.0                |
| Puck of Wickwire           | 44         | 314         | 47-56                 | 561               | 14.5     | 21.9                |
| Gaird of Delmeny           | 46         | 231         | 50-59                 | 435               | 5.4      | 15.6                |
| Mulben Envoist             | 50         | 139         | 53-57                 | 155               | 5.4      | 15.9                |
| Elector of Shempston       | 50         | 56          | 54-56                 | 85                | 0        | 8.4                 |
| Mulben Eclator             | 51         | 57          | 53-56                 | 107               | .2       | 2.1                 |
| Elimast of Ballindalloch   | 53         | 60          | 58-65                 | 76                | 1.2      | 1.3                 |
| Geordus                    | 54         | 114         | 57-65                 | 318               | .2       | 8.8                 |
| Buckmaster of Cairnfield   | 55         | 11          | 58                    | 6                 | 3.0      | 1.5                 |
| Vindicator of Milford      | 55         | 43          | 60-68                 | 61                | .1       | 2.7                 |
| Valour of Ardrass          | 56         | 55          | 58-79                 | 147               | .3       | 10.5                |
| Ernest of Bolton           | 56         | 4           | 58-59                 | 1                 | 1.4      | 1.8                 |
| Prince of Malpas           | 56         | 144         | 59-76                 | 466               | 2.4      | 12.3                |
| Edict of Wyndcrest         | 56         | 19          | 59-61                 | 27                | 1.5      | 2.0                 |
| Jalnac Eric                | 56         | 73          | 59-67                 | 77                | .6       | 5.7                 |
| George of Swiftbrook       | 56         | 62          | 62-78                 | 142               | .3       | 6.1                 |
| Eldorado of Macaroni Downs | 58         | 85          | 60-68                 | 73                | 0        | 3.3                 |
| Jai of Frampton            | 58         | 64          | 62-72                 | 90                | .1       | .6                  |
| Janvren Eric               | 58         | 59          | 60-70                 | 64                | 7.0      | 6.5                 |

TABLE 3. DESCRIPTION OF WYE-BRED SIRES WITH 50 OR MORE PROGENY OR GRANDPROGENY BY 1981

| NAME <sup>1</sup> | DAM  | COW FAMILY | BIRTH YEAR | NO. PROGENY | BIRTH YR. OF PROGENY | NO. GRAND PROGENY | PERCENT INBRED | % REL. TO 1981 CROP | GEN. NO. | PERCENT IMPORT |
|-------------------|------|------------|------------|-------------|----------------------|-------------------|----------------|---------------------|----------|----------------|
| Caliban Pride     | 82   | 82         | 41         | 12          | 45-46                | 54                | 1.5            | 6.4                 | 1.0      | 0              |
| Perfect Jester    | 84   | 81         | 47         | 52          | 50-51                | 14                | 0              | 8.3                 | 1.0      | 50.0           |
| Foremost          | 82   | 82         | 54         | 56          | 56-64                | 260               | 0              | 19.8                | 1.0      | 50.0           |
| Ayer              | 181  | 83         | 55         | 22          | 57-58                | 89                | .4             | 19.8                | 1.5      | 75.0           |
| Fabron            | 302  | 61         | 57         | 120         | 60-79                | 878               | 4.2            | 26.4                | 2.0      | 50.0           |
| Francis           | 384  | 82         | 58         | 78          | 62-78                | 376               | 18.3           | 26.3                | 2.7      | 75.0           |
| Career            | 684  | 97         | 60         | 12          | 63                   | 197               | 3.8            | 26.5                | 2.9      | 68.8           |
| Fendell           | 302  | 61         | 61         | 70          | 67-74                | 81                | 27.1           | 22.2                | 2.5      | 50.0           |
| Columbus          | 417  | 97         | 61         | 58          | 65-79                | 124               | 6.8            | 20.7                | 2.8      | 62.5           |
| Bevis             | 300  | 95         | 62         | 59          | 66-70                | 64                | 6.8            | 18.9                | 2.9      | 62.5           |
| Lodge             | 854  | 85         | 63         | 86          | 66-75                | 355               | 2.8            | 24.7                | 3.4      | 78.1           |
| Conan             | 684  | 97         | 63         | 189         | 66-80                | 886               | 9.1            | 32.3                | 3.2      | 81.3           |
| Adelard           | 906  | 83         | 63         | 78          | 69-75                | 63                | 1.0            | 14.7                | 2.4      | 81.3           |
| Federal           | 865  | 61         | 63         | 57          | 66-76                | 62                | 7.2            | 23.2                | 3.2      | 71.9           |
| Fortrel           | 741  | 82         | 63         | 48          | 65-73                | 206               | 10.9           | 19.3                | 3.9      | 72.7           |
| Flennar           | 711  | 82         | 63         | 49          | 66-68                | 69                | 0              | 12.1                | 1.9      | 87.5           |
| Corbin            | 417  | 97         | 64         | 129         | 67-75                | 170               | 6.8            | 20.5                | 2.8      | 62.5           |
| Fornson           | 1005 | 82         | 65         | 103         | 71-79                | 139               | 3.1            | 18.2                | 3.9      | 80.1           |
| Lortez            | 909  | 77         | 65         | 57          | 68-73                | 54                | 0              | 10.9                | 2.4      | 81.3           |
| Father            | 1018 | 82         | 66         | 104         | 68-81                | 146               | 1.6            | 25.9                | 3.6      | 87.5           |
| Freestate         | 755  | 82         | 66         | 9           | 74-75                | 69                | 12.2           | 22.2                | 3.6      | 68.8           |
| Lothair           | 1171 | 77         | 68         | 65          | 70-79                | 40                | 4.0            | 19.3                | 4.8      | 72.3           |
| Churchill         | 417  | 97         | 68         | 13          | 71-77                | 62                | 7.3            | 19.2                | 3.4      | 76.6           |
| Plantation        | 423  | 80         | 69         | 70          | 71-75                | 58                | 9.3            | 21.8                | 2.8      | 62.5           |
| Favour            | 1005 | 82         | 69         | 195         | 71-81                | 343               | 4.3            | 24.7                | 3.7      | 82.8           |
| Chesley           | 981  | 97         | 69         | 52          | 71-75                | 36                | 2.2            | 17.1                | 2.9      | 71.9           |
| Fritch            | 935  | 82         | 72         | 63          | 74-77                | 98                | 4.6            | 26.8                | 3.7      | 81.3           |
| Franchester       | 1209 | 61         | 72         | 126         | 74-81                | 144               | 3.4            | 29.7                | 4.0      | 71.9           |
| Lonestar          | 1022 | 77         | 72         | 62          | 74-78                | 100               | 8.9            | 19.7                | 3.6      | 71.9           |
| Contact           | 1404 | 93         | 73         | 94          | 75-79                | 77                | 5.9            | 25.1                | 5.1      | 83.6           |
| Flick             | 1096 | 82         | 73         | 65          | 75-79                | 42                | 4.7            | 21.7                | 3.0      | 71.9           |
| Framework         | 935  | 82         | 74         | 50          | 76-81                | 13                | 8.2            | 19.7                | 3.9      | 75.0           |
| Linebacker        | 1055 | 85         | 75         | 23          | 77-81                | 51                | 5.9            | 23.3                | 4.1      | 79.7           |
| Checkmate         | 1404 | 93         | 75         | 53          | 77-80                | 1                 | 5.9            | 24.4                | 5.1      | 83.6           |
| Palladium         | 1572 | 80         | 76         | 52          | 78-80                | 12                | 8.7            | 26.0                | 5.1      | 78.7           |
| Fracas            | 1659 | 61         | 76         | 67          | 79-81                | 3                 | 8.7            | 24.5                | 5.1      | 73.8           |
| Lucan             | 1708 | 77         | 77         | 82          | 79-81                | 27                | 5.5            | 32.3                | 5.3      | 79.7           |
| Perseus           | 1097 | 80         | 78         | 54          | 80-81                | 0                 | 4.1            | 28.5                | 3.7      | 81.3           |

<sup>1</sup>The words "Of Wye" should be added to all names except Caliban Pride and Perfect Jester.

marily Wye-bred bulls were being used. The range in relationship with the calf crops over the past 10 years for the four main bulls was: Juryman, 11.0 to 12.7%; Puck, 18.6 to 22.3%; Gaird, 14.8 to 15.9%; and Prince, 11.4 to 13.6%. The future influence of all imported bulls will remain nearly the same as during the past 10 years if the herd remains closed to outside breeding.

This group of bulls of imported ancestry account for 78 to 80% of the genetic material of the present herd. This influence has remained relatively stable since 1965 (Table 4) and will remain so as long as the herd remains closed.

#### WYE-BRED BULLS

A listing of the Wye-bred bulls that produced 50 or more progeny or grandprogeny by 1981 is presented in Table 3. Information on the numbers of progeny and grandprogeny along with percent inbreeding, percent relationship to the 1981 calf crop, generation number and percent of imported ancestry is also provided. The number of progeny indicates how extensively the bull was used whereas the number of grandprogeny provides an insight to the bull's contribution to the present herd. There is close correspondence between the number of grandprogeny by bulls and their relationships to the 1981 calf crop among bulls used during the same time period. Grandprogeny are still being produced by many of the sires used more recently.

The paternal lineage of sires that produced 50 or more progeny or grandprogeny by 1981 is presented in Figure 1. As can be seen, almost all of these sires (33 of 38) have a direct paternal lineage to Puck of Wickwire. Essentially, there were two paternal sublines formed through Puck by his two heavily-used sons, Foremost and Ayer. The five sires unrelated to Puck, Adelard, Flennar, Lortez, Caliban Pride and Perfect Jester left no sons that were used heavily and their impact in the herd was diminished over time. The average relationships of these five sires to the 1981 calf crop ranged from 6.4 to 14.7%. All other sires listed in Table 3 had average relationships of 17.1% or higher.

Foremost of Wye sired 56 calves from 1956 through 1964 and was the first Wye-bred bull to have a large impact upon the herd. He had 260 grandprogeny, mainly through his son Fabron of Wye. Foremost had a 19.8% average relationship to the 1981 calf crop even though he was several generations removed. Ayer of Wye also had a 19.8% average relationship to the 1981 calves. Although he sired only 22 progeny in 1957-1958 and had only 89 grandprogeny, he contributed heavily through his son Francis of Wye and through grandsons and great grandsons (Figure 1).

Fabron of Wye, by Foremost, sired more heavily-used sons (8) than any other sire. He had 878 grandprogeny and had an average relationship to the 1981 calf crop of 26.4%.

Francis of Wye, by Ayer, had 376 grandprogeny and a 26.3% average relationship to the 1981 calves. Conan of Wye, by Francis, was born in 1963 and sired 189 calves from 1966-1980. He had the largest number of grandprogeny (886) of all Wye-bred sires through 1981. He and his grandson Lucan have the highest average relationships (32.3%) to the 1981 calf crop. Fabron, Francis and Lodge contributed many grandprogeny and have average relationship values with the 1981 calf crop of 26.4, 26.3 and 24.7% respectively. Other heavily-used sires born before 1975 that have about 25% average relationship to the 1981 calves include Father, Favour, Franchester and Contact. All sires born after 1975 have fairly high average relationship values with the 1981 calves since they are more nearly contemporaries.

Only two of the heavily-used sires were highly inbred and both were born early in the program. Francis was 18.3% inbred; he had Puck of Wickwire as both the paternal and maternal grandsire and Juryman of Wickwire as a great grandsire on both sides of the pedigree. Fendell was 27.1% inbred and resulted from a son (Fabron) X dam (Matilida G of Wye) mating. All other bulls listed in Table 3 were only slightly inbred.

Of the sires listed, Lucan represents the most generations of Wye breeding with a generation number of 5.3. However, several of the bulls born after 1973 have generation numbers of 5.0 or greater.

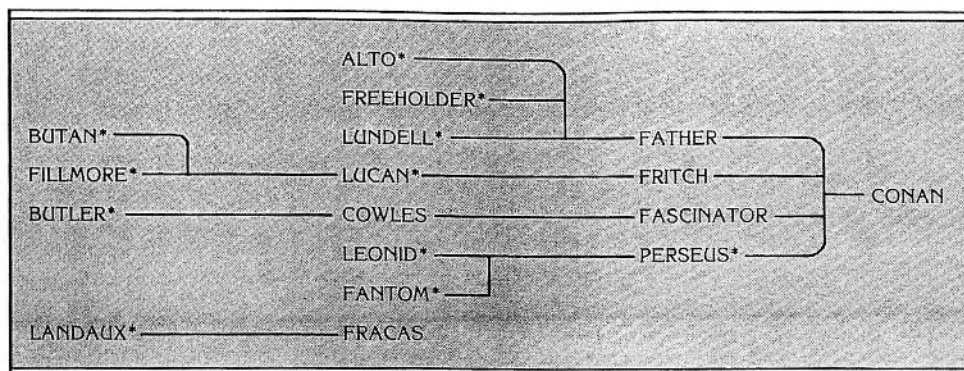


Figure 2. Paternal lineage of Wye sires used in 1982 breeding season. (See Figure 1 for previous generations; \* = sires used).

All of the bulls listed in Table 3 had 50% or more of imported ancestry except Caliban Pride. They ranged from 50% for Perfect Jester, Foremost, Fabron and Fendell to 87.5% for Father. Almost all of the bulls listed and born after 1963 had over 70% imported ancestry except for Corbin (62.5%) and Plantation (62.5%).

Figure 2 presents the paternal lineage of the Wye-bred bulls that are being used during the 1982 breeding season. As can be seen, Conan figures prominently in the paternal pedigree of 10 of the 11 bulls. In addition, Landaux is as a maternal great grandson of Conan. It appears that the paternal subline of Puck through Ayer, Francis and Conan is the dominant group in the present herd.

#### COW FAMILIES

There have been many famous cows produced in the Wye herd over the years. Lingle (1976) describes some of these great matrons in his book. However, the cows that had a real genetic impact on the herd were the dams of the prominent sires listed in Table 3. The dam's chain number and cow family are also listed in Table 3. Ten of the 18 cow families are represented by these prominent sires. The Boghead Flora family tracing to Capearl (82), had the most influence with

nearly one-third (12 of 38) of the prominent sires being produced in this family. The Miss Copeland (97), Florelle (61) and Lullaby Lottie (77) families produced six, five, and four of the 38 heavily-used sires. Individual dams that produced two each of the prominent sires include 82, 302, 684, 935, 1005 and 1404. The 417 cow produced three of these elite sires. These dams had the largest number of direct-lineage offspring and had the most influence on the present herd.

The naming of the cattle at Wye has been by cow families, tracing back to the 18 foundation cows described in Table 1. Of the 18 original cows, direct maternal-lineage descendants of 11 of the families make up the present herd. There are no direct maternal lineage descendants of the foundation cows numbered 79, 84, 85, 86, 90, 92 and 94. The remaining 11 families are listed in Table 4 with the number of cows calving in 1982, the number of heifers born in 1981, the average inbreeding values of those heifers and their within-family average relationship coefficients.

In the 11 family groupings, the number of cows calving in 1982 ranged from 7 for the Clova (93) family to 39 for the Lullaby Lottie (77) family. The heifers born in 1981 had an average inbreeding value of 9.6% as compared to 9.4% for all calves born in 1981

(Table 5). The average within-family relationship among the 1981 heifers was 26.8% as compared to 24.6% among all calves born in 1981. Thus, the within-cow family relationship was only slightly higher than the average relationship among two randomly selected offspring from the 1981 calf crop. Using the 26.8% within-family value and the over-all 24.6% value, the average relationship between calves from different families was estimated to be 24.5%. Thus, cows have contributed as much to other families as to their own family through the use of sons. The phenomenon of no difference in genetic makeup between families is not surprising since the families were not maintained as distinct subgroups in the breeding procedures. Inbreeding was avoided for the most part and bulls were mated primarily to families different from their own.

#### HERD DESCRIPTION BY YEARS

Information on the average inbreeding, relationship among calves, generation number and percent imported ancestry by year of birth is listed in Table 5.

The level of inbreeding increased from .9% in 1939 and 1940 to 14.1% in 1946. Several sire X daughter matings involving Buxton and Juryman were made during this period. In 1946, sire X (sire X daughter) calves were produced involving Buxton and resulted in four calves of over 38% inbreeding. Six calves resulting from sire X daughter matings involving Juryman were born the same year. Several of those sire X daughter matings continued through 1950 and maintained the average inbreeding levels above 8%. Beginning in 1952 and thereafter, close matings that would result in high inbreeding levels were avoided except in a few cases. The inbreeding level increased steadily from .6% in 1952 to the present level of 9.4% in 1981. The range in inbreeding values in 1981 was from 2.8 to 20.1%.

The average relationship among calves in a given calf crop followed the same trends as the level of inbreeding, as expected. The

TABLE 4. NUMBERS, INBREEDING AND RELATIONSHIP BY COW FAMILY

| FOUNDATION COW NO.        | COW FAMILY              | NO. COWS IN 1982 | NO. 1981 HEIFERS | AVG. INBREEDING OF HEIFERS | AVG. REL. OF HEIFERS |
|---------------------------|-------------------------|------------------|------------------|----------------------------|----------------------|
| 61                        | Florelle                | 22               | 6                | 10.1                       | 29.2                 |
| 77                        | Lullaby Lottie          | 39               | 3                | 9.0                        | 25.4                 |
| 80                        | Pride of Aberdeen       | 17               | 9                | 9.1                        | 25.0                 |
| 81                        | Queen Mother            | 10               | 4                | 14.1                       | 29.3                 |
| 82                        | Boghead Flora           | 35               | 14               | 8.7                        | 24.4                 |
| 83                        | Alexina                 | 21               | 10               | 9.2                        | 24.2                 |
| 91                        | Ballindaloch Blackbird  | 26               | 13               | 10.5                       | 29.4                 |
| 93                        | Clova                   | 7                | 2                | 7.0                        | 81.3                 |
| 95                        | Second Branch Blackbird | 11               | 2                | 6.1                        | 18.6                 |
| 96                        | Golden Madge            | 17               | 9                | 9.2                        | 25.5                 |
| 97                        | Miss Copeland           | 20               | 5                | 12.5                       | 30.6                 |
| Total or weighted average |                         | 225              | 87               | 9.6                        | 26.8                 |

TABLE 5. DESCRIPTION OF CALF CROPS BY YEARS

| YEAR | NO. CALVES | AVG. % INBREEDING | AVG. % RELATIONSHIP | AVG. AGE OF PARENTS | AVG. GEN. NO. | AVG. % IMPORT |
|------|------------|-------------------|---------------------|---------------------|---------------|---------------|
| 1939 | 10         | .9                | 33.6                | 2.0                 | 1.0           | 0             |
| 1940 | 9          | .9                | 33.6                | 3.0                 | 1.0           | 0             |
| 41   | 20         | 4.9               | 33.0                | 3.5                 | 1.1           | 0             |
| 42   | 24         | 6.2               | 33.2                | 4.2                 | 1.1           | 4.2           |
| 43   | 32         | 6.9               | 24.8                | 4.4                 | 1.2           | 20.3          |
| 44   | 48         | 1.3               | 26.8                | 4.6                 | 1.3           | 41.1          |
| 1945 | 52         | 3.5               | 27.5                | 4.8                 | 1.5           | 40.9          |
| 46   | 45         | 14.1              | 34.3                | 5.1                 | 1.6           | 46.4          |
| 47   | 59         | 9.5               | 23.2                | 4.8                 | 1.7           | 48.7          |
| 48   | 66         | 9.6               | 24.1                | 5.5                 | 1.6           | 57.2          |
| 49   | 70         | 8.1               | 26.1                | 6.1                 | 1.7           | 61.1          |
| 1950 | 102        | 8.2               | 21.2                | 5.0                 | 1.9           | 59.7          |
| 51   | 100        | 4.4               | 19.7                | 5.8                 | 1.8           | 66.9          |
| 52   | 102        | .6                | 18.5                | 5.9                 | 1.7           | 64.6          |
| 53   | 114        | 1.6               | 16.3                | 6.2                 | 1.7           | 69.2          |
| 54   | 136        | 2.6               | 14.1                | 5.5                 | 1.8           | 75.3          |
| 1955 | 158        | 3.2               | 16.6                | 5.7                 | 1.9           | 76.4          |
| 56   | 150        | 2.6               | 16.8                | 5.5                 | 2.1           | 79.4          |
| 57   | 83         | 4.6               | 17.9                | 5.3                 | 2.4           | 79.0          |
| 58   | 141        | 6.4               | 14.3                | 4.6                 | 2.3           | 80.0          |
| 59   | 113        | 2.0               | 10.8                | 5.2                 | 1.9           | 82.8          |
| 1960 | 124        | 4.5               | 13.5                | 4.8                 | 2.5           | 77.8          |
| 61   | 92         | 3.3               | 13.2                | 5.7                 | 2.1           | 83.4          |
| 62   | 95         | 3.5               | 10.3                | 6.4                 | 2.2           | 86.4          |
| 63   | 101        | 3.0               | 12.7                | 6.3                 | 2.3           | 83.7          |
| 64   | 118        | 3.4               | 10.5                | 7.0                 | 2.3           | 86.2          |
| 1965 | 152        | 7.1               | 15.5                | 6.3                 | 3.0           | 80.5          |
| 66   | 134        | 5.2               | 14.0                | 5.3                 | 3.1           | 81.9          |
| 67   | 185        | 6.2               | 14.2                | 6.4                 | 2.8           | 81.2          |
| 68   | 197        | 5.6               | 13.8                | 6.1                 | 3.3           | 80.5          |
| 69   | 215        | 6.2               | 15.5                | 5.9                 | 3.5           | 79.6          |
| 1970 | 277        | 7.8               | 17.1                | 5.3                 | 3.9           | 77.7          |
| 71   | 185        | 7.1               | 17.3                | 6.1                 | 4.0           | 78.6          |
| 72   | 218        | 6.4               | 16.3                | 6.3                 | 4.0           | 79.8          |
| 73   | 226        | 7.3               | 18.5                | 6.7                 | 4.2           | 77.3          |
| 74   | 289        | 6.8               | 18.3                | 5.9                 | 4.4           | 78.6          |
| 1975 | 325        | 7.7               | 19.2                | 5.6                 | 4.6           | 77.9          |
| 76   | 259        | 8.2               | 20.4                | 5.5                 | 4.7           | 78.9          |
| 77   | 259        | 8.3               | 21.4                | 5.7                 | 4.9           | 78.6          |
| 78   | 261        | 8.4               | 20.7                | 5.2                 | 5.0           | 78.1          |
| 79   | 214        | 9.1               | 22.1                | 6.2                 | 5.2           | 78.0          |
| 1980 | 230        | 10.3              | 25.0                | 5.4                 | 5.5           | 78.3          |
| 81   | 200        | 9.4               | 24.6                | 5.2                 | 5.6           | 78.4          |

inbreeding levels since 1952 are less than expected from the average relationship values if parents were mated at random, indicating that outbreeding was the desired practice for the most part during that time period. The average relationship among calves in 1981 was 24.6%, or slightly less than half-sibs which would be 25%.

Stonaker (1943) studied the breeding structure of the Angus breed and calculated inbreeding and relationship coefficients of cattle born in the U.S. from 1900 to 1939. In 1939, the average inbreeding and relationship coefficients estimated from sampling procedures were 11.3% and 13.3%. He found that inbreeding levels were larger than expected from the relationship values, indicating that mates were more closely related than if mating were at random with respect to pedigree. The opposite tendency was true in this study, especially beginning in 1952 where mates were less closely related than if mating was random with respect to pedigree.

Results from Stonaker's study for 1939 may be representative of the domestic foundation stock in the study. He traced pedigrees back to breed foundation animals with average birth dates of 1850 whereas only six-generation pedigrees were used in this study. However, since the imported bulls used in

the Wye program were isolated pedigree-wise from the Wye domestic foundation animals for several generations, the Wye herd is probably somewhat less inbred than the average Angus herd in the U.S. at present.

#### GENERATION INTERVAL

The average age of parents when the offspring are born is a measure of generation interval. This value ranged from two years in 1939 to a high of seven years in 1964. During the past 10 years, generation interval ranged from 5.2 to 6.7 years (Table 5). In 1981 the average age of dams was 6.21 and for sires was 4.20 years for an overall generation interval of 5.21 years. Inspection of the cow records indicates that once replacement heifers were selected, they tended to remain in the herd a long time.

The actual rate of generation turnover in this herd is given by the generation number (Table 5). All foundation cows and bulls and all bulls of imported ancestry were assigned to generation zero. Since imported bulls were used extensively for a long time, generation turnover was slow in the early years and reached generation three only in 1965. Generation four was reached in 1971 and increased steadily until reaching generation 5.6 in the 1981 calf crop. The range in generation number among calves in 1981 was from

4.1 to 6.9.

The average percent of imported ancestry increased from 0% in 1939-41 to 75.3% in 1954. Thereafter the range was from 76.4% in 1955 to 86.4% in 1962. For the past 10 years this percentage has remained nearly constant at 77-80%. The range among calves in the 1981 calf crop was from 69.9 to 88.5%.

#### IN SUMMARY

The above information presents a fairly detailed genetic history of the Wye Angus-UMF herd from its formation through 1981. In the future, it is expected that inbreeding will increase from .5 to 1.0% per year and that average relationships will increase 1.0 to 2.0% per year. The percent of imported ancestry will remain fairly constant and the generation turnover should be more rapid due to use of younger bulls.

*For more detailed information in bulletin form, write the Department of Animal Science, University of Maryland, College Park, Md.*

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